(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 241 692 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
19.10.2011 Bulletin 2011/42

(51) Int Cl.:
E04B 1/348 *(2006.01)*

(21) Application number: **10159843.1**

(22) Date of filing: **14.04.2010**

(54) **House module, assembly and house of a number of house modules, and method for manufacturing a house**

Hausmodul, Haus aus Hausmodulen und Verfahren zum Herstellen eines Hauses

Module de maison, maison comprenant des modules et procédé pour construire une maison

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

(30) Priority: **15.04.2009 NL 2002754**

(43) Date of publication of application:
20.10.2010 Bulletin 2010/42

(73) Proprietor: **Ballast Nedam Bouw & Ontwikkeling Holding B.V.**
3439 LM Nieuwegein (NL)

(72) Inventor: **van Halder, Gerardus Johannes Marie**
3430 BN, Nieuwegein (NL)

(74) Representative: **Hatzmann, Martin et al**
Vereenigde
Johan de Wittlaan 7
2517 JR Den Haag (NL)

(56) References cited:
DE-A1- 2 926 969 **FR-A- 1 414 158**

EP 2 241 692 B1

Description

[0001] The invention relates to a house module as defined by claim 1, an assembly of a number of house modules for forming a house as defined by claim 10, a house comprising a number of house module as defined by claim 12 and to a method for manufacturing a house as defined by claim 13.

[0002] DE-2926969 discloses a house module which is provided with three sidewalls, a bottom wall and a ceiling wall. As a result of the three sidewalls, the known house module is not suitable to be placed in series one behind the other for forming a boundary of a larger living space. This known house module is provided with bottom wall reinforcing ribs and ceiling wall reinforcing ribs which form an integral part of the bottom wall and the ceiling wall, respectively. When a second known house module is placed on a first known house module, the bottom wall reinforcing ribs of the second house module extend next to the ceiling wall reinforcing ribs of the first house module. Between neighbouring reinforcing ribs of a bottom wall and a ceiling wall, there is a space in which pipes can be received.

[0003] NL-1024512 discloses a method for constructing a building. Here, house modules are manufactured which are subsequently joined for forming the building. With the disclosed house modules, which are indicated in this publication with the term segments, both a bottom wall and a ceiling wall thereof are self-supporting. The house modules can be stacked one on top of the other in a fairly simple manner. A drawback of the self-supporting nature of both the bottom wall and the ceiling wall is that these walls are relatively thick and must be reinforced. Therefore, a bottom wall/ceiling wall combination which is formed when stacking the two known house modules is relatively thick. This relatively great thickness leads to an increased building height, which leads to a larger building volume. A larger building volume leads to increased costs, for instance in that outside covering, such as, for instance, facework is to be provided on the outer walls.

[0004] NL1029449 proposes a solution to this problem in that in there, the ceiling wall is of relatively thin design and is provided with an upwards projecting coupling element. During the transport of the house modules, the ceilings are to be temporarily supported by means of, for instance, building stays or props. The fact is that the ceiling wall is not self-supporting. After placing a second module on an underlying module, the projecting coupling elements are connected to coupling elements provided in the bottom wall of the second module. Thus, sufficient robustness is provided to the ceiling wall of the underlying module which is then suspended, as is were, from the self-supporting bottom wall of the second module. Thereupon, the temporary support can be removed. An advantage of this known proposal is that the total thickness of a bottom wall/ceiling wall combination is smaller than in the proposal of NL-1024512. Consequently, this limits the total building height and the building volume. However, for providing the connections between the ceiling wall and the bottom wall, additional assembly operations are required. Furthermore, there is the risk that the transport support for the ceiling wall is removed before the connection between bottom wall and ceiling wall has been effected. Under those circumstances, there is the risk the ceiling wall will collapse, which is highly undesirable.

[0005] The object of the invention is an alternative solution to a house module which combines the advantages of the two known systems. This means a house module of which a ceiling wall/bottom wall combination obtained through stacking has a relatively limited thickness, while yet no cost increasing assembling operations are required, nor the risk arises of collapse during assembly of a ceiling wall. Furthermore, a house module is envisaged which, upon stacking, allows for the feed-through of pipes in different directions between the ceiling wall and bottom wall bounding one another.

[0006] To that end, the invention provides a house module which is suitable for forming a house through combination with at least one similar house module, the house module comprising:

- a bottom wall from concrete;
- a ceiling wall from concrete which extends parallel to the bottom wall;
- a first sidewall from concrete which extends perpendicularly to the bottom wall; and
- a second sidewall from concrete which extends parallel to the first sidewall;

wherein the walls mentioned together form a concrete, tubular section which bounds a tube inside space and which has an imaginary central axis which extends parallel to the walls and runs through a geometrical centre of the tube inside space; and wherein the house module is provided with:

- bottom wall reinforcing ribs which form an integral part of the bottom wall, extend perpendicularly to the tube central axis from the first sidewall in the direction of the second sidewall and which are provided on a side of the bottom wall remote from the tube inside space;
- ceiling wall reinforcing ribs which form an integral part of the ceiling wall, extend perpendicularly to the tube central axis from the first sidewall in the direction of the second sidewall, and which are provided on a side of the ceiling remote from the tube inside space;

wherein, viewed in the direction of the tube central axis, the bottom wall reinforcing ribs are provided in a manner staggered relative to the ceiling wall reinforcing ribs, so that, when a second house module is placed on a first house module, the bottom wall reinforcing ribs of the sec-

ond house module extend next to the ceiling wall reinforcing ribs of the first house module, while both the bottom wall reinforcing ribs and the ceiling wall reinforcing ribs end at a distance from the second sidewall, so that, at that location, in a condition of two house modules stacked one on the other, a first channel recess is formed which extends parallel to the tube central axis, and wherein the width of the bottom wall reinforcing ribs and the ceiling wall reinforcing ribs is such that in a condition of two house modules stacked one on the other, between at least one pair of a ceiling wall reinforcing rib and a neighbouring bottom wall reinforcing rib a second channel recess is formed which extends perpendicularly to the tube central axis.

[0007] The invention also provides an assembly of a number of such house modules for forming a house.

[0008] The invention further provides a house which comprises such an assembly and is built up therefrom.

[0009] Finally, the invention provides a method for manufacturing a house, comprising:

- centrally manufacturing a number of house modules of the above-described type;
- transporting the thus obtained number of house modules to a building site;
- providing a foundation on the building site; and
- positioning a number of house modules on the foundation for forming a first story.

[0010] Owing to the presence of the bottom wall reinforcing ribs and the ceiling wall reinforcing ribs, both the bottom wall and the ceiling wall are self-supporting. Therefore, there is no need to provide temporary support of the ceiling wall during transport of the house module. Nor is there the above-described risk of collapse due to incorrect assembling order. As the bottom wall reinforcing ribs are provided in a manner staggered relative to the ceiling wall reinforcing ribs, they extend next to each other when two housing modules are stacked one on top of the other. When stacking, the height of the bottom wall reinforcing ribs and the ceiling wall reinforcing ribs is therefore not added up. As a result thereof, the thickness of a ceiling wall/bottom wall combination that is formed upon stacking may be smaller than with the self-supporting ceiling wall and bottom wall constructions known from NL-1024512. This will result in a proportionally smaller building height and building volume with all associated financial advantages, while between a ceiling wall and a bottom wall, still, spaces are present between the neighbouring reinforcing ribs for feeding through pipes and wiring. As both the bottom wall and the ceiling wall are self-supporting, in one embodiment, there may be no contact at all between bottom wall and ceiling wall, upon stacking. This may be the case when the house modules rest on each other by their sidewalls. In such an embodiment, no contact sounds are transmitted via the bottom wall and the ceiling wall. Feeding through pipes such as, for instance, even drains of a toilet in a direction parallel to the tube central axis is possible through the first channel recess. This has as an advantage that a free positioning option is provided in the direction of the tube central axis of objects that are provided with feed pipes and discharge pipes, such as, for instance, a toilet, a tap, a bath tub, a power point, an electricity switch, etc. Also the second channel recesses between neighbouring reinforcing ribs, which therefore extend perpendicularly to the tube central axis, can be used for feed-through of pipes, such as even a drain of a toilet. Thus, a great freedom of positioning is provided also in a direction perpendicular to the tube central axis for objects that are provided with feed pipes and/or drain pipes of which examples are mentioned hereinabove.

[0011] It is noted that FR-1.414.158 , disclosing the features of the preamble of claim 1, describes a prefabricated house module with two sidewalls, a bottom wall and a ceiling wall. The known house module is provided with bottom wall reinforcing ribs and ceiling wall reinforcing ribs which form an integral part of the bottom wall and the ceiling wall, respectively. However, with this known house module, the bottom wall reinforcing ribs are not all arranged in a manner staggered relative to the ceiling wall reinforcing ribs, so that, when stacking two house modules, the thickness of a ceiling wall/bottom wall combination is determined by the sum of thicknesses of the ceiling wall, the bottom wall and the heights of a ceiling wall reinforcing rib and a bottom wall reinforcing rib. An important advantage that is envisaged by the invention is therefore not achieved with this known device.

[0012] Further elaborations of the invention are described in the subclaims and will be further elucidated in the following on the basis of an exemplary embodiment with reference to the drawing.

Fig. 1 shows a perspective view from a top side of an exemplary embodiment of a house module;
Fig. 2 shows a perspective view from a bottom side of the exemplary embodiment of a house module represented in fig. 1;
Fig. 3 shows a top plan view of the exemplary embodiment represented in Fig. 1 which is placed on a lower house module;
Fig. 4 shows a cross sectional view along the line IV-IV of fig. 3;
Fig. 5 shows a cross sectional view along the line V-V of fig. 3;
Fig. 6 shows a detail VI of fig. 4;
Fig. 7 shows detail VII of fig. 5;
Fig. 8 shows a perspective view of an exemplary embodiment of a casting mould partially in cross section; and
Fig. 9 shows an exemplary embodiment of a house that is provided with a number of house modules.

[0013] Figs. 1 and 2 show an example of an embodiment of house module 10 which is suitable for forming a house through combination with at least one similar

house module 10. Here, house can mean different types of living units, such as a terraced house, a semi-detached house, a detached house and an apartment. The embodiment of the house module 10 comprises a bottom wall 12 from concrete and a ceiling wall 14 from concrete which extends parallel to the bottom wall 12. The embodiment further comprises a first sidewall 16 from concrete which extends perpendicularly to the bottom wall 12 and a second sidewall 18 from concrete which extends parallel to the first sidewall 16. The walls form together a concrete, tubular section 20 which bounds a tube inside space 22 and which has an imaginary tube central axis L which extends parallel to the walls 12-18 and runs through a geometrical centre of the tube inside space 22.

[0014] The embodiment of the house module 10 is further provided with bottom wall reinforcing ribs 24 which form an integral part of the bottom wall 12. The bottom wall reinforcing ribs 24 extend perpendicularly to the tube central axis L from the first sidewall 16 in the direction of the second sidewall 18. It is clearly visible that the bottom wall reinforcing ribs 24 are provided on a side of the bottom wall 12 remote from the tube inside space 22. The embodiment is further provided with ceiling wall reinforcing ribs 26 which form an integral part of the ceiling wall 14. The ceiling wall reinforcing ribs 26 extend perpendicularly to the tube central axis L from the first sidewall 16 in the direction of the second sidewall 18. The ceiling wall reinforcing ribs 26 too are provided on a side of the ceiling wall 14 remote from the tube inside space 22. Viewed in the direction of the tube central axis L, the bottom wall reinforcing ribs 24 are provided in a manner staggered relative to the ceiling wall reinforcing ribs 26 so that, when a second house module 10' is placed on a first house module 10, the bottom wall reinforcing ribs 24' of the second house module 10' extend next to the ceiling wall reinforcing ribs 26 of the first house module 10. The staggered positioning of the bottom wall reinforcing ribs 24' of the second house module 10' relative to the ceiling wall reinforcing ribs 26 of the first house module 10 is clearly visible in fig. 5.

[0015] A thus designed house module 10 has as an advantage that both the bottom wall 12 and the ceiling wall 14 thereof are self-supporting as a result of the presence of the bottom wall reinforcing ribs 24 and the ceiling wall reinforcing ribs 26. The total thickness of a ceiling wall/bottom wall combination upon stacking of the two house modules 10, 10', can still remain relatively limited in that, viewed in the direction of the tube central axis L, the bottom wall reinforcing ribs 24 are provided in a manner staggered relative to the ceiling wall reinforcing ribs 26. Owing to the relatively limited thickness of the ceiling wall/bottom wall combination, a relatively small building height and a relatively small building volume is obtained, which, from a point of view of costs, is particularly advantageous. At the same time, a feed-through space for pipes between the bottom wall and the ceiling wall is provided. Owing to the thin design of the bottom wall and the ceiling wall, the house module is furthermore lighter, which is favourable upon transport and leads to further reduced transport costs.

[0016] Fig. 3 shows a single house module 10 in a top plan view. A number of such house modules 10 can be placed next to each other and form a first story 102; see to that end fig. 5. In fig. 3, cross sections IV-IV and V-V are indicated. It should be noted here that the cross sections represented in Figs. 4 and 5 show two stories 102, 104 which each consist of three house modules 10, 10' of which only one is represented in the top plan view of Fig. 3. The various elements of the house modules 10' of the second story 104 are provided with primed reference numerals. It is clear that in alternative embodiments, a story 102, 104 can consist of more than three or less than three house modules 10, 10'.

[0017] Figs. 5 and 7 clearly show that neighbouring house modules 10, 10' can be mutually interconnected by means of, for instance, nut/bolt assemblies 49. Optionally, the house modules 10' of a second story 104 can also be connected by means of nut/bolt assemblies (not shown) to house modules 10 of the first story 102, this is, however, not necessary.

[0018] The dimensions of the house modules 10, 10' can vary also. When the width direction is defined parallel to the tube central axis L, a tube width of, for instance, 3 m can be considered. The outside dimensions from the first sidewall 16 to the second sidewall 18 can, for instance, be 4.5 to 7 meters. A house module 10 of such dimensions can very well be transported by road with the aid of a truck. The top of the bottom wall 12' of the second story 104 can be, for instance, approximately 3.1 m above ground level.

[0019] In one embodiment, also, special end modules can be provided having a width of 1.5 meters and provided with an outer wall for closing the end face of the tubular end module. Thus, two end modules can be transported one next to the other on one truck without this truck being locally loaded due to the presence of the outer wall. The fact is that the two end modules can be placed on the truck mirror symmetrically relative to a central longitudinal axis of the truck and can balance each other.

[0020] In one embodiment of the house module 10, of which an example is shown, both the bottom wall reinforcing ribs 24 and the ceiling wall reinforcing ribs 26 can end at a distance from the second sidewall 18 so that at that location, in a condition of two house modules 10, 10' stacked one on the other, a first channel recess 28 is formed which extends parallel to the tube central axis L. This is clearly visible in Figs. 4 and 6. Feeding through pipes, such as, for instance, even toilet drains, is an option through the first channel recess 28. This has as an advantage that there is free positioning option in the direction of the tube central axis L of objects which are provided with feed and/or drain pipes, such as, for instance, a toilet, a tap, a bath tub, a power point, an electrical switch, etc. In an alternative embodiment, the first channel recess 28 can also be provided at a distance from the second sidewall 118, while then, the bottom wall

reinforcing ribs 24 and the ceiling wall reinforcing ribs 26 extend on both sides of the first channel recess 28. However, the advantage of a first channel recess 28 near the second sidewall 18 is that with such a configuration, the bottom wall 12 and the ceiling wall 14 will have optimal rigidity and strength.

[0021] In one embodiment, of which an example is shown, the width of the bottom wall reinforcing ribs 24 and the ceiling wall reinforcing ribs 26 can be such that in a condition of two house modules 10, 10' stacked one on the other, between at least one pair of a ceiling wall reinforcing rib 26 and a neighbouring bottom wall reinforcing rib 24' a second channel recess 30 is formed which extends perpendicularly to the tube central axis L. This is clearly visible in fig. 5. The second channel recesses 30 too can be used for feeding through pipes, such as even a toilet drain. Thus, also in a direction perpendicular to the tube central axis L a good freedom of positioning is provided for objects which are provided with feed and/or drain pipes of which examples are mentioned hereinabove.

[0022] In one embodiment, of which an example is shown, the first and the second sidewalls 16, 18 can extend not only between the bottom wall 12 and the ceiling wall 14, but also slightly beyond at least one of the bottom wall 12 and the ceiling wall 14 on a side of this or these walls remote from the tube inside space 22 such that in a condition of two house modules 10, 10' stacked one on the other, the overlying house module 10' rests by the first and second sidewalls 16', 18' thereof on the underlying house module 10. There may be some clearance P between the ceiling wall reinforcing ribs 26 of the underlying house module 10 and the bottom wall 12' of the overlying house module 10' and some clearance between the bottom wall reinforcing ribs 24 of the overlying house module 10' and the ceiling wall 14 of the underlying house module 10. This is clearly visible in figs. 4 and 6. As a result of this clearance, the transmission of contact noise is prevented or in any case reduced to a large extent. Such a clearance between neighbouring ceiling wall reinforcing ribs 26 and bottom wall reinforcing ribs 24' for that matter is also of advantage in horizontal direction for providing a certain freedom of positioning and for preventing contact noise. Furthermore, owing to the relatively small contact surface between two house modules 10, 10', a better defined positioning is enabled at the location of the first and the second sidewalls 16, 18, 16', 18' only. With a small contact surface, the risk that the connection is over-defined, like with a table with four legs, is limited so that the risk of an overlying house module 10 "wobbling" on the lower house module 10 is minimized. Optionally, between the contact surfaces, a layer of compressible material can be included for rendering stacking more stable.

[0023] The figures show an example of an embodiment in which the first and the second sidewalls 16, 18 each extend somewhat beyond both the bottom wall 12 and the ceiling wall 14 on the sides of this ceiling wall 14 and the bottom wall 12 remote from the tube inside space 22.

[0024] In one embodiment, the clearance P between the ceiling wall reinforcing ribs 26 of the underlying house module 10 and the bottom wall 12' of the overlying house module 10' can be in the range of 1 - 3 cm. The clearance P between the bottom wall reinforcing ribs 24' of the overlying house module 10' and the ceiling wall 14 of the underlying house module 10 can be in the range of 1 - 3 cm. The clearance P can be, for instance, 2 cm.

[0025] In one embodiment, the bottom wall 12 can have a thickness in the range of 6 - 10 cm. The bottom wall reinforcing ribs 24 can have height from the bottom wall 12, in the range of 12 - 16 cm. The ceiling wall 14 can have a thickness in the range of 6 - 10 cm. The ceiling wall reinforcing ribs 26 can have a height from the ceiling wall 16 in the range of 12 - 16 cm. Thus, the total thickness of a ceiling wall/bottom wall combination of two house modules 10, 10' placed one on the other including the above-mentioned clearance P can be in the range of 25 - 37 cm. In one example of such an embodiment, the bottom wall 12 and the ceiling wall 14 can each have a thickness of 8 cm. In that example, the bottom wall reinforcing ribs 24 can have a height from the bottom wall 12 of 14 cm and the ceiling wall reinforcing ribs 26 can have a height from the ceiling wall 14 of 14 cm. The total thickness of this ceiling wall/bottom wall combination of two house modules 10, 10' placed one on the other including the above-mentioned clearance P can then be, for instance, 32 cm. Such a construction has sufficient rigidity and stiffness both during transport of the house module 10 and after assembly of the various house modules 10, 10' for forming a house.

[0026] In one embodiment, of which an example is shown in figs. 1 and 2, at least one of the bottom wall 12 and the ceiling wall 14 can be provided with a stairwell recess 32, 34. Here, the ceiling wall 14 or the bottom wall 12 in which the stairwell recess 32, 34 is provided, can be provided with at least one transverse reinforcing rib 36 which extends parallel to the tube central axis L and which bounds the stairwell recess 32, 34. With such an embodiment, more particularly with the example of the embodiment shown in the figures, the middle two bottom wall reinforcing ribs 24 and ceiling wall reinforcing ribs 26 extend from the transverse reinforcing rib 36. For these middle reinforcing ribs 24, 26 too, it holds that they extend from the first sidewall 16 at least in as far as there is a bottom wall 12 or ceiling wall 145 available there. Owing to the presence of the transverse reinforcing rib 36 and the bottom wall reinforcing ribs 24 and ceiling wall reinforcing ribs 26 linking up therewith, despite the limited thickness of these walls, still, a bottom wall 12 and a ceiling wall 14 are provided with sufficient rigidity and strength to be self-supporting.

[0027] In one embodiment, in which both the bottom wall reinforcing ribs 24 and the ceiling wall reinforcing ribs 26 end at a distance from the second sidewall 18, so that at that location, in a condition of two house mod-

ules 10, 10' stacked one on the other, the channel recess 28 is formed which extends parallel to the tube central axis L, it is advantageous from a point of view of rigidity and strength, that the stairwell recesses 32, 34 of the two house modules 10, 10' are provided near the first sidewall 16, 16'.

[0028] Preferably, the tubular section 20 is a unitary moulded unit. In the light of the automation of the production of house modules 10, such a unitary moulded house module 10 can be advantageous. In particular with mass production a cost advantage can be obtained. In an alternative embodiment, the sidewalls 16, 18, the bottom wall 12 and the ceiling wall 14 could be manufactured separately in a factory and then, in the factory, be interconnected for forming the tubular section 20. With smaller, special series this could be advantageous because then, no relatively expensive casting mould is to be provided but relatively simple moulds can suffice. Although, then, assembly operations are required for interconnecting the different walls for forming the tubular section 20.

[0029] As already indicated hereinabove, also, an assembly of a number of house modules 10, 10' is provided, of which embodiments are described hereinabove, for forming a house 100. Such assemblies can be centrally manufactured and then be transported to a building site.

[0030] In one embodiment, such an assembly can also comprise a folding roof 50 (see fig. 9), which is provided with two hingedly interconnected roof parts 52, 54 which abut against each other in collapsed condition and form a saddle roof 50 in assembled condition.

[0031] Also, a house 100 is provided which comprises an assembly as described hereinabove, and which is built up therefrom. An example of an embodiment of such a house 100 is shown in Fig. 9.

[0032] From figs. 1 and 2 in particular, it appears that the house module 10 can also be provided with interior elements, such as one or more partition walls 40, washbasins 42, bathtubs 44, doors 46, windows 48, wall and floor tiles, and stairs. These interior elements can be provided at a central location, usually in a factory, before the house module 10 is transported to a building site. This has a very positive effect on the completion time required for finishing the house on the building site.

[0033] For manufacturing such a house, a method is provided. An embodiment of this method comprises:

- centrally manufacturing a number of house modules 10, 10' of the type described hereinabove;
- transporting the thus obtained number of house modules 10, 10' to a building site;
- providing a foundation 38 on the building site; and
- positioning a number of house modules 10 on the foundation for forming a first story 102.

[0034] Such a method has a favourable effect on the completion on the building site, on quality control and on costs.

[0035] Figs. 4 and 5 show an example of an embodiment of a house 100 that can be obtained with the aid of the method. In the example shown, an embodiment is concerned whereby the method also comprises positioning a number of house modules 10' on the first story for forming a next story 104.

[0036] A house 100 provided with a saddle roof 50, of which an example is shown in fig. 9, can be obtained with an embodiment of the method as described hereinabove, which then comprises:

- centrally manufacturing a folding roof 50 which comprises two hingedly interconnected roof parts 52, 54;
- transporting the folding roof 50 with the two roof parts 52, 54 folded against each other in folded together condition to the building site; and
- bringing the folding roof 50 to a folded out position and placing it on a story 104 which comprises a number of house modules 10'.

[0037] After central manufacture of the house module 10, 10' and the folding roof 50, with the described method, a house 100 provided with a saddle roof 50 can be manufactured on the building site in a particularly rapid and effective manner.

[0038] In an alternative embodiment, with the house modules 10, 10', also, a house or a block of flats with a flat roof can be manufactured.

[0039] In one embodiment of the method, central manufacture of one of the number of house modules 10, 10' can comprise providing a casting mould 200 which contains a mould cavity. An example of an embodiment of such a casting mould is shown in fig. 8. The mould cavity can be provided with a bottom wall cavity 212 and a ceiling wall cavity 214 which extends parallel to the bottom wall cavity 212. The mould cavity can further comprise a first sidewall cavity 216 which extends perpendicularly to the bottom wall cavity 212 and a second sidewall cavity 218 which extends parallel to the first sidewall cavity 216. The wall cavities 212 - 218 can together form a unitary section tube cavity 220 which has an imaginary tube central axis L which extends parallel to the wall cavities 212 - 218 and runs through a geometrical centre of the section tube cavity 220. The section tube cavity 220 can also contain bottom wall reinforcing rib recesses 224 which form an integral part of the bottom wall cavity 212, which extend perpendicularly to the tube central axis L from the first sidewall cavity 216 in the direction of the second sidewall cavity 218, and which are provided on a side of the bottom wall cavity 212 remote from the tube inside space. The section tube cavity 220 can further contain ceiling wall reinforcing rib recesses (not shown) which form an integral part of the ceiling wall cavity 214, which extends perpendicularly to the tube central axis L from the first sidewall cavity 216 in the direction of the second sidewall cavity 218, and which are provided on a side of the ceiling wall cavity 214 remote from the tube inside space. Viewed in the direction of the tube central axis L, the bottom wall reinforcing rib cavities 224 can be pro-

vided in a manner staggered relative to the ceiling wall reinforcing rib cavities so that, when a second house module 10' formed with such a casting mould is placed on a first house module 10 formed with such a casting mould, the bottom wall reinforcing ribs 24' of the second house module 10' extend next to the ceiling wall reinforcing ribs 26 of the first house module 10.

[0040] The embodiment for manufacturing the house module 10, 10' at a central location can further comprise arranging the casting mould 200 such that the tube central axis L extends perpendicularly to a horizontal floor surface H. Here, in this position, the section tube cavity 220 can be filled with liquid concrete. The concrete thus provided in the section tube cavity 220 can then be left to harden. After that, the casting mould 200 can be removed for obtaining the hardened concrete, tubular house module 10, 10'. With this embodiment, tubular house module 10, 10' can then be tilted, so that the bottom wall 12 and the ceiling wall 14 of the house module 10, 10' extend in a horizontal plane.

[0041] In one embodiment of the casting mould 200, this can be provided with a filling opening 202 adjacent an underside thereof, with filling taking place via this filling opening 202. Filling the section tube cavity 220 with concrete from the underside has as an advantage that the risk of the formation of air inclusions in the concrete is minimized.

[0042] In one embodiment, for filling with concrete, also, reinforcement can be placed in the casting mould 200. This leads to bottom walls, ceiling walls and sidewalls 12, 14, 16, 18 with high rigidity and great strength.

[0043] The invention, as defined by the appended claims, is not limited to the described embodiments. Furthermore, aspects of the described embodiments can be combined with each other for forming alternative embodiments. The figures are only intended as example of the different embodiments. It is noted that constructive differences can occur between for instance the house modules 10 of the first story 102 and those of the second story 104. Also within one story 102, 104, house modules can be used that are mutually different. To that end, different types of casting moulds 200 are to be provided.

Claims

1. A house module suitable for forming a house (200) through combination with at least one similar house module (10), the house module (10) comprising:

- a bottom wall (12) from concrete;
- a ceiling wall (14) from concrete which extends parallel to the bottom wall (12);
- a first sidewall (16) from concrete which extends perpendicularly to the bottom wall; and
- a second sidewall (18) from concrete which extends parallel to the first sidewall;

wherein said walls together form a concrete, tubular section (20) which bounds a tube inside space (22) and which has an imaginary tube central axis (L) which extends parallel to the said walls (12-18) and runs through a geometrical centre of the tube inside space (22); and

wherein the house module (10) is provided with:

- bottom wall reinforcing ribs (24) which form an integral part of the bottom wall (12), extend perpendicularly to the tube central axis (L) from the first sidewall (16) in the direction of the second sidewall (18), and which are provided on a side of the bottom wall (12) remote from the tube inside space (22)
- ceiling wall reinforcing ribs (26) which form an integral part of the ceiling wall (14), extend perpendicular to the tube central axis (L) from the first sidewall (16) in the direction of the second sidewall (18), and which are provided on a side of the ceiling remote from the tube inside space (22);

wherein, viewed in the direction of the tube central axis (L), the bottom wall reinforcing ribs (24) are provided in a manner staggered relative to the ceiling wall reinforcing ribs (26), so that when a second house module (10') is placed on a first house module (10), the bottom wall reinforcing ribs (24') of the second house module (10') extend next to the ceiling wall reinforcing ribs (26) of the first house module (10), and wherein the width of the bottom wall reinforcing ribs (24) and the ceiling wall reinforcing ribs (26) is such that in a condition of two house modules (10,10') stacked one on the other, between at least one pair of a ceiling wall reinforcing rib (26) and a neighbouring bottom wall reinforcing rib (24') at least a second channel recess (30) is formed which extends perpendicularly to the tube central axis (L), characteized in that both the bottom wall reinforcing ribs (24) and the ceiling wall reinforcing ribs (26) end at a distance from the second sidewall (18), so that, at that location, in a condition of two house modules (10, 10') stacked one on the other, a first channel recess (28) is formed which extends parallel to the tube central axis (L).

2. A house module according to claim 1, wherein the first and the second sidewalls (16, 18) extend not only between the bottom wall (12) and the ceiling wall (14) but also somewhat beyond at least one of the bottom wall (12) and the ceiling wall (14) on a side of this wall or these walls remote from the tube inside space (22), such that in a condition of two house modules (10, 10') stacked one on the other, the overlying house module (10') rests by the first and the second sidewalls (16', 18') thereof on the underlying house module (10) and that there is some

clearance (P) between the ceiling wall reinforcing ribs (26) of the underlying house module (10) and the bottom wall (12') of the overlying house module (10') and that there is some clearance (P) between the bottom wall reinforcing ribs (24') of the overlying house module (10') and the ceiling wall (14) of the underlying house module (10).

3. A house module according to claim 2, wherein the first and the second sidewalls (16, 18) each extend somewhat beyond both the bottom wall (12) and the ceiling wall (14) on the sides of this ceiling wall (14) and this bottom wall (12) remote from the tube inside space (22).

4. A house module according to claim 2 or 3, wherein the clearance (P) between the ceiling wall reinforcing ribs (26) of the underlying house module (10) and the bottom wall (12') of the overlying house module (10') is in the range of 1 - 3 cm, and wherein the clearance (P) between the bottom wall reinforcing ribs (24') of the overlying house module (10') and the ceiling wall (14) of the underlying house module (10) is in the range of 1 - 3 cm.

5. A house module according to any one of the preceding claims, wherein the bottom wall (12) has a thickness in the range of 6 - 10 cm, and wherein the bottom wall reinforcing ribs (24) have a height from the bottom wall (12) in the range of 12 - 16 cm, wherein the ceiling wall (14) has a thickness in the range of 6 - 10 cm, wherein the ceiling wall reinforcing ribs (26) have a height from the ceiling wall (14) in the range of 6 - 10 cm, such that the total thickness of a ceiling wall/bottom wall assembly of two house modules (10, 10') placed one on the other is in the range of 25 - 37 cm.

6. A house module according to claim 5, wherein the bottom wall (12) and the ceiling wall (14) each have a thickness of 8 cm, wherein the bottom wall reinforcing ribs (24) have a height from the bottom wall (12) of 14 cm, wherein the ceiling wall reinforcing ribs (26) have a height from the ceiling wall (14) of 14 cm, while the total thickness of a ceiling wall/bottom wall assembly of two house modules (10, 10') placed one on the other is 32 cm.

7. A house module according to any one of the preceding claims, wherein at least one of the bottom wall (12) and the ceiling wall (14) is provided with a stairwell recess (32, 34), wherein the ceiling wall (14) and/or the bottom wall (12) in which the stairwell recess (32, 34) is arranged is provided with at least one transverse reinforcing rib (36) which extends parallel to the tube central axis (L) and which bounds the stairwell recess (32, 34).

8. A house module according to claim 7, wherein both the bottom wall reinforcing ribs (24) and the ceiling wall reinforcing ribs (26) end at a distance from the second sidewall (18), so that, at that location, in a condition of two house modules (10, 10') stacked one on the other, the first channel recess (28) is formed which extends parallel to the tube central axis (L), and wherein the stairwell recesses (32, 34) of the two house modules (10, 10') are arranged near the associated first sidewall (16, 16').

9. A house module according to any one of the preceding claims, wherein the tubular section (20) is a unitary moulded unit.

10. An assembly of a number of house modules (10, 10') according to any one of the preceding claims for forming a house (100).

11. An assembly according to claim 10, further comprising:

a folding roof (50) which is provided with two hingedly interconnected roof parts (52, 54) which abut against each other in collapsed condition and form a saddle roof (50) in assembled condition.

12. A house comprising and built up from an assembly according to claim 10 or 11.

13. A method for manufacturing a house, comprising:

- centrally manufacturing a number of house modules (10, 10') according to any one of claims 1 - 9;
- transporting the thus obtained number of house modules (10, 10') to a building site;
- providing a foundation (38) on the building site; and
- positioning a number of house modules (10) on the foundation for forming a first story (102).

14. A method according to claim 13, comprising:

- positioning a number of house modules (10') on the first story (102) for forming a next story (104).

15. A method according to claim 13 or 14, comprising:

- centrally manufacturing a folding roof (50) which comprises two roof parts (52, 54) which are hingedly interconnected;
- transporting the folding roof (50) to the building site with the two roof parts (52, 54) folded against each other in collapsed condition; and
- bringing and placing the folding roof (50) in

folded out condition onto a story (104) which comprises a number of house modules (10').

16. A method according to any one of claims 13 - 15, comprising:

• finishing the house modules (10, 10') on the building site after they have been positioned relative to each other.

17. A method according to any one of claims 13 - 15, wherein centrally manufacturing one of the number of house modules (10, 10') according to any one of claims 1 - 9 comprises:

• providing a casting mould (200) which contains a mould cavity, the mould cavity being provided with:

○ a bottom wall cavity (212);
○ a ceiling wall cavity (214) which extends parallel to the bottom wall cavity (212);
○ a first sidewall cavity (216) which extends perpendicularly to the bottom wall cavity (212);
○ a second sidewall cavity (218) which extends parallel to the first sidewall cavity (216);

wherein the wall cavities (212 - 218) together form a unitary section tube cavity (220) which has an imaginary tube central axis (L) which extends parallel to the said wall cavities (212 - 218) and runs through a geometric centre of the section tube cavity (220), wherein the section tube cavity also comprises:

○ bottom wall reinforcing rib recesses (224) which form an integral part of the bottom wall cavity (212), extend perpendicularly to the tube central axis (L) from the first sidewall cavity (216) in the direction of the second sidewall cavity (218), and which are provided on a side of the bottom wall cavity (212) remote from the tube inside space;
○ ceiling wall reinforcing rib recesses which form an integral part of the ceiling wall cavity (214), extend perpendicularly to the tube central axis (L) from the first sidewall cavity (216) in the direction of the second sidewall cavity (218), and which are provided on a side of the ceiling wall cavity (214) remote from the tube inside space;
○ wherein, viewed in the direction of the tube central axis (L), the bottom wall reinforcing rib cavities (224) are provided in a manner staggered relative to the ceiling wall reinforcing rib cavities, such that, when a second house module (10') formed with such a casting mould is placed on a first house module (10) formed with such a casting mould, the bottom wall reinforcing ribs (24') of the second house module (10') extend next to the ceiling wall reinforcing ribs (26) of the first house module (10),

wherein manufacturing the house module (10, 10') further comprises:

• arranging the casting mould (200) such that the tube central axis (L) extends perpendicularly to a horizontal floor surface (H);
• filling the section tube cavity (220) with liquid concrete;
• having the concrete harden;
• removing the casting mould (220) for obtaining the hardened concrete, tubular house module (10, 10');
• tilting the house module (10, 10'), such that the bottom wall (12) and the ceiling wall (14) extend in a horizontal plane.

18. A method according to claim 17, wherein the casting mould (200) is provided with a filling opening (202) adjacent an underside thereof, with the filling taking place via this filling opening (202).

Patentansprüche

1. Hausmodul zum Bau eines Hauses (200) durch Kombination mit mindestens einem ähnlichen Hausmodul (10), wobei das Hausmodul (10) aufweist:

• eine Bodenwand (12) aus Beton;
• eine Deckenwand (14) aus Beton, die parallel zu der Bodenwand (12) verläuft;
• eine erste Seitenwand (16) aus Beton, die rechtwinklig zu der Bodenwand verläuft; und
• eine zweite Seitenwand (18) aus Beton, die parallel zu der ersten Seitenwand verläuft;

wobei die Wände zusammen einen rohrförmigem Betonabschnitt (20) bilden, der einen Rohr-Innenraum (22) begrenzt und der eine imaginäre Rohr-Mittelachse (L) hat, die sich parallel zu den Wänden (12-18) erstreckt und durch die geometrische Mitte des Rohr-Innenraums (22) verläuft; und
wobei das Hausmodul (10) versehen ist mit:

• Bodenwandverstärkungsrippen (24), die einen integralen Teil der Bodenwand (12) bilden, parallel zu der Rohr-Mittelachse (L) von der ersten Seitenwand (16) in Richtung der zweiten Seitenwand (18) verlaufen und an einer von dem Rohr-Innenraum (22) entfernten Seite der Bo-

denwand (12) vorgesehen sind;
• Deckenwandverstärkungsrippen (26), die einen integralen Teil der Deckenwand (14) bilden, parallel zu der Rohr-Mittelachse (L) von der ersten Seitenwand (16) in Richtung der zweiten Seitenwand (18) verlaufen und an einer von dem Rohr-Innenraum (22) entfernten Seite der Dekke vorgesehen sind;

wobei bei Betrachtung in Richtung der Rohr-Mittelachse (L) die Bodenwandverstärkungsrippen (24) relativ zu den Deckenwandverstärkungsrippen (26) derart versetzt angeordnet sind, dass, wenn ein zweites Hausmodul (10') auf einem ersten Hausmodul (10) angeordnet ist, die Bodenwandverstärkungsrippen (24') des zweiten Hausmoduls (10') nahe den Dekkenwandverstärkungsrippen (26) des ersten Hausmoduls (10) verlaufen, und wobei die Breite der Bodenwandverstärkungsrippen (24) und der Deckenwandverstärkungsrippen (26) derart vorgesehen ist, dass im Fall zweier aufeinandergestapelter Hausmodule (10,10') zwischen mindestens einem Paar aus einer Deckenwandverstärkungsrippe (26) und einer benachbarten Bodenwandverstärkungsrippe (24') mindestens eine zweite Kanalausnehmung (30) gebildet ist, die rechtwinklig zu der Rohr-Mittelachse (L) verläuft,
dadurch gekennzeichnet, dass die Bodenwandverstärkungsrippen (24) und die Deckenwandverstärkungsrippen (26) derart im Abstand von der zweiten Seitenwand (18) enden, dass an dieser Stelle im Fall zweier aufeinandergestapelter Hausmodule (10,10') eine erste Kanalausnehmung (28) gebildet ist, die parallel zu der Rohr-Mittelachse (L) verläuft.

2. Hausmodul nach Anspruch 1, bei dem die ersten und die zweiten Seitenwände (16,18) nicht nur zwischen der Bodenwand (12) und der Deckenwand (14), sondern auch etwas über mindestens eine der Bodenwand (12) und der Deckenwand (14) hinaus verlaufen, und zwar an einer Seite dieser Wand oder dieser Wände, die von dem Rohr-Innenraum (22) entfernt ist, derart, dass im Fall zweier aufeinandergestapelter Hausmodule (10,10') das überliegende Hausmodul (10') mit seinen ersten und zweiten Seitenwänden (16',18') auf dem unterliegenden Hausmodul (10) aufliegt, und dass etwas Freiraum (P) zwischen den Deckenwandverstärkungsrippen (26) des unterliegenden Hausmoduls (10) und der Bodenwand (12') des überliegenden Hausmoduls (10') besteht, und dass etwas Freiraum (P) zwischen den Bodenwandverstärkungsrippen (24') des überliegenden Hausmoduls (10') und der Deckenwand (14) des unterliegenden Hausmoduls (10) besteht.

3. Hausmodul nach Anspruch 2, bei dem die ersten und die zweiten Seitenwände (16,18) etwas über die Bodenwand (12) und die Deckenwand (14) vorstehen, und zwar an denjenigen Seiten dieser Deckenwand (14) und dieser Bodenwand (12), die von dem Innenraum (22) entfernt sind.

4. Hausmodul nach Anspruch 2 oder 3, bei dem der Freiraum (P) zwischen den Deckenwandverstärkungsrippen (26) des unterliegenden Hausmoduls (10) und der Bodenwand (12') des überliegenden Hausmoduls (10') im Bereich von 1 - 3 cm liegt und bei dem Freiraum (P) zwischen den Bodenwandverstärkungsrippen (24') des überliegenden Hausmoduls (10') und der Deckenwand (14) des unterliegenden Hausmoduls (10) im Bereich von 1 - 3 cm liegt.

5. Hausmodul nach einem der vorhergehenden Ansprüche, bei dem die Bodenwand (12) eine Dicke im Bereich von 6 - 10 cm hat, und bei dem die Bodenwandverstärkungsrippen (24) ausgehend von der Bodenwand (12) eine Höhe im Bereich von 12 - 16 cm haben, bei dem die Deckenwand (14) eine Dicke im Bereich von 6 - 10 cm hat, und bei dem die Dekkenwandverstärkungsrippen (26) ausgehend von der Deckenwand (14) eine Höhe im Bereich von 6 - 10 cm haben, derart, dass die Gesamtdicke einer Deckenwand/Bodenwand-Anordnung zweier aufeinander platzierter Hausmodule (10,10') im Bereich von 25 - 37 cm liegt.

6. Hausmodul nach Anspruch 5, bei dem die Bodenwand (12) und die Deckenwand (14) jeweils eine Dikke von 8 cm haben, bei dem die Bodenwandverstärkungsrippen (24) ausgehend von der Bodenwand (12) eine Höhe von 14 cm haben, und bei dem die Deckenwandverstärkungsrippen (26) ausgehend von der Deckenwand (14) eine Höhe von 14 cm haben, wobei die Gesamtdicke einer Deckenwand/Bodenwand-Anordnung zweier Hausmodule (10,10') 32 cm beträgt.

7. Hausmodul nach einem der vorhergehenden Ansprüche, bei dem mindestens eine der Bodenwand (12) und der Deckenwand (14) mit einer Treppenhaus-Ausnehmung (32,34) versehen ist, wobei die Deckenwand (14) und/oder die Bodenwand (12), in der die Treppenhaus-Ausnehmung (32,34) angeordnet ist, mit mindestens einer Querverstärkungsrippe (36) versehen sind, die parallel zu der Rohr-Mittelachse (L) verläuft und die Treppenhaus-Ausnehmung (32,34) begrenzt.

8. Hausmodul nach Anspruch 7, bei dem die Bodenwandverstärkungsrippen (24) und die Deckenwandverstärkungsrippen (26) derart im Abstand von der zweiten Seitenwand (18) enden, dass an dieser Stelle im Fall zweier aufeinandergestapelter Hausmodule (10,10') die erste Kanalausnehmung (28) gebildet ist, die parallel zu der Rohr-Mittelachse (L) verläuft, und

bei dem die Treppenhaus-Ausnehmungen (32,34) der beiden Hausmodule (10,10') nahe der zugehörigen ersten Seitenwand (16,16') angeordnet sind.

9. Hausmodul nach einem der vorhergehenden Ansprüche, bei dem der rohrförmige Abschnitt (20) eine einstückig geformte Einheit ist.

10. Anordnung aus einer Anzahl von Hausmodulen (10,10') nach einem der vorherigen Ansprüche zum Bau eines Hauses (100).

11. Anordnung nach Anspruch 10, ferner mit:

einem Faltdach (50) mit zwei schwenkbar miteinander verbundenen Dachteilen (52,54), die im kollabierten Zustand gegeneinander anliegen und im montierten Zustand ein Satteldach (50) bilden.

12. Haus, das eine Anordnung gemäß Anspruch 10 oder 11 aufweist und aus dieser gebaut ist.

13. Verfahren zum Bau eines Hauses, mit folgenden Schritten:

• zentrales Herstellen einer Anzahl von Hausmodulen (10,10') gemäß einem der Ansprüche 1 - 9;
• Transportieren der so erhaltenen Hausmodule (10,10') zu einer Baustelle;
• Ausbilden eines Fundaments (38) an der Baustelle; und
• Positionieren einer Anzahl von Hausmodulen (10) auf dem Fundament zum Ausbilden eines ersten Stockwerks (102).

14. Verfahren nach Anspruch 13, mit folgendem Schritt:

• Positionieren einer Anzahl von Hausmodulen (10') auf dem ersten Stockwerk (102) zum Ausbilden eines folgenden Stockwerks (104).

15. Verfahren nach Anspruch 13 oder 14, mit folgenden Schritten:

• zentrales Herstellen eines Faltdachs (50) mit zwei schwenkbar miteinander verbundenen Dachteilen (52,54);
• Transportieren des Faltdachs (50) zu einer Baustelle, wobei die beiden Dachteile (52,54) im kollabierten Zustand gegeneinander gefaltet sind; und
• Versetzen des Faltdachs (50) in den auseinandergefalteten Zustand und Platzieren des Faltdachs auf einem Stockwerk (104), das eine Anzahl von Hausmodulen (10') aufweist.

16. Verfahren nach einem der Ansprüche 13 - 15, mit folgenden Schritten:

• Fertigstellen der Hausmodule (10,10') an der Baustelle, nachdem sie relativ zueinander positioniert worden sind.

17. Verfahren nach einem der Ansprüche 13 - 15, bei dem das zentrale Herstellen einer Anzahl von Hausmodulen (10,10') gemäß einem der Ansprüche 1 - 9 folgende Schritte aufweist:

• Bereitstellen einer Gussform (200), die einen Formungshohlraum enthält, wobei der Formungshohlraum versehen ist mit:

○ einem Bodenwand-Hohlraum (212);
○ einem Deckenwand-Hohlraum (214), der parallel zu dem Bodenwand-Hohlraum (212) verläuft;
○ einem ersten Seitenwand-Hohlraum (216), der rechtwinklig zu dem Bodenwand-Hohlraum (212) verläuft;
○ einem zweiten Seitenwand-Hohlraum (218), der parallel zu dem ersten Seitenwand-Hohlraum (216) verläuft;
wobei die Wand-Hohlräume (212-218) zusammen einen einteiligen Abschnitts-Rohr-Hohlraum (220) bilden, der eine imaginäre Rohr-Mittelachse (L) hat, die sich parallel zu den Wand-Hohlräumen (212-218) erstreckt und durch die geometrische Mitte des Abschnitts-Rohr-Hohlraums (220) verläuft, wobei der Abschnitts-Rflhr-Hohlraum (220) ferner aufweist:

○ Bodenwandverstärkungsrippen-Ausnehmungen (224), die einen integralen Teil der Bodenwand-Ausnehmung (212) bilden, parallel zu der Rohr-Mittelachse (L) von der ersten Seitenwand-Ausnehmung (216) in Richtung der zweiten Seitenwand-Ausnehmung (218) verlaufen und an einer von dem Rohr-Innenraum entfernten Seite der Bodenwand-Ausnehmung (212) vorgesehen sind;
○ Deckenwandverstärkungsrippen-Ausnehmungen, die einen integralen Teil der Deckenwand-Ausnehmung (214) bilden, parallel zu der Rohr-Mittelachse (L) von der ersten Seitenwand-Ausnehmung (216) in Richtung der zweiten Seitenwand-Ausnehmung (218) verlaufen und an einer von dem Rohr-Innenraum entfernten Seite der Dekkenwand-Ausnehmung (214) vorgesehen sind;

○ wobei bei Betrachtung in Richtung der Rohr-Mittelachse (L) die Bodenwandverstärkungsrippen- Ausnehmungen (224) relativ zu den Dekkenwandverstärkungsrippen- Ausnehmungen derart versetzt angeordnet sind, dass, wenn ein mittels dieser Gussform gebildetes zweites Hausmodul (10') auf einem mittels dieser Gussform gebildeten ersten Hausmodul (10) angeordnet wird, die Bodenwandverstärkungsrippen (24') des zweiten Hausmoduls (10') nahe den Deckenwandverstärkungsrippen (26) des ersten Hausmoduls (10) verlaufen,

wobei das Herstellen des Hausmoduls (10,10') ferner umfasst:

• Anordnen der Gussform (200) derart, dass die Rohr-Mittelachse (L) rechtwinklig zu einer horizontalen Fußbodenfläche (H) verläuft;
• Füllen des Abschnitts-Rohr-Hohlraums (220) mit flüssigem Beton;
• Aushärtenlassen des Betons;
• Entfernen der Gussform (220) zum Erhalten des aus ausgehärtetem Beton bestehenden, rohrförmigen Hausmoduls (10,10');
• Kippen des Hausmoduls (10,10') derart, dass die Bodenwand (12) und die Deckenwand (14) in einer horizontalen Ebene verlaufen.

18. Verfahren nach Anspruch 17, bei dem die Gussform (200) nahe einer Unterseite mit einer Füllöffnung (202) versehen ist, wobei das Füllen über diese Füllöffnung (202) erfolgt.

Revendications

1. Module de maison approprié pour former une maison (200) par combinaison avec au moins un module de maison similaire (10), le module de maison (10) comprenant :

- une paroi de plancher (12) en béton ;
- une paroi de plafond (14) en béton, qui s'étend parallèlement à la paroi de plancher (12) ;
- une première paroi latérale (16) en béton, qui s'étend perpendiculairement à la paroi de plancher ; et
- une seconde paroi latérale (18) en béton, qui s'étend parallèlement à la première paroi latérale ;

dans lequel lesdites parois forment ensemble une section tubulaire en béton (20) qui borde un espace intérieur tubulaire (22) et qui possède un axe central de tube imaginaire (L) qui s'étend parallèlement auxdites parois (12-18) et qui passe par un centre géométrique de l'espace intérieur tubulaire (22) ; et dans lequel le module de maison (10) est doté :

- de nervures de renforcement de paroi de plancher (24) qui forment une partie intégrale de la paroi de plancher (12), qui s'étendent perpendiculairement à l'axe central du tube (L) depuis la première paroi latérale (16) dans la direction de la seconde paroi latérale (18), et qui sont prévues sur un côté de la paroi de plancher (12) éloigné de l'espace intérieur tubulaire (22) ;
- de nervures de renforcement de paroi de plafond (26) qui forment une partie intégrale de la paroi de plafond (14), qui s'étendent perpendiculairement à l'axe central du tube (L) depuis la première paroi latérale (16) dans la direction de la seconde paroi latérale (18), et qui sont prévues sur un côté de la paroi de plafond éloigné de l'espace intérieur tubulaire (22) :

dans lequel, vues dans la direction de l'axe central du tube (L), les nervures de renforcement de paroi de plancher (24) sont prévues d'une manière étagée par rapport aux nervures de renforcement de paroi de plafond (26), de sorte que lorsqu'un second module de maison (10') est placé sur un premier module de maison (10), les nervures de renforcement de paroi de plancher (24') du second module de maison (10') s'étendent au voisinage des nervures de renforcement de paroi de plafond (26) du premier module de maison (10), et dans lequel la largeur des nervures de renforcement de paroi de plancher (24) et des nervures de renforcement de paroi de plafond (26) est telle que dans une condition dans laquelle deux modules de maison (10, 10') sont empilés l'un sur l'autre, entre au moins une paire formée d'une nervure de renforcement de paroi de plafond (26) et d'une nervure de renforcement de paroi de plancher (24') voisine, au moins un second évidement formant canal (30) est formé qui s'étend perpendiculairement à l'axe central du tube (L), **caractérisé en ce que** les nervures de renforcement de paroi de plancher (24) et les nervures de renforcement de paroi de plafond (26) se terminent à une distance de la seconde paroi latérale (18), de telle manière que, à cet emplacement, dans une condition dans laquelle deux modules de maison (10, 10') sont empilés l'un sur l'autre, un premier évidement formant canal (28) est formé qui s'étend parallèlement à l'axe central du tube (L).

2. Module de maison selon la revendication 1, dans lequel, la première et la seconde paroi latérale (16,18) s'étendent non seulement entre la paroi de plancher (12) et la paroi de plafond (14), mais s'détendent également quelque peu au-delà d'une paroi au moins parmi la paroi de plancher (12) et la paroi de plafond

(14) sur un côté de cette paroi ou de ces parois éloigné de l'espace intérieur tubulaire (22), de sorte que dans une condition dans laquelle deux modules de maison (10, 10') sont empilés l'un sur l'autre, le module de maison (10') situé en haut repose par sa première et sa seconde paroi latérale (16', 18') sur le module de maison (10) situé en bas, et en ce qu'il existe un certain jeu (P) entre les nervures de renforcement de paroi de plafond (26) du module de maison situé en bas (10) et la paroi de plancher (12') du module de maison (10') situé en haut, et en ce qu'il existe un certain jeu (P) entre les nervures de renforcement de paroi de plancher (24') du module de maison situé en haut (10') et la paroi de plafond (14) du module de maison situé en bas (10).

3. Module de maison selon la revendication 2, dans lequel la première et la seconde paroi latérale (16, 18) s'étendent chacune quelque peu au-delà de la paroi de plancher (12) et due la paroi de plafond (14) sur les côtés de cette paroi de plafond (14) et de cette paroi de plancher (12) éloigné de l'espace intérieur tubulaire (22).

4. Module de maison selon la revendication 2 ou 3, dans le lequel le jeu (P) entre les nervures de renforcement de paroi de plafond (26) du module de maison (10) situé en bas et la paroi de plancher (12') du module de maison situé en haut (10') est dans la plage de 1 à 3 cm, et dans lequel le jeu (P) entre les nervures de renforcement de paroi de plancher (24') du module de maison situé en haut (10'), et la paroi de plafond (14) du module de maison situé en bas (10) est dans la plage de 1 à 3 cm.

5. Module de maison selon l'une quelconque des revendications précédentes, dans lequel la paroi de plancher (12) a une épaisseur dans la plage de 6 à 10 cm, et dans lequel les nervures de renforcement de paroi de plancher (24) ont une hauteur, depuis la paroi de plancher (12), dans la plage de 12 à 16 cm, tandis que la paroi de plafond (14) a une épaisseur dans la plage de 6 à 10 cm, et telle que les nervures de renforcement de paroi de plafond (26) ont une hauteur, depuis la paroi de plafond (14) dans la plage de 6 à 10 cm, de telle façon que l'épaisseur totale d'un ensemble paroi de plafond/paroi de plancher de deux modules de maison (10, 10') placés l'un sur l'autre est dans la plage de 25 à 37 cm.

6. Module de maison selon la revendication 5, dans lequel la paroi de plancher (12) et la paroi de plafond (14) ont chacune une épaisseur de 8 cm, dans lequel les nervures de renforcement de paroi de plancher (24) ont une hauteur, depuis la paroi de plancher (12), de 14 cm, dans lequel les nervures de renforcement de paroi de plafond (26) ont une hauteur, depuis la paroi de plafond (14), de 14 cm, alors que l'épaisseur totale d'un ensemble paroi de plafond/paroi de plancher de deux modules de maison (10, 10') placés l'un sur l'autre est de 32 cm.

7. Module de maison selon l'une quelconque des revendications précédentes, dans lequel une paroi au moins parmi la paroi de plancher (12) et la paroi de plafond (14) est pourvue d'un évidement de cage d'escalier (32, 34), telle que la paroi de plafond (14) et/ou la paroi de plancher (12) dans laquelle l'évidement de cage d'escalier (32, 34) et agencé est pourvue d'au moins une nervure de renforcement transversale (36) qui s'étend parallèlement à l'axe central du tube (L) et qui borde l'évidement de cage d'escalier (32, 34)

8. Module de maison selon la revendication 7, dans lequel à la fois les nervures de renfoncement de paroi de plancher (24) et les nervures de renforcement de paroi de plafond (26) se terminent à une distance de la seconde paroi latérale (18), de telle façon que, à cet emplacement, dans une condition dans laquelle deux modules de maison (10, 10') sont empilés l'un sur l'autre, le premier évidement formant canal (28) est formé qui s'étend parallèlement à l'axe central du tube (L), et dans lequel les évidements de cage d'escalier (32, 34) des deux modules de maison (10, 10') sont agencés à proximité de la première paroi latérale associée (16, 16').

9. Module de maison selon l'une quelconque des revendications précédentes, dans lequel la section tubulaire (20) est une unité moulée unitaire.

10. Ensemble composé d'un certain nombre de modules de maison (10, 10') selon l'une quelconque des revendications précédentes pour former une maison (100).

11. Ensemble selon la revendication 10, comprenant en outre :

un toit repliable (50) qui est doté de deux parties de toit (52, 54),
interconnectées de façon articulée, qui butent l'une contre l'autre dans une condition escamotée et forment un toit en bâtière (50) dans une condition assemblée.

12. Maison comprenant et construite à partir d'un ensemble selon la revendication 10 ou 11.

13. Procédé pour fabriquer une maison, comprenant :

de fabriquer de manière centralisée un certain nombre de modules de maison (10, 10') selon l'une quelconque des revendications 1 à 9 ;
de transporter le nombre ainsi obtenu de modu-

les de maison (10, 10') jusqu'à un site de construction ;
de réaliser une fondation (38) sur le site de construction ; et
de positionner un nombre de modules de maison (10) sur la fondation pour former un premier étage (102).

14. Procédé selon la revendication 13, comprenant :

de positionner un certain nombre de modules de maison (10') sur le premier étage (102) pour former un étage suivant (104).

15. Procédé selon la revendication 13 14, comprenant :

de fabriquer de manière centralisée un toit repliable (50) qui comprend deux parties de toit (52, 54) qui sont interconnectées de manière articulée ;
de transporter le toit repliable (50) au site de construction avec les deux parties de toi (52, 54) repliées l'une contre l'autre dans une condition escamotée ; et
d'amener et de placer le toit repliable (50) dans une condition dépliée sur un étage (104) qui comprend un nombre de modules de maison (10').

16. Procédé selon l'une quelconque des revendications 13 à 15, comprenant :

de terminer les modules de maison (10, 10') sur le site de construction après qu'ils aient été positionnés les uns par rapport aux autres.

17. Procédé selon l'une quelconque revendication 13 à 15, dans lequel, la fabrication centralisée d'un module de maison parmi le nombre de modules de maison (10, 10') selon l'une quelconque des revendications 1 à 9 comprend :

de fournir un moule de coulée (200) qui contient une cavité de moule,
la cavité de moule étant dotée
d'une cavité de paroi de plancher (212) ;
d'une cavité de paroi de plafond (214) qui s'étend parallèlement à la cavité de paroi de plancher (212) ;
d'une première cavité de paroi latérale (216) qui s'étend perpendiculairement à la cavité de paroi de plancher (212) ;
d'une seconde cavité de paroi latérale (218) qui s'étend parallèlement à la première cavité due paroi latérale (216) ;
dans lequel les cavités de paroi (212-218) forment ensemble une cavité tubulaire de section unitaire (220) qui possède un axe central de tube imaginaire (L) qui s'étend parallèlement auxdites cavités de paroi (212-218) et qui passe par un centre géon-rctrique de la cavité tubulaire de section (220), dans lequel la cavité tubulaire de section comprend également :
des évidements pour nervures de renforcement de paroi de plancher (224) qui forment une partie intégrale de la cavité de paroi de plancher (212), qui s'étendent perpendiculairement à l'axe central du tube (L) depuis la première cavité de paroi latérale (216) dans la direction de la seconde cavité de paroi latérale (218), et qui sont prévues sur un côté de la cavité de paroi de plancher (212) éloigné de l'espace intérieur tubulaire ;
des évidements pour nervures de renforcement de paroi de plafond qui forment une partie intégrale de la cavité de paroi de plafond (214), qui s'étendent perpendiculairement à l'axe central du tube (L) depuis la première cavité de paroi latérale (216) dans la direction de la seconde cavité de paroi latérale (218), et qui sont prévues sur un côté de la cavité de paroi de plafond (214) éloigné de l'espace intérieur tubulaire ;
dans lequel, vues dans la direction de l'axe central du tube (L), les cavités pour nervures de renforcement de paroi de plancher (224) sont prévues d'une manière étagée par rapport aux cavités pour nervures de renforcement de paroi de plafond, de telle sorte que, lorsqu'un second module de maison (10') formé avec un tel moule de coulée est placé sur un premier module de maison (10) formé avec un tel moule de coulée, les nervures de renforcement de paroi de plancher (24') du second module de maison (10') s'étendent au voisinage des nervures de renforcement de paroi de plafond (26) du premier module de maison (10),
dans lequel la fabrication du module de maison (10, 10') comprend encore :
d'arranger le moule de coulée (200) de telle manière que l'axe central du tube (L) s'étend perpendiculairement à une surface de plancher horizontal (H) ;
de remplir la cavité tubulaire de section (220) avec du béton liquide ;
de laisser durcir le béton :
d'enlever le moule de coulée (220) pour obtenir le module de maison tubulaire en béton durci (10, 10') ;
de faire basculer le module de maison (10, 10') de telle façon que la paroi de plancher (12) et la paroi de plafond (14) s'étendent dans un plan horizontal.

18. Procédé selon la revendication 17, dans lequel le moule de coulée (200) est doté d'une ouverture de remplissage (202) adjacente à un côté intérieur de ceirxi-ci, le remplissage ayant lieu via cette ouverture de remplissage (202).

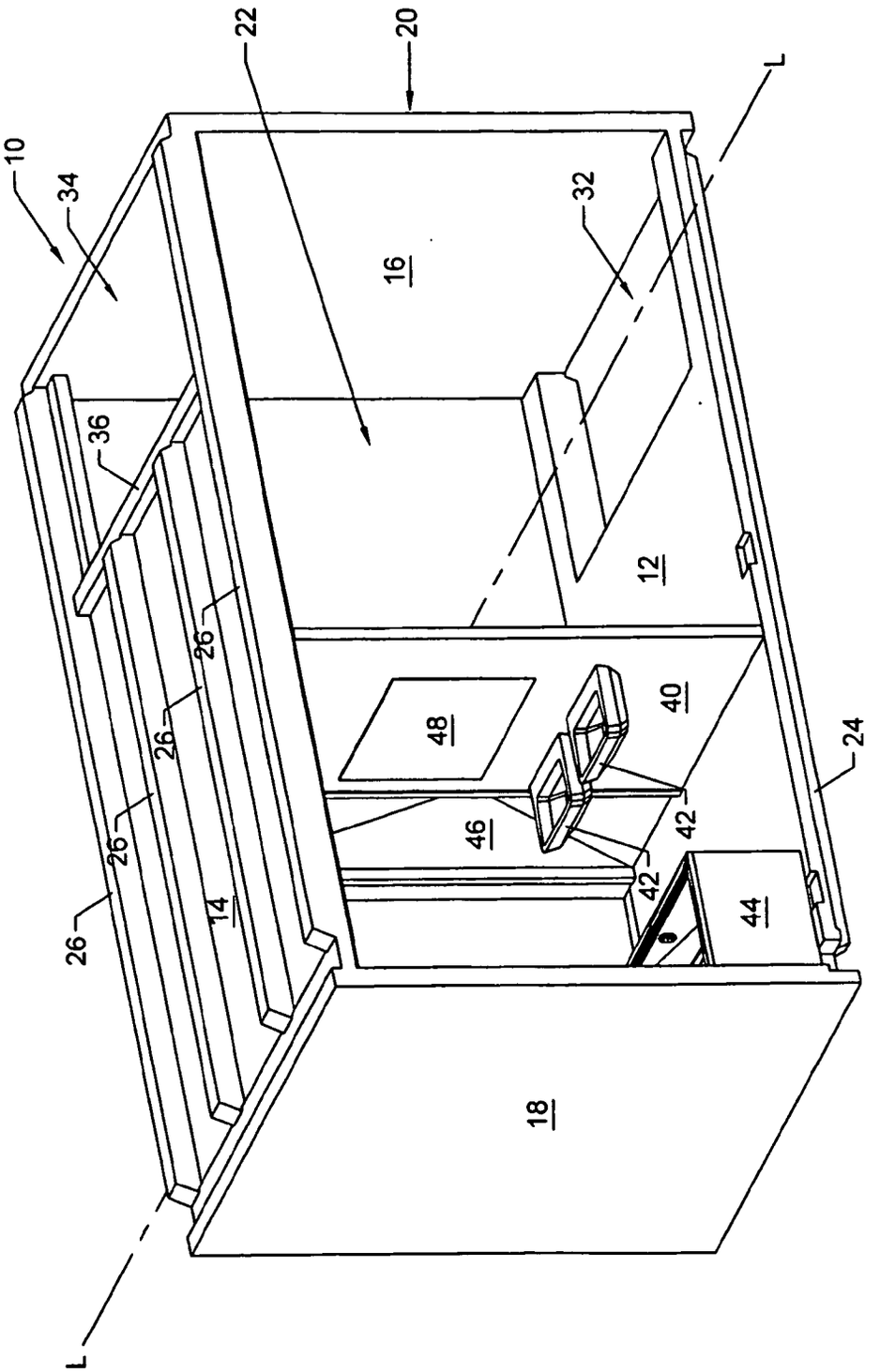

Fig. 1

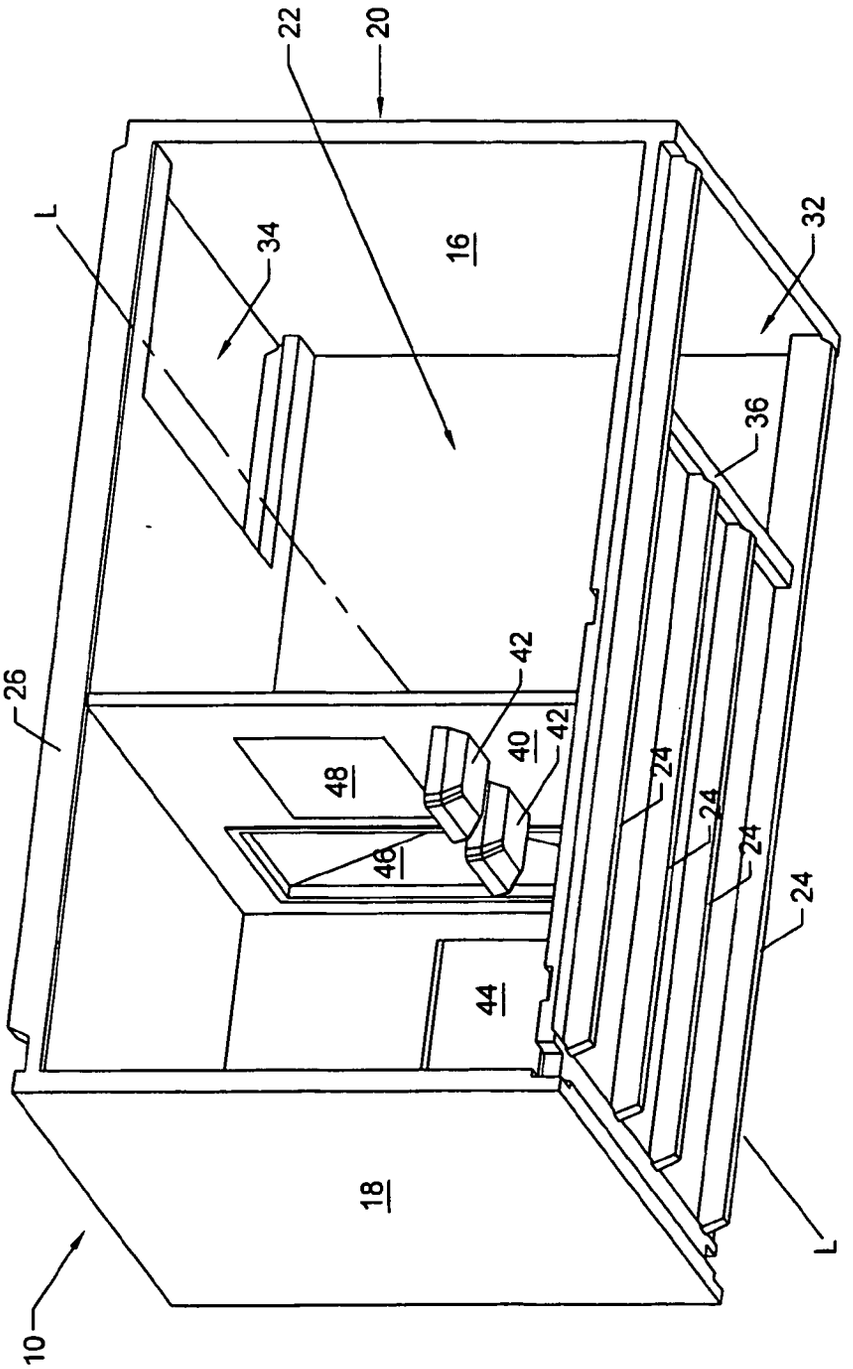

Fig. 2

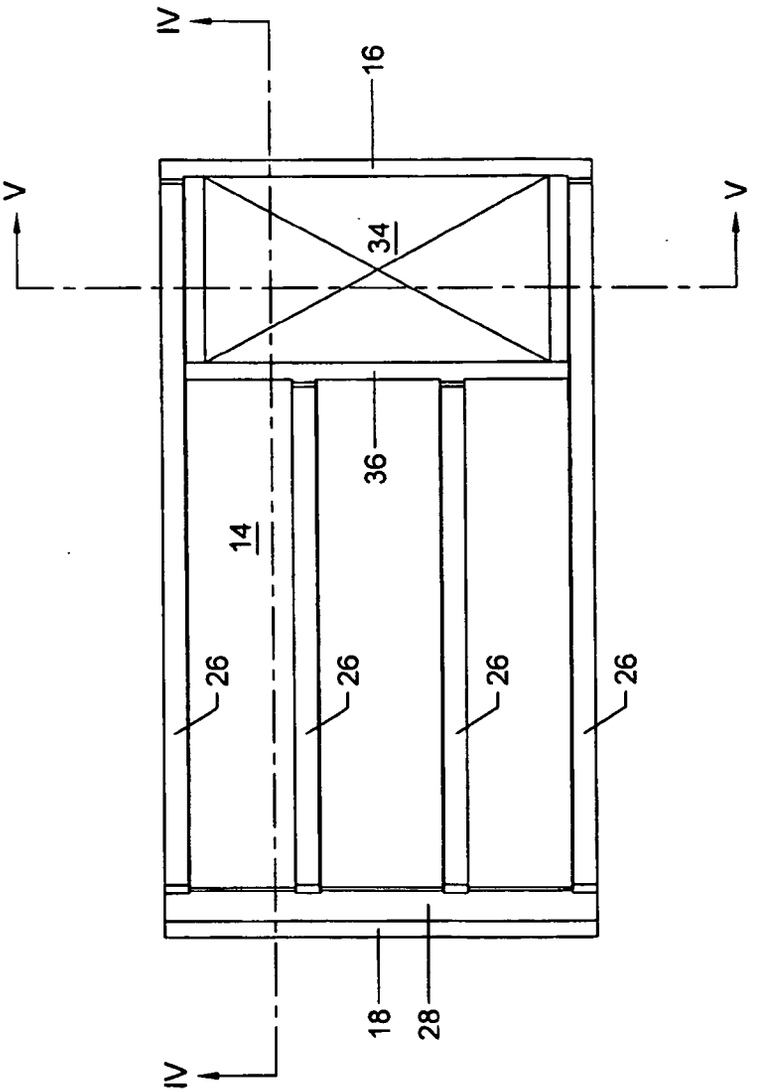

Fig. 3

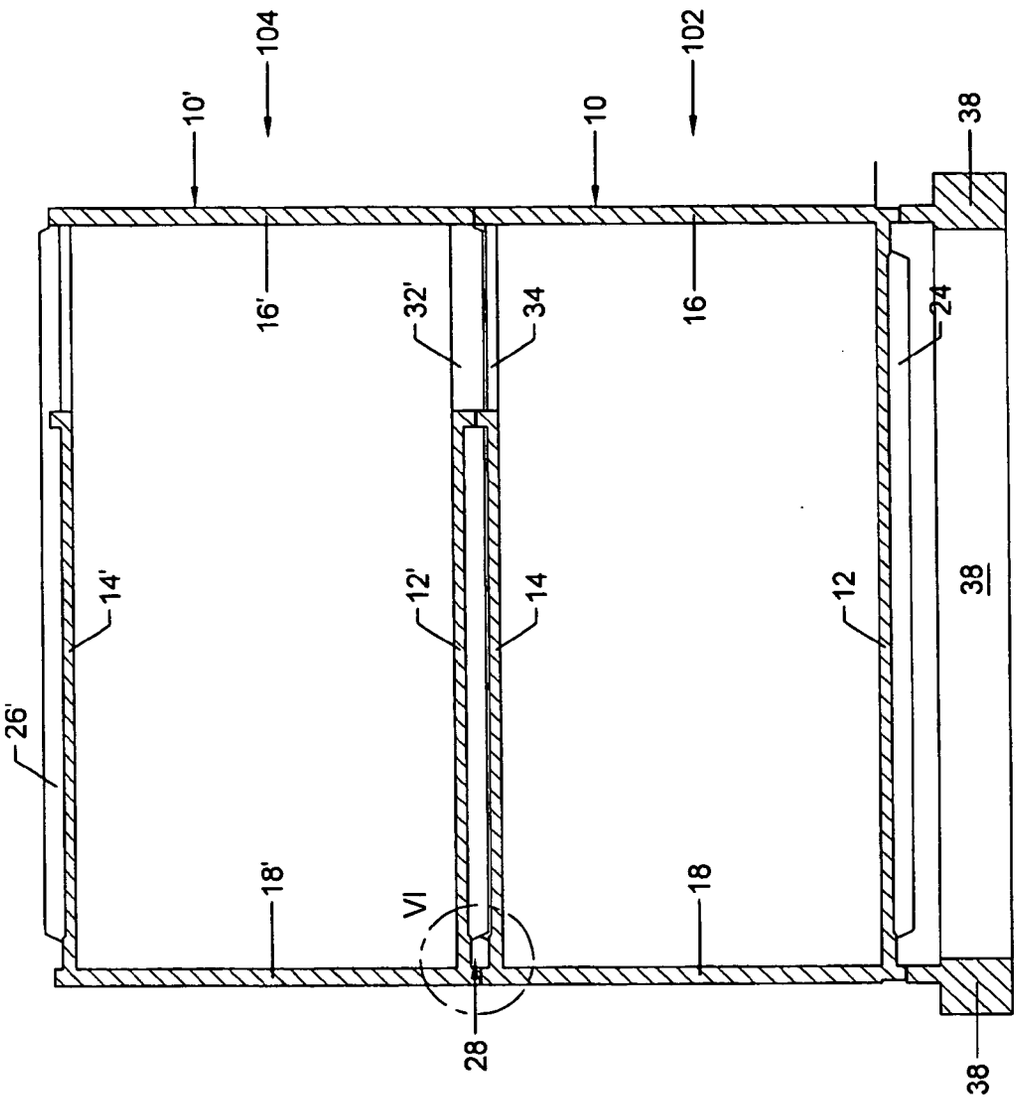

Fig. 4

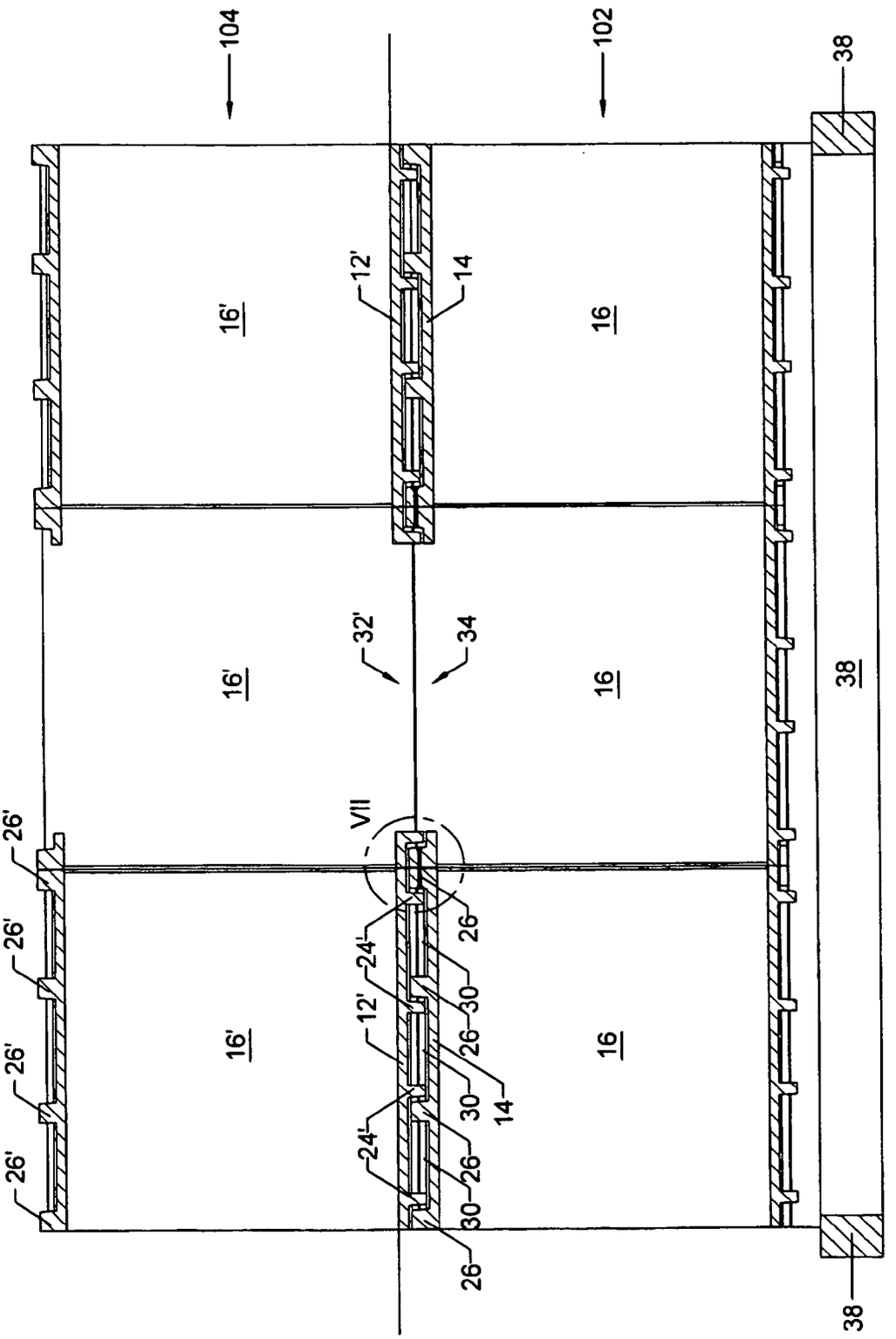

Fig. 5

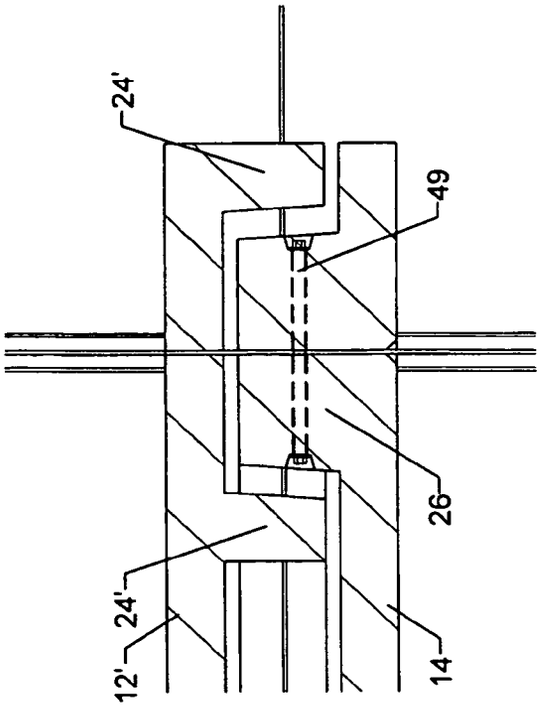

Fig. 7

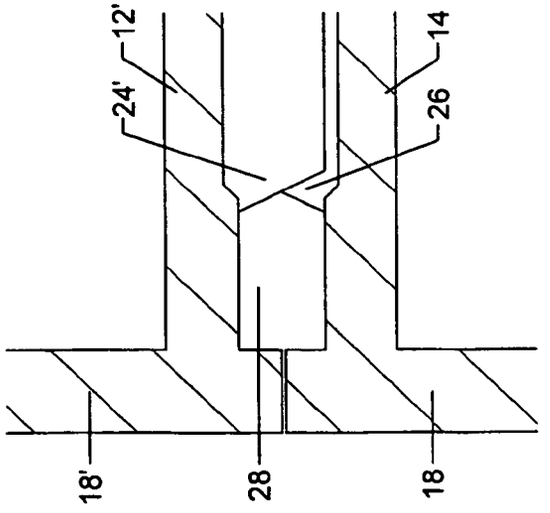

Fig. 6

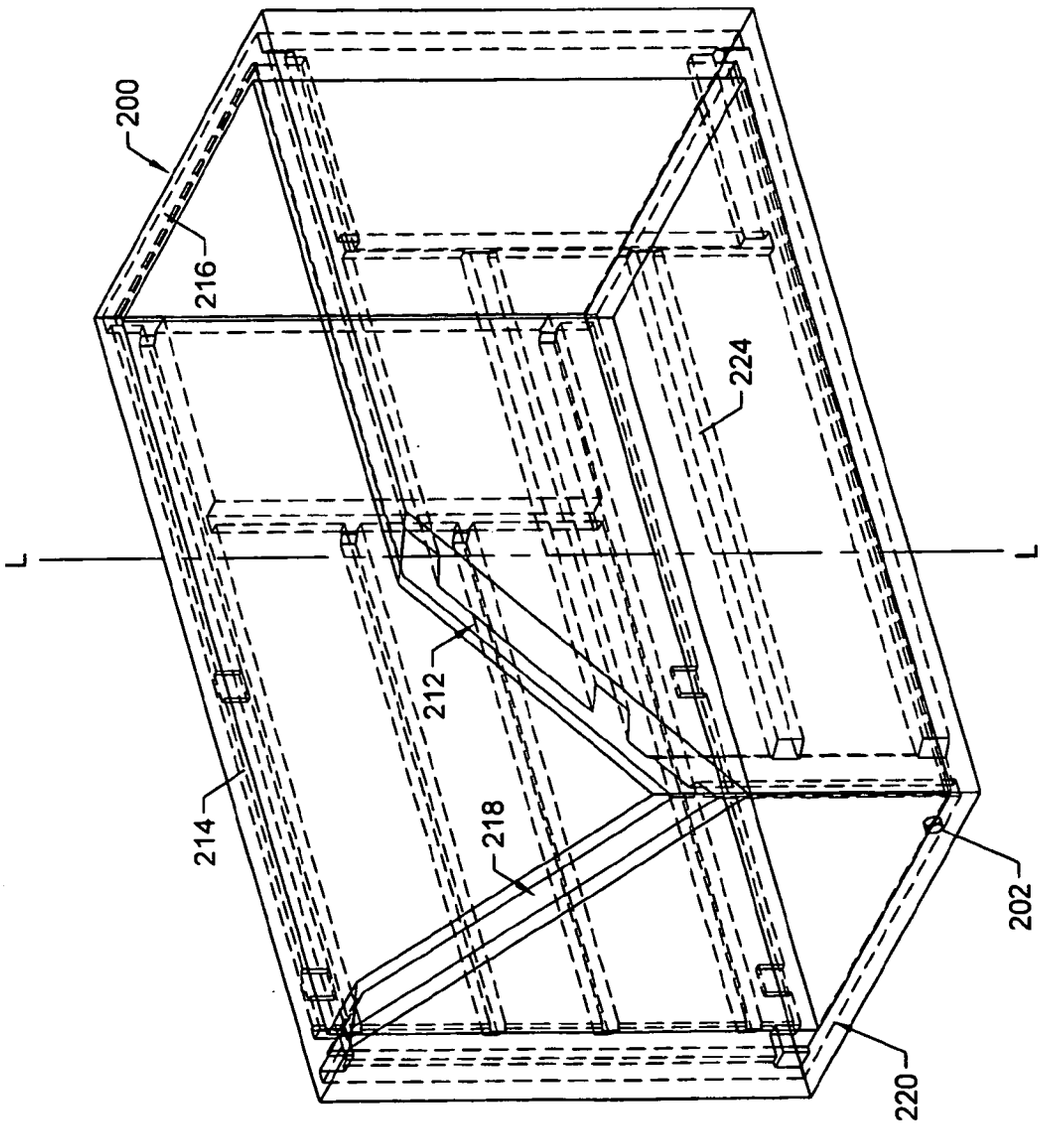

Fig. 8

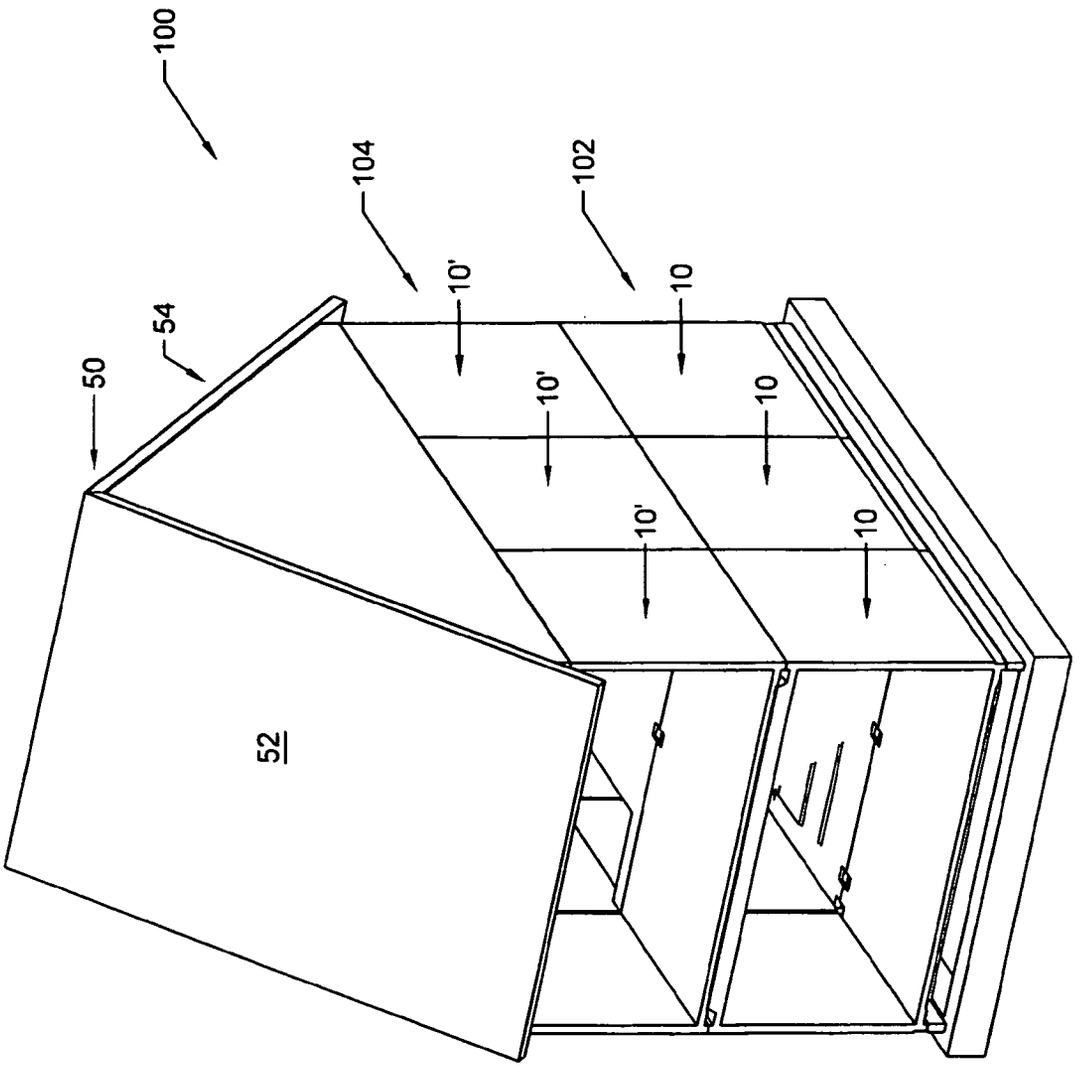

Fig. 9

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 2926969 **[0002]**
- NL 1024512 **[0003] [0004] [0010]**
- NL 1029449 **[0004]**
- FR 1414158 **[0011]**