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

(57) House module (10) provided with a bottom wall (12), a ceiling wall (14) and a first and a second sidewall (16,18), which house module is a concrete construction and is also provided with bottom wall reinforcing ribs (24) which form an integral part of the bottom wall, and with ceiling wall reinforcing ribs (26) which form an integral part of the ceiling wall, wherein the bottom wall reinforcing ribs are provided in a manner staggered relative to the ceiling wall reinforcing ribs in a manner such that when a second house module is placed on a first 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. Further, a method for manufacturing a house (200) is disclosed, and an assembly and a house which is provided with a number of such house modules.

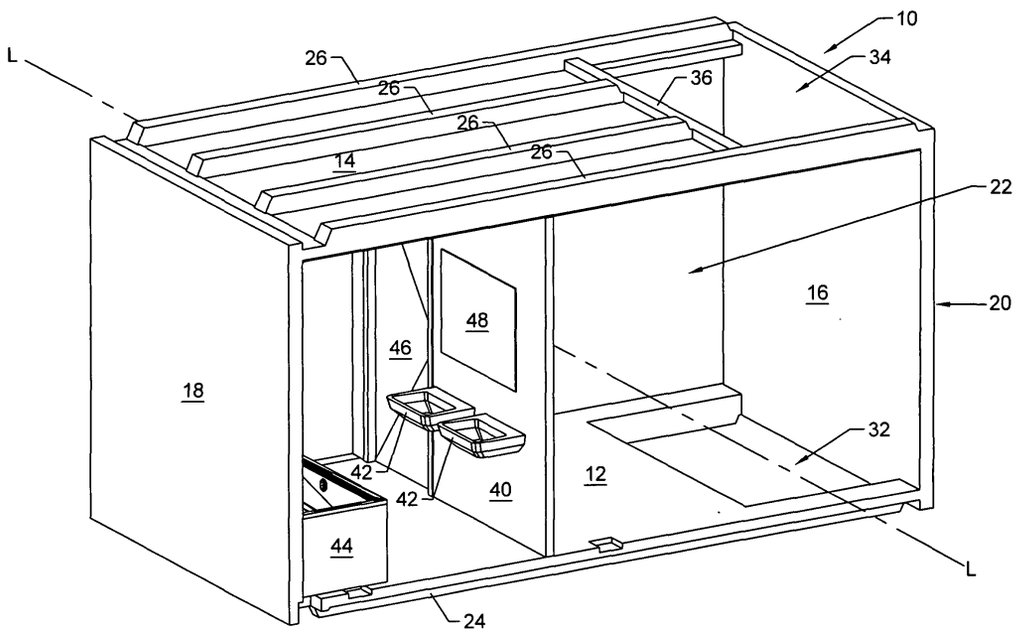

Fig. 1

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Description

[0001] The invention relates to a house module, an assembly of a number of house modules for forming a house, a house comprising a number of house modules and to a method for manufacturing a house.

[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 second house module extend next to the ceiling wall reinforcing ribs of the first house module, while both the bot-

tom 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 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 em-

bodiment 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 modules 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 provided 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 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), while 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), 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).

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).

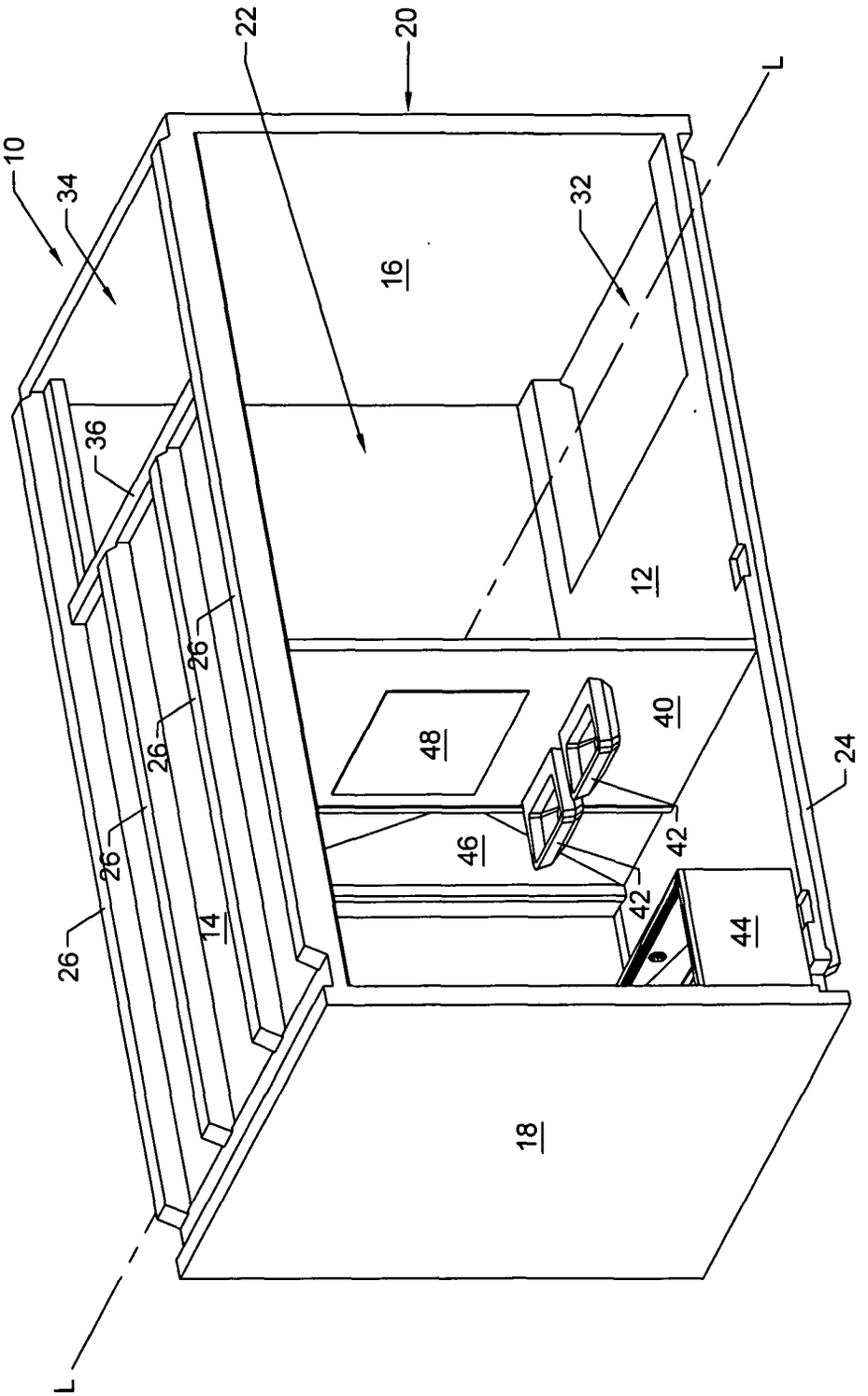

Fig. 1

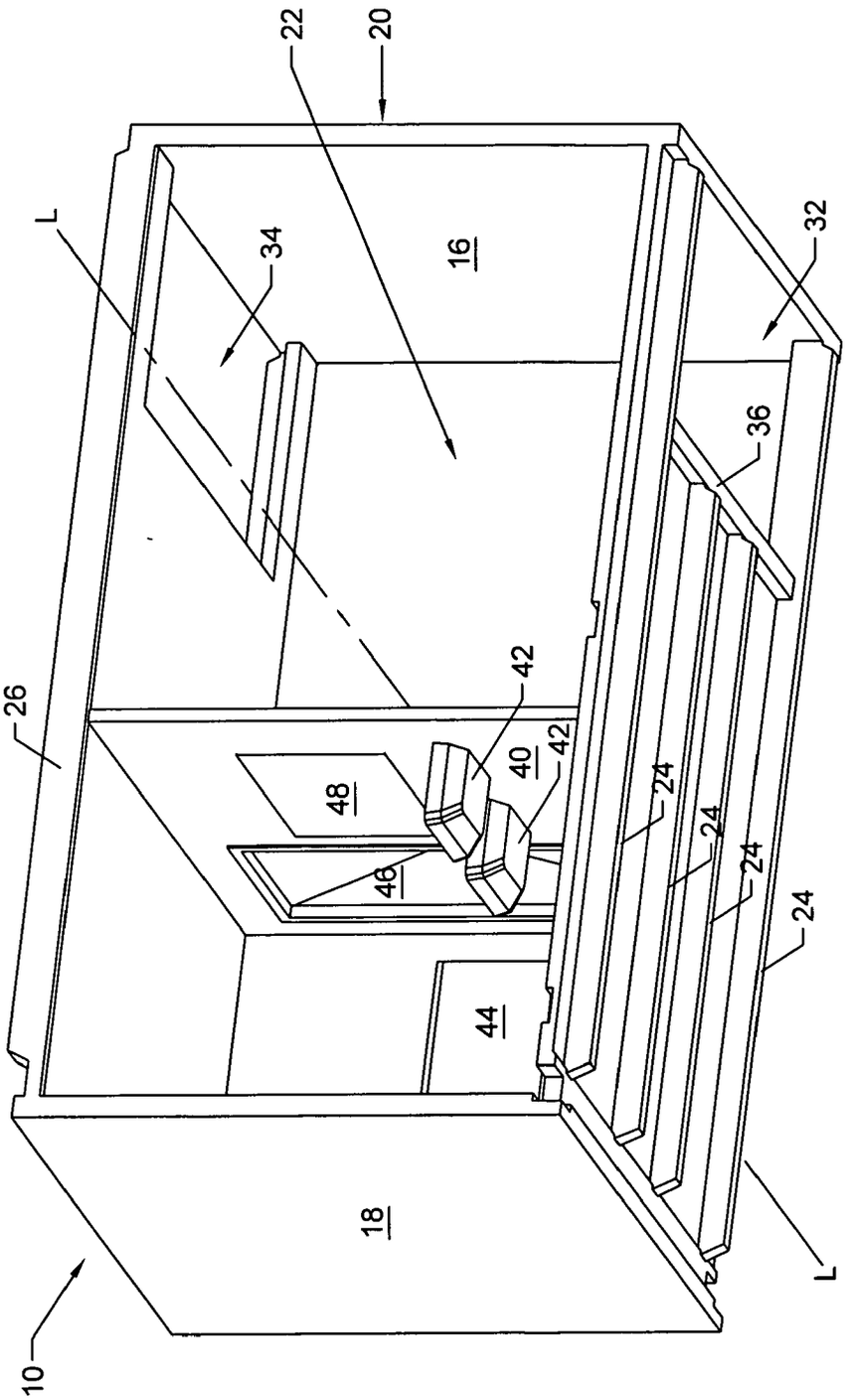

Fig. 2

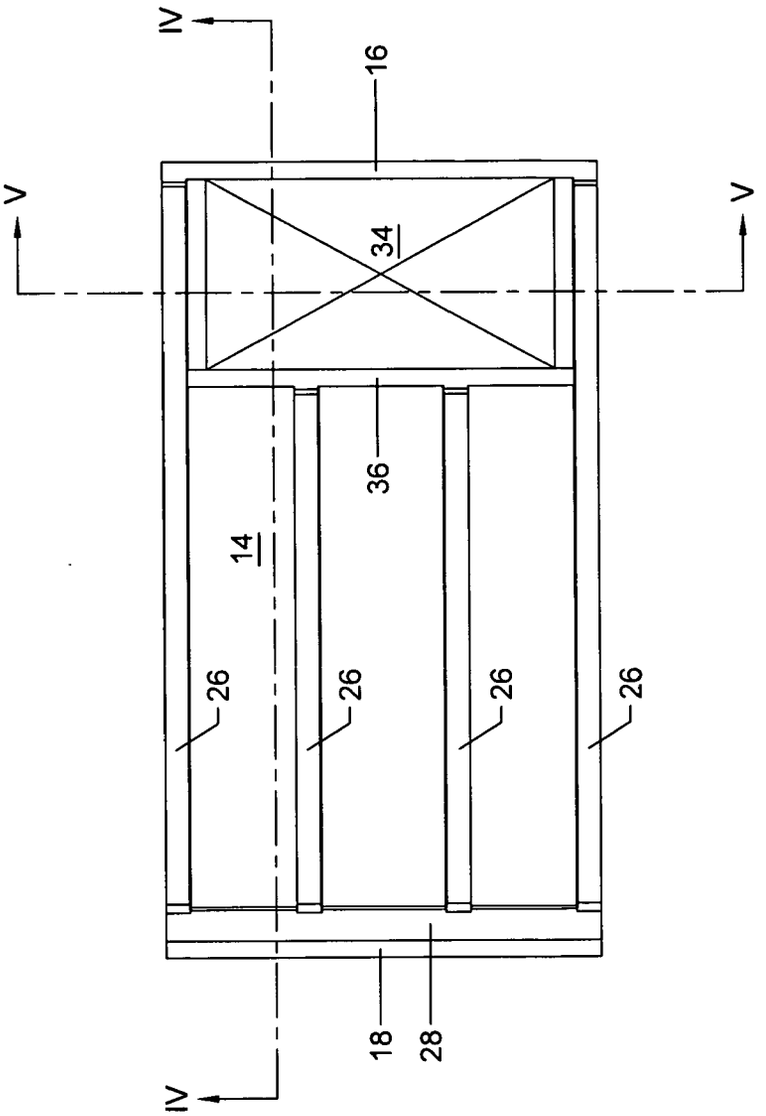

Fig. 3

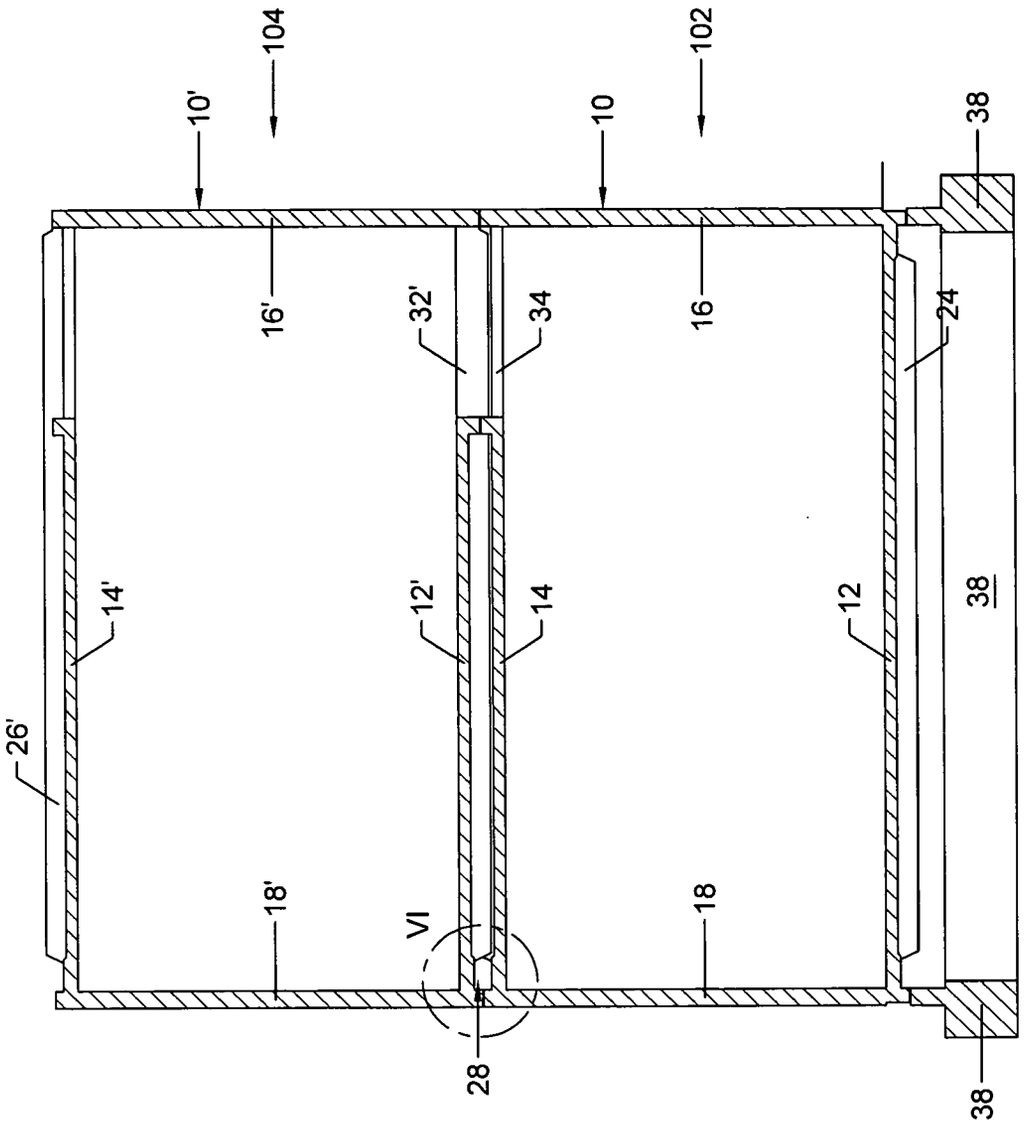

Fig. 4

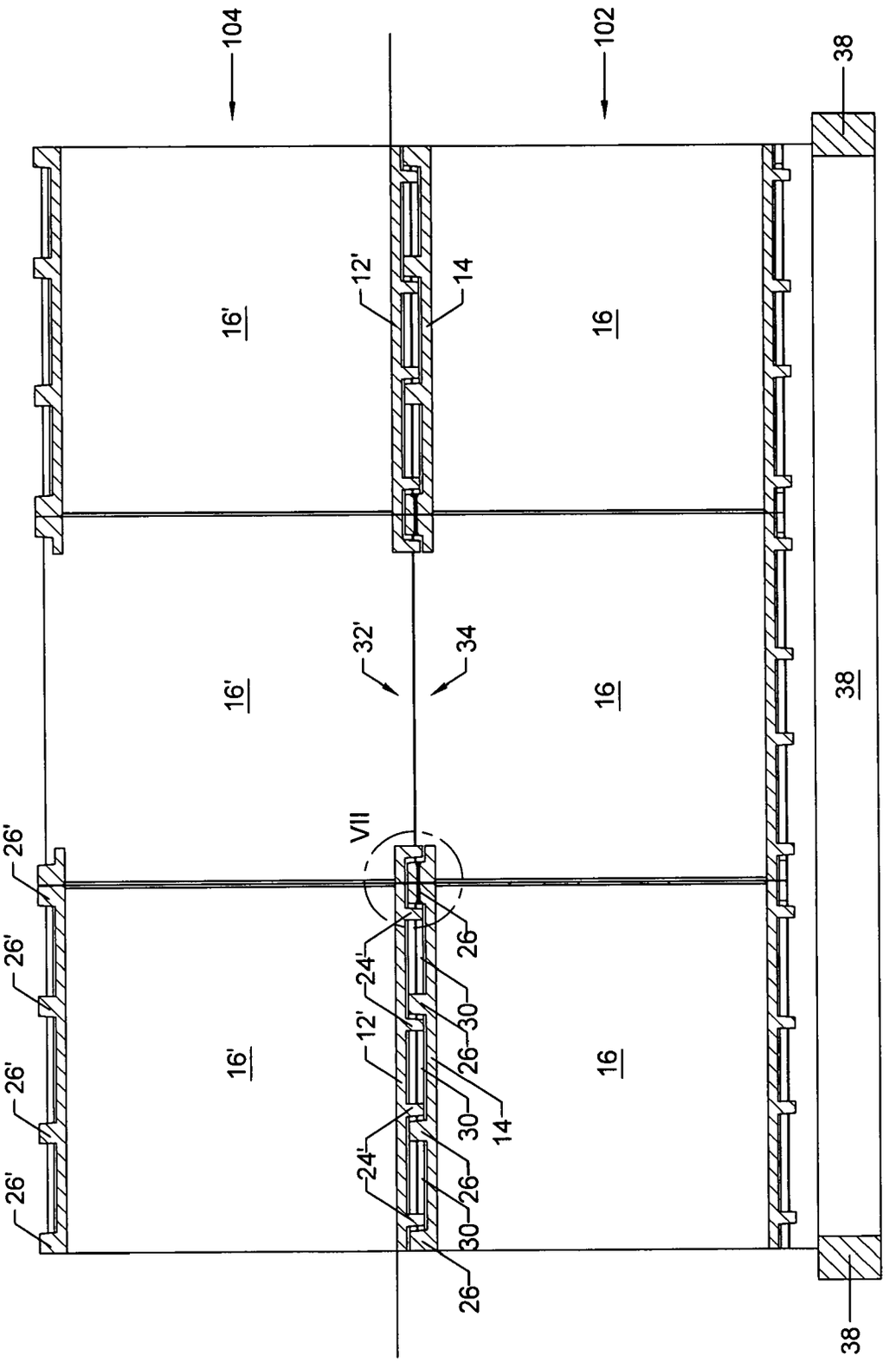

Fig. 5

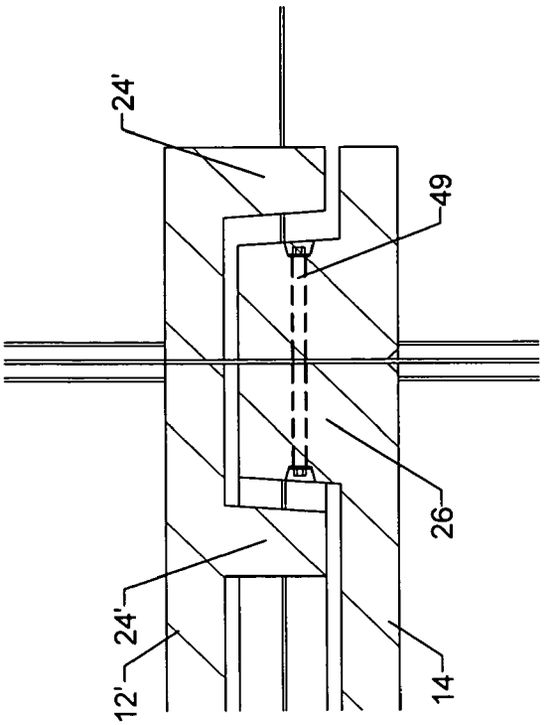

Fig. 7

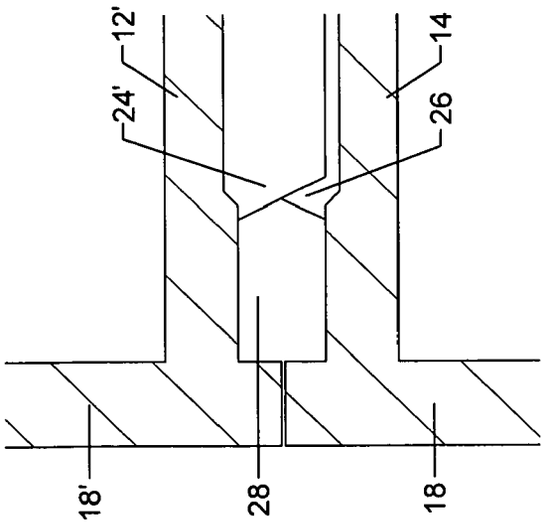

Fig. 6

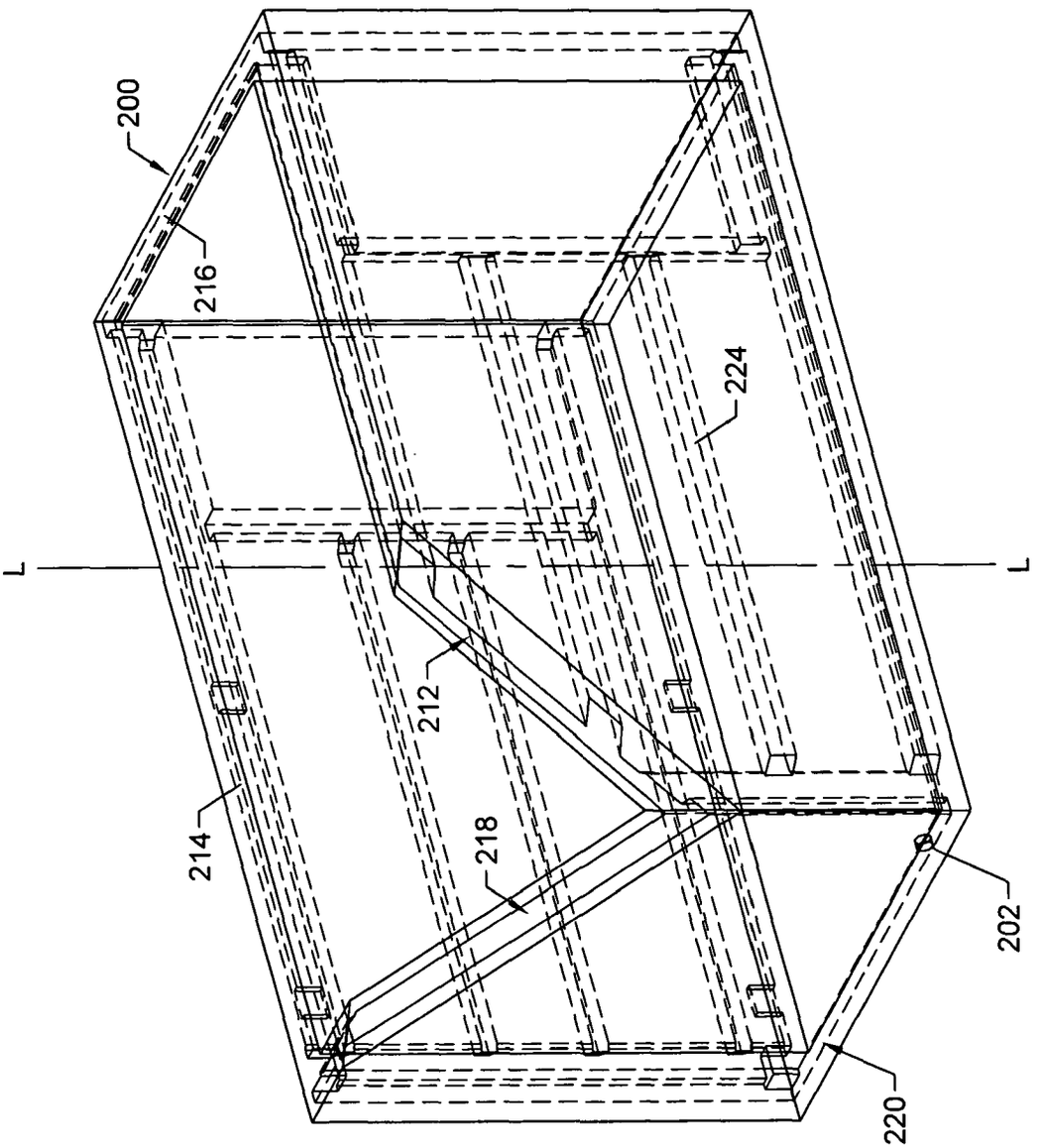

Fig. 8

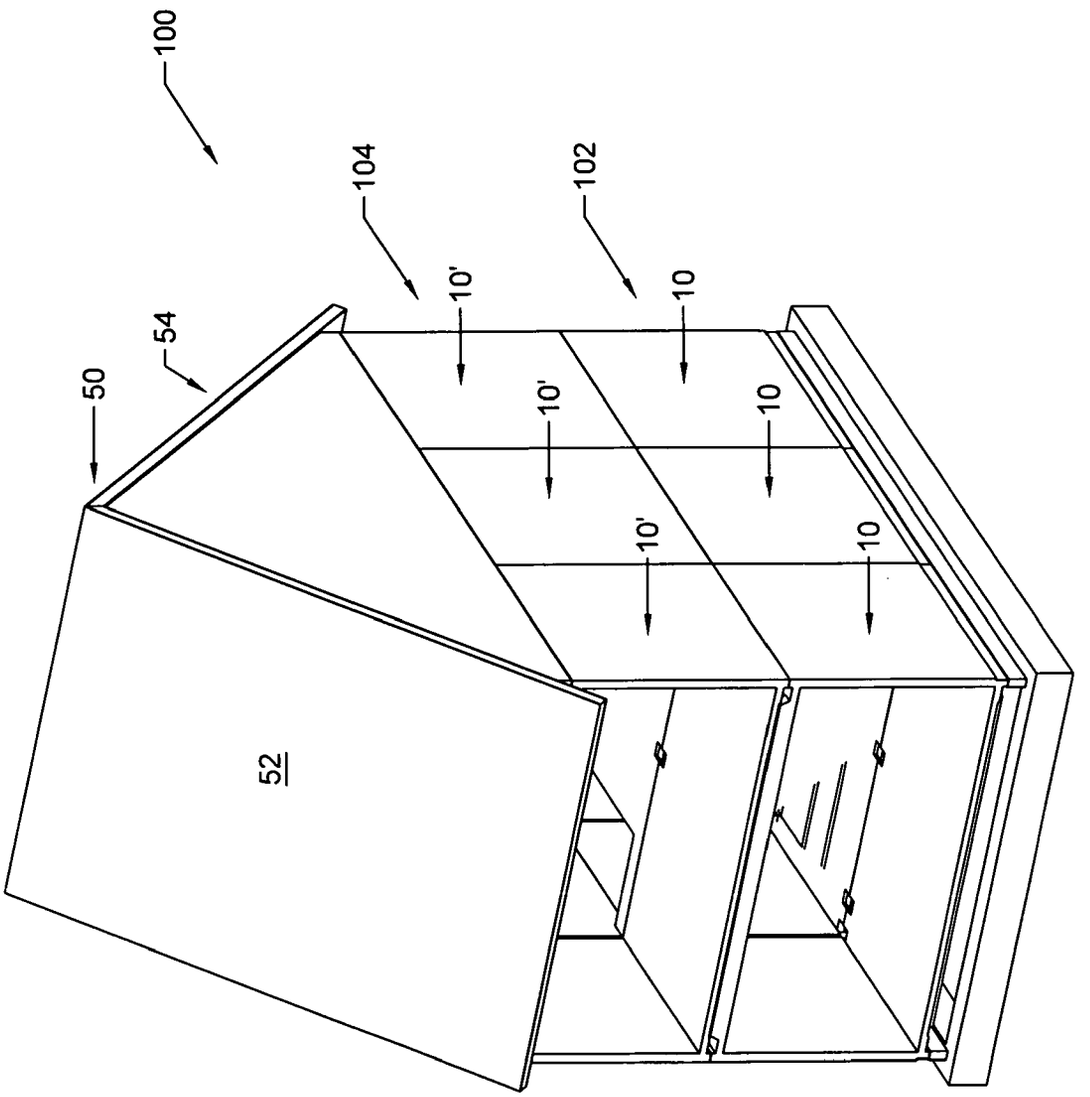

Fig. 9

REFERENCES CITED IN THE DESCRIPTION

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