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(72) Inventor: **Kerkhofs, Paul**
3940 Hechtel-Eksel (BE)

(74) Representative: **Luys, Marie-José A.H. et al**
Gevers & Vander Haeghen
Intellectual Property House
Holidaystraat 5
1831 Diegem (BE)

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(71) Applicant: **Algemene Participatie Kerkhofs, afgekort APK**
3900 Overpelt (BE)

(54) **Wall frame**

(57) The present invention relates to a wall frame comprising at least a first wall panel provided for positioning at a predefined distance from and opposite to a second wall panel, to define an inner volume between them, which wall panels are connected to each other in transverse direction of the wall frame by means of a plurality of connectors connected to an inner face of the first and second wall panel, wherein each connector comprises a plurality of connecting members, wherein the connecting members are spaced from each other in upright and in longitudinal direction of the wall frame, wherein the wall frame comprises at least one injection position to permit injection of filling material for filling the inner volume and wherein the connecting members comprise a fibrous reinforced plastic material.

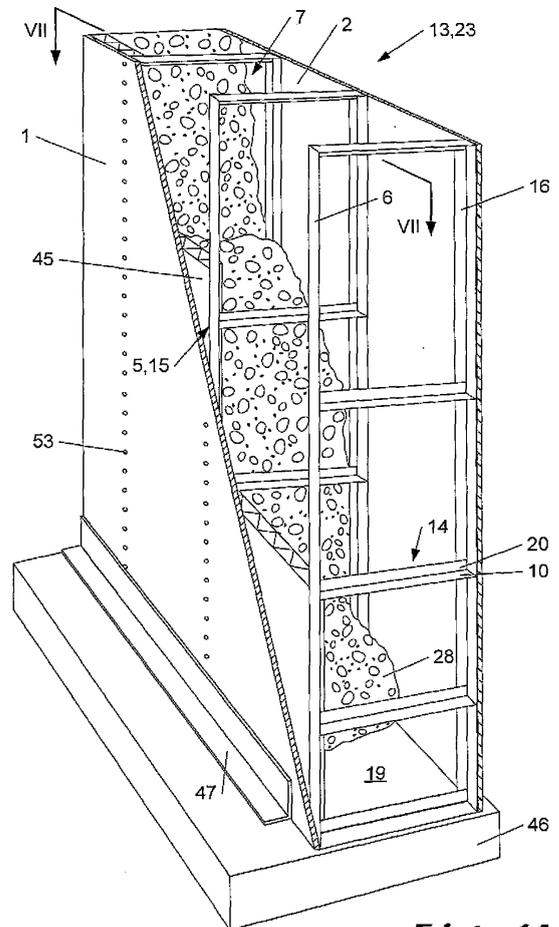


Fig. 1A

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Description

[0001] The present invention relates to a wall frame according to the preamble of the first claim, and to a wall construction built thereof, and to a method for constructing a wall by filling the wall frame with filling material.

PRIOR ART DESCRIPTION.

[0002] US-B1-6.698.710 discloses a system for forming foundations, walls, buildings and other structures of concrete or other pourable, hardenable materials. The system comprises two or more adjacent pairs of vertical spaced apart forming panels, wherein each pair of panels defines a cavity for receiving concrete. One panel of the pair defines an inner wall, the other panel defines an outer wall. Tie rails extend in transverse direction of the structure and engage the edges of the panels to fix a panel in a predetermined position relative to the other panels. Each tie rail comprises a first upright retaining section holding the upright edges of two adjacent inner wall forming panels, a second upright retaining section holding the edges of two adjacent outer wall forming panels and at least one web which extends in transverse direction of the system between the first and second retaining sections. The web comprises one or more retainers which assist in positioning reinforcing bars in a predetermined position between the outer and inner wall. Each tie rail further comprises exterior and interior flanges, which define a channel for positioning the panel edges. The flanges extend along a substantial length of the vertical edges of the panels and over a distance of the panel surface, which is sufficient to inhibit displacement of the panel edges from the retaining sections when the panels are subject to outward oriented pressure when filling the forming cavity with concrete. The panels are usually made of low density expanded foam panels with relatively high insulating properties. The choice of the tie rail material may be made without regard to the panel material, and the tie rails are usually made of a polymeric material or metal.

[0003] The system disclosed in US-B1-6.698.710 may be assembled in advance or on site, and is usually mounted on a prepared footing. The system disclosed in US-B1-6.698.710 presents the disadvantages that the tie rails provide a contact surface towards the exterior and may function as heat transfer bridges, which may infer important heat losses as the width of the panels is relatively small. Besides that, the use of reinforcement bars is still required to provide sufficient load bearing capacity.

[0004] WO9533106 discloses a modular building positioned on a supporting base, the walls of which are constructed by interlocking a plurality of adjacent hollow elongated extruded thermoplastic parts of rectilinear cross section. The parts are made by extrusion of reprocessed plastic material, their outer surfaces are covered with a protecting thermoplastic skin. Adjacently positioned parts provide a predetermined pattern of ducts

along the length of the walls, to provide internal flow passages for concrete filling material. The interior of the parts is provided with one or more webs, each web having a plurality of holes. As parts are made of plastic material, the load bearing capacity of a wall built thereof will be insufficient, unless metal reinforcement bars are inserted in situ.

[0005] EP1434919 discloses a hollow elongated building element which comprises a pair of spaced apart longitudinally extending side walls, joined by means of multiple transversely extending webs. Each building element contains at least one longitudinally extending groove and at least one longitudinally extending flange. The flange and groove of adjacent building elements are configured to engage each other by movement in transverse direction of the element. The building elements are made of extruded polyvinylchloride and may be filled with concrete. Because of the absence of metal reinforcement, these building elements show insufficient load bearing capacity. No provisions are made to permit mounting of insulation material.

[0006] US2001/0029717 discloses a discrete composite block, with a separately formed inner and an outer wall, joined with a connective structure, before being placed in a wall. Either the inner or outer wall has vertical load bearing capacity, for example cement, clay brick, stone or other masonry type material. Walls constructed with such modular blocks may be fabricated at the site at which they are to be used, or off-site. The cavity between the inner and outer wall may be utilized as a space to place electrical wires, water conduits etc., or it may be partially filled with concrete.

[0007] US5.809.726 discloses a form system to be built on site, which comprises two spaced parallel wall members between which concrete can be poured to form a structural member. Each wall member consists of a plurality of U-shaped members which extend in longitudinal direction of the wall member and which function to maintain panels in a spaced-apart relationship and in a vertical orientation. The panels are connected laterally using the T-shaped members. Filling and back filling with a liquid building material can be performed when time and weather permits. The T member also act as a load bearing system once the liquid building material has hardened. However, the flanges of the U and T members provide a contact surface towards the exterior and may therefore function as heat transfer bridges,

[0008] US2004/0003567 discloses a lattice structure which is to be constructed on site. The lattice structure comprises a plurality of vertically disposed stud members positioned in a spaced-apart, generally parallel fashion. Interstitial blocks of insulating material are positioned between adjacent stud members and are held together by a plurality of horizontal bar members extending between stud members. The interior and exterior surfaces of the wall structure are covered with a concrete shell. The studs and horizontal bars are coated with concrete as well.

[0009] There is however a need for wall frames which are suitable for constructing building walls, which are light and easy transportable and do not require the use of metal reinforcement bars to provide for the required load bearing capacity. The use of metal in some concrete building constructions is unwanted for several reasons: it creates the risk to the formation of cold bridges between the exterior and the interior of a building. In particular in buildings for electrical power or electrical equipment the presence of exposed metal parts is unwanted as it may give rise to electrical conductance or discharge outside of the building.

[0010] There is a need for wall frames with good insulating properties and with a rigid structure and sufficient load bearing capacity to allow fixing of protective or decorative elements already before the wall frame is filled with concrete, thus saving time and money.

[0011] There is also a need for a method of filling such wall frame in a fast way without breaking it or causing cracks or slits.

DESCRIPTION OF THE INVENTION.

[0012] It is therefore an object of the present invention to provide a wall frame, which, although it is light and easily transportable, shows sufficient rigidity and load bearing capacity, even before it is filled with filling material, and which does not require the use of the conventional metal reinforcement bars.

[0013] This is achieved according to the present invention with a wall frame showing the technical features of the characterising portion of the first claim.

[0014] Thereto, the wall frame of the present invention comprises at least a first wall panel provided for positioning at a predefined distance from and opposite to a second wall panel, to define an inner volume between them, which wall panels are connected to each other in transverse direction of the wall frame by means of a plurality of connectors connected to an inner face of the first and second wall panel, wherein each connector comprises a plurality of connecting members, wherein the connecting members are spaced from each other in upright and in longitudinal direction of the wall frame, wherein in a lower part of the wall frame subsequent connecting members in height direction of the wall frame are positioned at a distance which is smaller than the distance between subsequent connecting members in an upper part of the wall frame, and wherein the wall frame comprises at least one injection position to permit injection of filling material for filling the inner volume.

[0015] The connecting members ensure that the first wall panel is maintained at a predetermined distance from the second wall panel, also upon filling of the inner volume of the frame with a filling material, for example concrete. Because the connecting members are fastened to the face of respectively the first and second wall panel which face the inner volume, the connecting members are received within the inner volume of the wall

frame and the risk that the connecting members contact the outside of the wall frame is minimised. Thus the risk to the occurrence of cold bridges from the outside of a building towards the interior of a building made using the wall frame of this invention is minimised, as well as the risk to leaking of moisture from the outside into the wall structure, which may give rise to corrosion of the metal reinforcement commonly used in wall construction.

[0016] Upon filling of the inner volume of the wall frame with the filling material for example concrete a static or hydrostatic pressure is created and exerted to the wall panels. This outward directed pressure appears to be larger near the bottom of the frame than near the top and is particularly important in case the whole inner volume is filled with filling material in one go. Positioning the connecting members in a lower part at a smaller distance from each other than in an upper part, provides increased reinforcement and a better ability to absorb and withstand pressure in the lower parts of the wall frame. This is particularly advantageous when filling the inner volume in one go. Separating the connecting members further apart on the higher parts of the wall frame, where the outward pressure is lower, results in material savings.

[0017] The inventors have found that the wall frame of the current invention has sufficient strength to be filled with even self compacting concrete over its entire height in one go, which can be one entire floor-level of a building, or even more than one floor-level. By interconnecting the inner volumes of the wall frames of an entire building, and by filling the entire height of those inner volumes with concrete or self compacting concrete in one go, a monolithic construction is obtained without having interconnection surfaces between old and new concrete, thus being more resistant against fractures in the wall frame in case of an explosion or earth shake. The fact that the connecting members are fastened to the wall panels has the effect that connecting members and wall panels form one, interconnected structural reinforcing framework, with a high load bearing capacity even before the wall frame is filled with concrete. The interconnection ensures that local loads may be absorbed and transferred to the remainder of the structure and absorbed and dampened therein. As a result, the use of metal reinforcement bars which are commonly used in wall construction can be dispensed with. Because of the absence of metal the risk to electrical conduction and discharge towards the exterior is minimised.

[0018] Within the scope of the present invention, the second wall panel of the wall frame can be an individual wall panel, or can be part of an existing wall, e.g. part of an existing construction, a building etc. In the latter case the first wall panel is positioned at a predefined distance from and opposite to the existing wall panel, to define an inner volume between them, which wall panels are connected to each other in transverse direction of the wall frame by means of a plurality of connectors connected to an inner face of the first and second wall panel, wherein each connector comprises a plurality of connecting mem-

bers, wherein the connecting members are spaced from each other in upright and in longitudinal direction of the wall frame, wherein the wall frame comprises at least one injection position to permit injection of filling material for filling the inner volume and wherein the connecting members comprise a fibrous reinforced plastic material. If needed, part of the existing wall can be removed before positioning the wall frame against it. If needed, the length of the connecting members can be variable, or grooves can be provided in the existing wall as positioning means for the upright profiles. In this way the wall frame of the present invention can be positioned against a wall of an irregular shape.

[0019] In a preferred embodiment of the present invention, the wall frame additionally comprises a second wall panel and is prefabricated. By providing a prefabricated wall frame with two interconnected wall panels, the complete wall frame can be transported to the place of the building, and the work to be done in situ is minimised.

[0020] The connecting members can be made of any material considered suitable by the skilled person, but preferably they are made of a fibrous reinforced plastic material, since this material is capable of inducing the strength and load bearing capacity to the wall frame required when applying filling material and thereafter.

[0021] Preferably the connecting members have an angular shape and comprise a first portion which extends in longitudinal direction of the wall frame and a second portion which extends in upward direction from the first portion, in height direction of the frame.

[0022] More preferably, the connecting members are substantially L-shaped. Such angularly shaped connecting members have been found to show good mechanical strength as well as resistance against movement in all directions. Also when filling the frame with material of reduced viscosity, for example self compacting concrete (SCC), the first and second portion create obstructions which have the effect that they reduce internal movement in the filling material, and reduce the amount of turbulence in case of relatively low viscosity filling materials. While filling the frame with concrete, the L-shape particularly helps to create dead zones, where flowing of the concrete is prohibited. This way the connecting members assist in stabilizing the filling material in a stage where it is not yet fully hardened and often still relatively fluid. This aspect is especially important for SCC as this material has a quite low viscosity. The more flow or turbulence in the filling material, the higher the hydrostatic pressure in a lower part of the inner volume, and thus the higher the outward directed forces exerted to the wall panels. The inventors have observed that the L-shaped connecting members show good resistance against torsion, which helps to keep the first and second wall panels substantially parallel.

[0023] In a preferred embodiment of the present invention, the connecting members are arranged in columns which extend in height direction of the wall frame, a plurality of columns being spaced apart in longitudinal di-

rection of the wall frame.

[0024] To facilitate fastening to the wall panel, first end parts of the connecting members are fastened to a first upright profile which extends in height direction of the wall frame, and second end parts of the connecting members are fastened to a second upright profile, wherein the first and second upright profiles are made of fibrous reinforced plastic material and are fastened to an inner face of respectively the first and second wall panel.

[0025] The upright profiles preferably have an angular shape, preferably an L-shape. This provides a good connection between the upright profiles and the connecting members, and it allows a good connection of the connectors to the wall panels. When connecting two adjacent wall frames, the profiles at the corners can be firmly connected to each other, thus preventing any concrete to leak between the connections of the adjacent wall panels. Further, similar to the connecting members, the angular shape of the upright profiles and their orientation towards the closest injection position helps to limit flow and to reduce turbulence in the filling material, thus reducing outward pressure against the wall panels while filling the inner volume. The L-shape of the upright profile provides an additional strength to the wall panel, allowing the use of panels with reduced thickness without adversely affecting rigidity. The L-shape facilitates connection of the frame to further panels, such as for windows or doors, connection of adjacent frames to each other, connection to a transverse cover panel.

[0026] The wall frame of the present invention is preferably beam shaped and an upright profile is positioned in the vicinity of each upright edge of the wall frame, to permit connection to a further wall frame or to a further wall panel, for example a transverse cover panel at the edge of the wall frame. Positioning upright profiles in the edges of the wall frame provides means for connecting the wall frame to an adjacent wall frame. As described before, the L-shape of the upright profile is especially useful at the edges. By tightly connecting the upright profiles of adjacent wall frames, leakage openings between the wall panels are prevented. In addition, forces exerted upon one wall frame can be transferred to an adjacent wall frame. The upright profiles are also especially useful when connecting a transverse cover panel to the wall frame.

[0027] The present invention also relates to a wall construction comprising at least a first and a second wall frame, wherein at least part of a first side of the first wall frame is positioned against at least part of a second side of the second wall frame along a contact surface area, wherein at the position of the contact surface area at least part of the first and second wall panel is open in such a way that the inner volume of the first wall frame is connected to the inner volume of the second wall frame. By interconnecting the inner volumes of several adjacent wall frames, the filling material e.g. concrete can form a single structure.

[0028] The present invention additionally relates to a

method for constructing a wall, wherein a wall frame or a wall construction as described above, is filled with a substantially fluid filling material, wherein the filling material is supplied on at least one injection position using a supply member comprising at least one nozzle through which the filling material is supplied in downward direction, wherein the at least one nozzle is moved at a predetermined speed in upright direction of the wall frame and wherein the at least one nozzle is kept in a position at a substantially constant distance below the upper surface of the filling material during filling. Supplying the filling material from under the surface creates less turbulence, thus less pressure, as compared to the method where the filling material is dropped from the top of the wall frame. When multiple nozzles are used, all the nozzles should be moved simultaneously to minimize the movements of the filling material, thus reducing turbulences and minimising the outward pressure on the wall panels.

[0029] Within the scope of this invention, as a filling material any hardenable material considered suitable by the skilled person may be used. The person skilled in the art will be capable of selecting the most appropriate type of filling material taking into account the envisaged application of the wall frame. Usually the filling material will be a liquid or high viscous liquid material upon injection, which will harden with time. Preferably however, the filling material comprises a hardenable substance, preferably self compacting concrete, more preferably fibrous reinforced self compacting concrete. As the filling material, the wall panels and the connectors have an independent function, the material of each of them can be optimally chosen in view of the aimed properties.

[0030] Within the scope of the present invention, and depending on the envisioned application, several filling materials can be used to fill the inner volume of the wall frame, independent of the material chosen for the wall panels which is preferably selected for its structural strength, and independent of the techniques accommodated in the inner volume, such as thermal or acoustical insulation. The filling material is preferably selected for its properties. The filling material can have different functions: additional strength, thermal or acoustical isolation, or simply filling empty space. As the filling material does not have an aesthetic function, its functional properties can be maximally exploited.

DESCRIPTION OF THE FIGURES.

[0031] The invention is further elucidated in the appended figures and figure description. Note that the figures are not drawn to the scale. The figures are intended to describe the principles of the invention.

Figure 1A shows a view to a preferred embodiment of a wall frame of the present invention with part of the wall panels taken away.

Figure 1B shows an exploded view of the wall frame

of the present invention with additional wall panels. Figure 2A shows a view to a preferred embodiment of the connector of the present invention.

Figure 2B and 2C show alternative embodiments of the interconnection of a connecting member and an upright profile.

Figure 3 is a top view to a preferred embodiment of the wall frame of this invention.

Figure 4A shows a possible wall corner construction using two wall frames of this invention.

Figure 4B shows a possible interconnection of two wall frames of this invention, and a wall end construction.

Figure 5 shows a top view to a preferred embodiment of two connected wall frames, adjacent in longitudinal direction.

Figure 6 shows a cross section view of the wall panel of Figure 3 according line VI-VI

Figure 7 shows a cross section view of the wall panel of Figure 1A according line VII-VII

[0032] Figure 1A shows a wall frame 13, 23 of the present invention, comprising a first wall panel 1 which extends along a first longitudinal side of the wall frame, and a second wall panel 2 which extends along a second longitudinal side of the wall frame opposite the first longitudinal side. Within the scope of the present invention, the second wall panel 2 can either be an individual wall panel as is usually the case for a new building, but the second wall panel 2 can also be part of an existing wall, such as part of an existing building. In the latter case the main purpose of the wall frame is to provide a new wall without completely removing the existing wall.

[0033] The wall panels 1, 2 are connected to each other in transverse direction of the wall frame 13 by means of a plurality of connectors 5, 15, comprising connecting members 14, 24 connected to the inner face of the first and second wall panel 21, 22. The connecting members 5, 15 ensure that the first and second wall panel are maintained at a predetermined distance and position from each other. Because the connectors 5, 15 are fastened to the wall panels 1, 2 the wall frame 13, 23 of the present invention provides a three dimensional skeleton, which is strong and the components of which form one unity. This unity is capable of absorbing the pressure that is build up upon filling of the inner volume 7 with filling material 28, and of distributing and dampening this pressure over the entirety of the wall frame 13, 23. Resistance to pressure is especially important in case of wall frames with large heights that will be filled in one go. The wall frame 13, 23 of this invention constitutes a circumferential reinforcement structure, which extends in three directions and which determines the strength and load bearing capacities of the wall, often quite independently of the nature of the filling material 28. In other words, the formwork of the wall frame contributes considerably to the load bearing capacity of the wall frame. After filling, the filling material 28 provides an additional contribution. In-

corporation of at least part of the fastening members used to mechanically fasten the connectors 5, 15 to the wall panels 1, 2, permits optimising contact between the filling material 28 and the reinforcing frame and permits optimising transfer of loads and pressure from the filling material to the reinforcing frame. Thus a monolithic structure is provided, which functions as one single unity and incorporates both the three dimensional reinforcing wall frame and the filling material.

[0034] Optionally either the inner or outer wall of the wall frame 13, 23 or both may be covered with a decorative material for example bricksstrips, paint, etc. This means in fact that the wall frames for a building may be fully pre-fabricated, including one or two decorative layers (on the inside of the building and on the outside of the building) and including various desired techniques, such as insulation, inserted beforehand in the inner volume. The main last step left to be done at the building site, is assembling the individual wall frames into a building, and filling the inner volume 7 with a filling material 28.

[0035] The wall frame 13 comprises a first and a second transverse side 36, 37, which extend between the first and second longitudinal sides and together define an inner volume 7 of the wall frame. The first and second transverse side 36, 37 may either be closed off with respectively a third and/or fourth wall panel 3, 4, as will usually be the case when the wall frame as such is designed to form a wall. One or both of the third and fourth transverse sides may be left open in case connection to a further wall frame is envisaged. Similarly, each wall frame 13 has a top and a bottom face 17, 18, which can be closed off with a top respectively a bottom wall panel 38, 39 in case the wall frame as such is designed to form a wall. The bottom face 18 will usually be left open to improve connection to a support surface 46 for the wall frame or in case a connection to a further wall frame positioned below, is envisaged, but it may be closed as well. The top face 17 will usually be open in case a connection to a further wall frame positioned on top is envisaged, but it may be closed as well. When making a building construction, the inner volume 7 of the wall frame is filled with a filling material. In case openings e.g. windows, doors or ventilation openings etc are foreseen in the wall frame, additional wall panels are provided around the opening, to close off the inner volume.

[0036] The nature of the material of which the wall panel 1, 2, 3, 4, 38, 39 is made may be selected by the person skilled in the art, taking into account the nature of the application, the dimensions of the wall frame, the strengthening provided by the upright profiles, and the filling material for the wall frame. Suitable materials for the wall panel include cement fibre board, wood fibre-board, fibrous reinforced ceramic material, fibrous reinforced vubonite, ultra high strength concrete, glass, composite sandwich panels, panels of fibrous reinforced plastic materials, glass, plastic foam, polyurethane foam, polyethylene foam, polypropylene foam, a foam of an ethylene - propylene copolymer, phenol foam or aluminum

foam, thereby the foam materials may be reinforced with fibrous reinforcing material or not. By choosing a strong material, the thickness of the wall panel can be reduced, so that for a given thickness of the wall frame more space is available for technical use and/or for filling material with specific thermal or acoustical properties. Especially the combination of the thin panel with the upright profile is sufficiently strong. Preferably however, cement fibre board is used as these panels show good rigidity, mechanical strength and load bearing capacity even at reduced thickness of for example 10 mm, thus at reduced weight. Cement fibre board presents the advantage that it is thin and strong, shows good sound insulation properties, is water resistant and resistant against a wide variety of chemicals. In addition, it shows good cohesion with cement or concrete as filling material as well as with cement or plastering should the wall panel 1 be decorated with such materials.

[0037] Various thicknesses of the wall panels may be used. In general, the panel thickness will vary between 10 and 20 mm. If so desired a combination of two or more adjacent panels may be used on either side to improve the strength and load bearing capacity. The thickness of the cement fibre board panels typically varies from 10-20 mm and permits building wall frames with a thickness of about 20 cm. The use of concrete as material for the wall panels will perhaps be limited as those panels are only available in relative large thicknesses of at least 5 cm. The thickness of the wall panel will be adapted by the skilled person depending on its dimensions in height and longitudinal direction, the circumstances in which the panel is to be used, the expected loads and the nature of the material of which the panel is made.

[0038] In a preferred embodiment the inner volume 7 of the wall frame of the present invention is at least partly used for accommodating one or more means or materials for climate control. Preferably these materials are selected from the following list : piping system with heating or cooling fluid, phase change materials, mass thermal storage granules, isolation material. An advantage of a piping system for climate control in the inner volume of the wall frame is that it can be used for several purposes: 1) during construction of the wall, temperature control can be used to accelerate the hardening process of the filling material resulting in a faster construction time, or to control the quality of the concrete by controlling the temperature of the hardening process, 2) when a building of this wall frame is finished, the piping system in the wall frame can participate in the climate system of the building, 3) in the case where the building is an electrical power cabin, the temperature of the electrical transformer inside the building can be controlled by cooling the transformer with the fluid of the piping system, so that heat can dissipate through the wall without external openings or heat exchangers outside the building, which greatly enhances safety and security.

[0039] Figure 3 shows the wall frame 13 of the present invention comprising a plurality of connectors 5, 15 which

extend in transverse and height direction of the wall frame 13 and connect an inner face 21 of the first panel 1 to an inner face 22 of the second wall panel 2. Subsequent connectors 5, 15 are spaced apart in longitudinal direction of the wall frame. Usually the distance between subsequent connectors will be virtually constant to provide a uniform reinforcing web, but the distance may vary if the skilled person deems it appropriate. If a specific application so requires, the connectors 5, 15 may also connect opposite transverse sides 3, 4 in which case they extend in longitudinal direction of the wall frame.

[0040] In case a constant thickness of the wall frame over its entire length is envisaged, connectors 5, 15 will have a constant length in transverse direction of the wall frame. It is however also possible to vary the thickness of the wall frame in length or height direction. In that case the length of the connectors 5, 15 will vary in length/height direction of the wall frame.

[0041] Figure 1A and 2A show that each connector 5, 15 preferably comprises a plurality of connecting members 14, 24, which are spaced apart in height direction of the connector 5, 15. Between subsequent connecting members 14, 24 a cavity or open space 19 is left, to permit flowing of the filling material over the accessible part of the inner volume 7 of the wall frame.

[0042] Opposite end parts of each connector 5, 15 are fastened to an inner face 21, 22 of respectively the first and second wall panel 1, 2, with the purpose of maintaining the panels at a pre-determined distance and position from each other, and with the aim of providing additional rigidity and resistance against upright bending of the entire wall frame. Because the connectors 5, 15 are positioned in the inner volume 7 of the wall frame, there is a minimal risk that the connecting members 14, 24 extend to or contact the outside of the wall frame. Thus, the risk to the occurrence of cold bridges from the outside of a building towards the interior of a building comprising the wall frame of this invention is minimised, as well as the risk to leaking of moisture from the outside into the wall structure. The dimensions of the connector in height direction of the wall frame may either be the same as or different from the height of the wall panel.

[0043] Preferably in a lower part of the wall frame, the distance between subsequent connecting members 14, 24 is smaller than the distance between subsequent connecting members in an upper part of the wall frame. This closer positioning near the bottom of the wall frame strengthens the lower part of the frame and presents particular advantages when the inner volume 7 is filled with a filling material which is still relatively fluid and has a relatively low viscosity. This way problems encountered when filling a wall frame in the upright position, which do not occur with horizontal filling, are solved in an optimum manner. Thereby the wall frame may either be filled over only part of or over virtually its complete height. Because of the fluidity of the material, there is a risk to the occurrence of turbulence while filling, and the pressure exerted to the wall panels will be substantially higher near the

bottom of the wall frame than near the top. Positioning the connecting members 14, 24 in a lower part of the wall frame at a smaller distance from each other provides additional reinforcement and an increased ability to absorb and withstand pressure. This positioning of the connecting members is particularly important when self-compacting concrete is used as a filling material, as it usually has a high density and fluidity and may give rise to extremely high loads, especially when using high filling rates. The person skilled in the art will be capable of determining the sufficient number of connecting members 14, 24 required to achieve optimum force transfer and absorption.

[0044] Figure 6 shows that preferably the connecting members are arranged in columns 25 which extend in height direction of the wall frame 13, 23, a plurality of columns being spaced apart in longitudinal direction of the wall frame. The positioning in rows and columns is practical as this creates open spaces 19 in the frame for optional tubes, cables, wires, plumbing, etc to be applied in the wall frame, which can be connected to the connecting members to keep them in place before and during filling of the inner volume.

[0045] Figure 2A shows that in a preferred embodiment the connecting members 14, 24 usually take the form of an oblong rod, with an angular cross section as this provides a better stabilisation of fluid material present in the inner volume of the wall frame. Preferably however, the connecting members 14, 24 are angularly shaped as this provides optimum absorption of shear forces, optimum suppression of turbulence, optimum stabilisation of fluid material, which is particularly important when using filling materials which upon filling have a low viscosity and tend to flow and show turbulence, as this increases the pressure exerted to the wall frame. Thereto, each connecting member 14, 24 preferably comprises a first upright part 20 and a second part 10 which extends in longitudinal direction of the wall frame. The height of the upright part and the width of the second part can be the same, or can be different from each other. As an example both sizes can be 4 cm. However, the inventor has found that a large upright part causes more turbulence while filling, therefore the upright part is preferably smaller than the longitudinal part, and not larger than the diameter of the largest granules in the filling material. A longitudinal part of about 4 cm or more gives good stabilization. The connecting member 14 preferably has an L-shape, but T shape or + shape can also be used.

[0046] When the connector is not completely surrounded by filling material, as is e.g. the case when an isolating panel is present in the wall frame, the connector also functions as panel anchoring member. When filling the inner volume with filling material, this function is taken over by the filling material once hardened.

[0047] The longitudinally extending part 10 of the connecting member 14 may be used as a guiding surface for the positioning of conduits, ducts or electrical wiring, or if so desired for metal reinforcement bars positioned

in the interior of the wall frame. The longitudinally extending part 10 plays a significant role in shear force resistance, and in minimising fluid flow and turbulence.

[0048] As shown in Fig 2B the connectors can for example be made by moulding the connecting members 14, 24 and the upright profiles 6, 16 separately, and then connecting them together. Alternatively the connectors can also be moulded as a single product, in which case the connectors preferably look as shown in Fig 2C.

[0049] In a preferred embodiment, the upright part 20 of the connecting members 14 are preferably oriented upwards to the longitudinal part 10, especially in lower parts of the wall frame. At the top of the wall frame, or at the location of windows or doors, the connecting members are preferably mounted with the upright part 20 directed towards the bottom, for better mounting of a top wall panel 38.

[0050] Each connector 5, 15 preferably comprises a first and second upright profile 6, 16 which connect opposite end parts 31, 32 of the connecting members 14, 24. The surface of the entire connector, the connecting member or upright profile only, or two or more of them, may be roughened, for example by sand blasting or by application of a coating of a material with sufficient hardness such as sand, glass particles, ceramic particles, plastic particles, with the purpose of improving adhesion of the filling material 28 to the connector.

[0051] The upright profiles 6, 16 have an angular shape, preferably an L-shape, consisting of 2 parts: a first part 40 in the longitudinal direction of the wall frame, and a second part 41 in the transverse direction of the wall frame, as shown in Fig. 2.

[0052] At the edges of the wall frame, the transverse part 41 and the longitudinal part 40 preferably have the same dimension, allowing good interconnection with the transverse wall panel or with a neighboring wall frame. Between the edges of the wall frame however, the transverse parts 41 of the upright profiles 6, 16 are preferably somewhat smaller than the longitudinal parts, as their main function is to prevent upright bending of the wall frame. This saves material cost and minimizes turbulence upon filling. An advantage of the use of the upright profiles 6, 16 is that the connectors 5, 15 can be fabricated as ladder structures. Ladder structures present the advantage that they permit easy and elegant mounting of a plurality of connecting members 14, 24 between the wall panels 1, 2 in one go, as well as a rigid connection thereto. Subsequent ladder structures can be easily spaced from each other at any desired distance, while maintaining the envisaged upright distance between the connecting members, as described above. A further advantage is that ladder structures allow easy installation of insulation material 45 and may function as a support or fastening member for the insulation material.

[0053] The connectors 5, 15, the connecting members 14, 24 and upright profiles 6, 16 may be made of any material considered suitable by the skilled person. The connector 5, 15, connecting members 14, 24 and upright

profiles may be made of a different material, but they are preferably made of the same material for the ease of production. Examples of suitable materials include wood, metal for example steel, aluminium or any other material, ceramics, plastic material, fibrous reinforced plastic material, a combination of two or more of those or any other material deemed suitable by the skilled person. Preferably however the connectors, connecting members and upright profiles are preferably made of fibrous reinforced plastic material, and are typically only 2-3 mm thick. As a plastic material use can be made of a thermoplastic or thermosetting plastic material. Examples of suitable thermosetting materials include unsaturated polyester resins, vinylester resins, epoxy resins, phenolic resins, polyurethane resins. Preferably however polyester resin is used.

[0054] A wide variety of fibrous reinforcing materials may suitably be used, but the fibrous reinforcing material is preferably selected from the group of natural fibres, for example wool, cotton, flax fibres etc; mineral fibres, carbon fibres, metal fibres, glass fibres or synthetic fibres, for example polyester, polypropylene, polyethylene, polyamide, or mixtures of two or more of these fibres. However, because of its high impact strength the use of aramid fibres is preferred.

[0055] Figure 7 shows that in a preferred embodiment of the present invention fastening of the connector 5, 15 to the wall panel 1, 2 may either be done mechanically or by means of an adhesive or using a combination of both. Mechanical connection may be done either over the whole height of the connector or over only part thereof. Mechanical connection may be accomplished using any mechanical connection tools considered suitable by the skilled person, for example by means of screwing, nailing or stapling. Mechanical connection may also be achieved by the presence of co-operating connecting members on the wall panel 1, 2 and the connector 5, 15 which engage each other. Thereto either one single connecting member may be provided which extends over at least a significant part of the wall panel, or a plurality of individual connecting members may be used. The use of a mechanical connection which is localized and discontinuous is preferably used on the upper part of the connector, as it presents the advantage that vibration of at least part of the connector 5, 15 occurring while filling the inner volume 7 of the wall frame with fluid filling material 28, is permitted to a certain extent, and only a small fraction of the vibration energy is transmitted towards the bottom of the wall frame. As a result of the locally permitted vibrations, there is a minimum risk that the filling material 28 in another part of the wall frame is caused to vibrate and that its hardening would be disturbed.

[0056] As pressure is particularly high in a lower part of the wall frame, a strong fastening of the connector 5, 15 to the wall panels 1, 2 is required near the bottom of the wall frame to keep the panels in place. The lower part of the connector may therefore additionally be fastened to the lower part of the wall panel by means of an adhe-

sive, to improve force transfer between the connector and the wall panel. This also has the advantage that vibrations in the lower part of the wall frame are minimized. In cases where it is desirable to minimize force transfer from the connector to the wall panel, the surface area over which adhesive is applied is minimized. The person skilled in the art will however be capable of finding the optimum compromise between pressure build up in the connector and transfer thereof to the wall panel, to minimize cracking or breaking of the wall panel.

[0057] Figure 7 shows a preferred embodiment of the mechanical connection tools extending to a position in the inner volume 7 of the wall frame. According to the inventors, this permits embedding of the mechanical connection members, e.g. first and second panel screws 53, 54, in the filling material 28 and has the result that wall frame 13 and filling material 28 form one monolithic structure, wherein optimum force and pressure transfer between all components is rendered possible. Instead of screws, also bolts and nuts can be used. Preferably the head of the screw is completely hidden in the wall panel, and the rest of the screw hole on the outside of the wall is stuffed with another filling material, to hide the screws for aesthetic reasons, and to avoid moisture from entering the wall panel.

[0058] Due to the fact that opposite wall panels 1, 2 are connected to each other in transverse direction of the wall frame by means of a plurality of connectors 5, 15 which extend in height and transverse direction of the wall frame and at a plurality of positions in height direction of the wall frame, optimum transfer of forces between the connectors 5, 15 and the wall panels 1, 2 is permitted and the wall panels and connectors form one structural unity which functions as a three dimensional reinforcing skeleton for the filling material 28, with good rigidity and light weight. As a result, the use of conventional metal reinforcement bars can be dispensed with. This is a serious advantage since it reduces the risk to internal corrosion of the wall. This is particularly advantageous in the case of cabins for electrical applications, where the risk to the occurrence of electrical conduction and discharge needs to be minimised. By additionally using a monolithic structure where the inner volume 7, before filling with concrete, is effectively one single hollow area for the entire cabin, a strong housing is made, whereby in case of an explosion, impact or earth shake, the chance that a wall will break is minimised.

[0059] If so desired, sheets or panels of insulation material 45 may be mounted inside the wall frame for better thermal isolation, as shown in figure 5. The inventor has discovered that the isolation panels are preferably positioned against the inner face 21 of the outside wall panel 1 in longitudinal direction of the wall frame, between subsequent upright profiles 6, 16, to minimise the risk to condensation phenomena. A small channel for condensation 49 can be formed at the edge of the upright profiles, against the inner face 21 of the outside wall panel. The thickness of the insulation panel can be chosen depend-

ing on the desired isolation of the wall. By this way of working, part of the inner volume space is used to accommodate the desired techniques, while the rest of the inner volume is preferably filled with filling material such as concrete, with a high load bearing capacity.

[0060] A surprising advantage of using insulation material 45 positioned against the outer wall panel 1 and between the connectors 5, 15 is that it has a dimming effect on the vibrations of the wall panel and connectors caused during filling of the wall frame, thereby avoiding the generation of cracks or slits. This is especially useful in case of prefabricated wall frames decorated with for example a plaster material as decorative layer before it is filled with filling material such as concrete.

[0061] As a filling material, a wide variety of materials may be used, although it is preferred that at least part of the filling material is a hardenable material. A very suitable material is concrete. Self compacting concrete (SCC) is particularly preferred for its relatively high fluidity, for its ability of flowing into small even hidden cavities, which would never be accessed by normal concrete, especially in corners, or around openings for doors or windows, but also for example into slits left between the connectors and the wall panels, and especially because of the fact that SCC does not need not be subjected to vibrations to achieve compacting, which saves time and labour cost. Conventional concrete is a suitable material as well, however it is less fluid and needs to be subjected to vibration to achieve de-aeration and material compacting. Recycled materials may be included in the filling material as well, for example recycled gravel or shingle, or brick or clinker material or they may contain fibrous reinforcing material or fibrous reinforced self compacting concrete. By choosing a hardenable material such as concrete or clay, the filling material acts as a binding agent that assists in fixing the position of any other technical means e.g. a piping system. The filling material is preferably chosen such that its expansion coefficient as a function of temperature approximates that of the material of the wall panels and the connectors, to ensure optimum adhesion independent of the temperature of the environment, and to avoid internal stress. Adjacent wall frames 13, 23 will usually be filled with the same filling material. However, adjacent wall frames may be filled with different filling materials in case other requirements are imposed to different parts of the wall. A single wall frame may be filled with one single type of filling material, or different filling materials may be inserted on top of each other.

[0062] It may for example happen that a wall frame is in a first stage partly filled with a first filling material in the factory, where it is hardened, and then transported to the place where it is to be used, and finally in situ filled with further filling material.

[0063] As an alternative way of filling, textile or curtains can be used to partition the inner volume temporarily in upright compartments that can be filled with different filling material.

[0064] In the filling material, passive energy systems may be incorporated such as for example Phase Change Materials (PCM), for example Micronal which is commercially available from BASF. Inorganic and organic Phase Change Materials are capable of storing a significant amount of energy upon a phase change. Suitable examples include salt hydrates, paraffin or wax containing products. PCM's may be used as solid materials or in solution.

[0065] The inner volume 7, 27 of the wall frame may contain other types of passive energy systems, it may for example contain a conduit system for water or other cooling/heating liquids. In that case the connecting members 14, 24 may function as positioning and fastening means for the ducts forming the conduit system. After the production of the wall or the building, this water conduit system can be used for temperature control of the building. But the presence of such ducts, PCM and/or insulation material is also of particular interest during the production of the wall frame 13, 23, in case self compacting concrete is used as the filling material 28, since temperature control during the production of the wall frame may be used to control the quality or the speed of the hardening process, especially while filling in situ at outside temperature.

[0066] The wall frame 13, 23 of the present invention, when it has two wall panels 1, 2 is suitable to be prefabricated and to be transported to the location where a building is to be constructed, as a prefabricated unity. During prefabrication it may be partially filled with filling material 28, completely filled, or not filled at all. The remainder of the filling material will be supplied in situ. An advantage of partial or complete filling in the factory is that it can improve the strength of the wall frame when necessary. When the filling is also done horizontally, the hardening under controlled conditions provides uniform properties of the filling material. To improve compatibility and interconnection between the filling material which is applied in situ and the already hardened filling material during prefabrication, upright reinforcement bars may extend from the connecting members 14, 24 at the position of the interface between the already hardened and still liquid filling material.

[0067] Within the scope of the present invention, various types of filling material 28 may be used. Suitable examples include concrete, concrete containing recycled building materials, plastic materials, fibrous reinforced plastic materials, although self compacting concrete is preferred, or even fibrous reinforced self compacting concrete. Important is that the filling material is sufficiently fluid when supplied, to achieve filling of every corner and any slits occurring within the wall frame 13. This is particularly important at the connection positions of the connectors 5, 15 to the wall panel, in the corners of the wall panel and at the position of openings for doors or windows left out in the wall frame. Self compacting concrete presents the advantage that there is no need to subject it to vibration in order to achieve de-aeration and limit the

risk to the occurrence of air pockets and achieve filling of empty spaces in the wall frame. Making sure all slits are completely filled is of great benefit for the thermal isolation of the wall, and poses a great challenge with conventional concrete.

[0068] Figure 5 and figure 6 show a preferred embodiment of at least one injection position 30, 33 of the current wall frame 13, 23 to permit injection of filling material for filling the inner volume 7. The connectors 5, 15 are preferably oriented in such a way that the longitudinal portion 40 of the upright profiles 6, 16 and the longitudinal parts 10 of the connecting members 14, 24 extends towards the closest injection position 30. This has the effect that connectors 5, 15 on opposite sides of an injection position will point in opposite directions, towards each other. This positioning provides optimum suppression of turbulence in the liquid filling material 28 and optimum shear force absorption.

[0069] In each wall frame 13, preferably at least one connector 5, 15 will be mounted in the vicinity of each edge 26 connecting the transverse sides 36, 37 and longitudinal sides 1, 2 of the wall frame. This way the connectors 5, 15 at the corners of adjacent wall frames can be used as fastening means for connecting a wall frame 13 to a further wall frame 23 to make a wall construction extending in longitudinal direction. By tightly connecting the upright profiles of the different wall frames, any split between the wall frames is avoided.

[0070] Two or more adjacent wall frames may be connected to each other in different ways. Adjacent wall frames may be connected in such a way that adjacent transverse sides 36, 37 face each other, longitudinal sides face each other, adjacent top 17 and bottom sides 18 face each other. In cases where a wall frame is not positioned against another wall frame, the inner volume 7 needs to be closed using a wall panel 3 as shown in figure 4B. Figure 4A shows an example of a corner construction, where a transverse side and part of a longitudinal side face each other, whereby the transverse side wall of wall frame 13 is closed with a wall panel 3, while part of the longitudinal wall panel 1 is removed; This way, the inner volume 7 of the first wall frame 13 is connected to the inner volume 27 of the second wall frame 23 and filling material is permitted to flow in both inner volumes.

[0071] Figure 4B shows another embodiment of a wall construction where a first and a second wall frame 13, 23 of the current invention are positioned at an angle of 90 degrees, whereby at least part of a first side of the first wall frame 13 is positioned against at least part of a second side of the second wall frame 23 along a contact surface area. At the position of the contact surface area at least part of the first or second wall panel 1, 2 is open or removed in such a way that the inner volume 7 of the first wall frame is connected to the inner volume 27 of the second wall frame. The extent to which the wall panels are open or removed at the position of the contact surface area 29 will be determined by the person skilled in the art depending on the circumstances of the envis-

aged use.

[0072] Figure 1A shows how a wall frame of the present invention may be mounted on a support surface as such or by means of a support profile 47, for example an L-shaped profile, mounted along the bottom edges of the wall frame. These support profiles can be used for positioning the wall frame, but also help to withstand the pressure inside the wall frame when filling the inner volume 7 with a filling material 28, to prevent bending of the wall panel. The person skilled in the art can determine the optimal size of the support profile. In case the wall frame of the present invention is mounted on an existing concrete surface, preferably upright reinforcement bars extend from the existing concrete surface into the inner volume 7 of the wall frame, with the purpose of optimising the connection between the existing concrete phase and the new filling material 28.

[0073] The present invention also relates to a method for constructing a wall using the above-described wall frame 13, 23. According to the present invention at least one wall frame as described above is positioned at the position where the wall is to be built, the inner volume of the frame is filled, either partly or entirely, with a fluid filling material. The filling material is supplied on at least one injection position 30, 33 using a supply member 48. Preferably supply of filling material takes place at a plurality of spaced apart supply positions 33, 34, 35, to permit some motion but avoid unnecessary motion of the filling material 28 within the inner volume 7 of the wall frame, during and after injection, especially in lower parts of the wall frame. Some motion of the filling material is required to fill the entire space of the inner volume 7, 27, and to facilitate de-aeration of air encapsulated in the filling material. However excess motion of the filling material 28 is to be avoided as it creates turbulence and thereby increases the pressure exerted to the wall panels 1, 2.

[0074] The distance between adjacent supply positions 30, 33 is not critical to the invention, but is preferably between 2 to 5 m. If this distance is too small, the de-aeration might not be complete. If the distance is too long, demixing or segregation can take place. This way of supplying fluid filling material, permits that an initial flowing of the material takes place between adjacent injection positions 30, 33. The inventors have observed that the initial material flow is followed by a rather fast stabilisation and termination of the flow, which minimises pressure built up and loading of the walls.

[0075] In a preferred embodiment, the supply member comprises at least one nozzle 52 through which the filling material 28 is supplied in downward direction into the inner volume 7 of the wall frame 13, 23. The inventor has observed that supplying in downward direction creates less flow and turbulence than supplying in horizontal direction. During filling the nozzle 52 is moved at a predetermined speed from a lower position in the inner volume 7 of the wall frame, in upright direction towards a position in an upper part of the wall frame. Upon injection of the

filling material 28, the nozzle is preferably kept in a position below the upper surface of the filling material, to minimise the risk to unwanted incorporation of air and to minimise the risk to the occurrence of turbulence. Preferably, the nozzle 52 is kept at a substantially constant distance below the upper surface of the filling material, except when starting, in which case the nozzle is kept close to the bottom of the wall frame, until the upper surface has reached a height of about 10-20cm, after which the nozzle is moved upwards along with the upper surface. Preferably the injection position of the nozzle 52 is positioned maximum 20 cm below the surface of the filling material 28. Injection in the vicinity of the upper surface of the filling material solves the problem that there is a minimum risk to cause motion of the whole mass of filling material.

[0076] If so desired, either the entire inner volume 7 may be filled in one go over the entire height of the panel, or only part thereof may be filled with filling material 28 in one go while the rest is filled after the first part is sufficiently hardened. Within the scope of this invention it is however also permitted to combine in the inner volume several types of filling material in adjacent positions, for example adjacent wall frames, or on top of each other, or different layers on top of each other, or different layers next to each other, as explained above. For example, the filling material of a partly filled prefabricated wall frame can be different from the filling material supplied in situ. Because of the presence of the three dimensional reinforcing wall frame, filling materials with better or minor strength, and better or minor insulating properties, and more or less weight may be combined within the inner volume without substantially affecting the strength of the wall frame, and with no effect on the aesthetic aspects of the wall frame. The person skilled in the art can choose the optimum combination of filling materials, depending on the need.

[0077] It is preferred to move the nozzle in upward direction at a predetermined speed of between 5 - 15 m per hour, preferably 10-12 m per hour. The inventor has found that a higher filling rate results in less time required for the wall to be filled, thus resulting in cost savings and better quality control of the hardening process, but the internal pressure in the wall frame increases, thus requiring a stronger wall frame. According to the present invention, this can for example be solved by choosing more connectors 5, 15, higher upright parts 20 of the connecting member 14, thicker wall panels 1, 2, double wall panels on each side, or a combination of these. By moving the nozzle 52 at a constant speed, the quality of the concrete near the bottom and near the top of the wall frame is substantially the same. The person skilled in the art can choose the optimum combination of filling rate and structure of the wall frame.

[0078] As an example of an embodiment of the wall frame of the present invention, a curtain wall frame is presented. A curtain wall frame is a special case of a wall frame of claim 1, whereby at least part of an existing wall

is used as the second wall panel 2. The connectors 5, 15 of the curtain wall frame are connected between the first wall panel 1, and the existing wall, to form a rigid structure, and to define an inner volume that can be filled with filling material such as concrete or self compacting concrete. If needed, part of the existing wall can be removed before placing the curtain wall frame against it. In a specific example of this curtain wall frame the entire inner volume 7 is filled with insulation material, and no other filling material such as concrete is used. This is especially useful in renovation projects of a row of houses, whereby the facade of the existing house is removed or partially removed or not removed, and a curtain wall frame with good insulation properties is mounted to the outer face of the facade. The presence of insulation material in the vicinity of an outer wall of a building gives better results in terms of thermal insulation and condensation. As an example the thickness of such a curtain wall frame can be 10cm, of which 8cm is occupied by the insulation material, and 2 cm by the wall panel 1. If this curtain wall frame is prefabricated, the first and/or second upright profiles 6, 16 of the connectors 5, 15 can be temporarily or permanently connected to each other in longitudinal direction to avoid damage during transport or to facilitate placement against the existing wall. Usually a small part of the decoration of the wall panel 1 needs to be temporarily removed in situ, to facilitate fastening of the connectors to the existing wall. The main purpose of the connectors 5, 15 of the curtain wall frame is to keep the wall panel 1 at the correct or desired position with respect to the prior external wall, and to participate in the load bearing capacity for example when decorative elements are attached to this curtain wall frame. Such decorative material can already be attached to the prefabricated curtain wall frame, so that the renovation works only require a very short time at the location of the building to be renovated, thus causing only short annoyance for traffic and pedestrians, which is highly desirable especially in shopping streets or in cities.

[0079] In another example, the wall frame of the present invention is used in an electrical power cabin, housing electrical transformers. The total wall thickness is usually only 10cm but as it is 350cm high, use of a strong frame is required to minimise the risk to deformation of the frame. Usually, such a cabin has two floor levels: a first level sub-ground level, and a second ground level. Within the scope of this invention, the cabin can be designed as a monolithic structure, whereby the walls for both levels are made from one single wall frame of sufficient height, which is filled in one go to minimise the risk to the occurrence of fracture surfaces. Indeed, the contact interface between these levels could be a weak point. The present invention permits avoiding the use of metal reinforcement bars and this way the risk to electrical conductance or discharge to the outside of the building may be minimised. The walls are filled with concrete, preferably a concrete of heavy weight and high thermal capacity, as a way of cooling the inside of the building. The

cabin can be transported as a single and complete unit. Optionally insulation panels 45 covered with aluminum or other metal foil are mounted against the inner face 21 of the outer wall panel 1 to form a Faraday cage. This limits the risk to the occurrence of electromagnetic interference and radiation.

Claims

1. A wall frame (13, 23), comprising at least a first wall panel (1) provided for positioning at a predefined distance from and opposite to a second wall panel (2), to define an inner volume (7) between them, which wall panels are connected to each other in transverse direction of the wall frame by means of a plurality of connectors (5, 15) connected to an inner face of the first and second wall panel, wherein each connector comprises a plurality of connecting members (14, 24), wherein the connecting members are spaced from each other in upright and in longitudinal direction of the wall frame, wherein in a lower part of the wall frame subsequent connecting members (14) in height direction of the wall frame are positioned at a distance which is smaller than the distance between subsequent connecting members in an upper part of the wall frame, and wherein the wall frame comprises at least one injection position (30) to permit injection of filling material (28) for filling the inner volume (7).
2. A wall frame according to claim 1, wherein the wall frame additionally comprises a second wall panel (2) and is prefabricated.
3. A wall frame according to claim 1 or 2, **characterized in that** the connecting members comprise a fibrous reinforced plastic material, wood or metal or a combination of two or more of these materials..
4. A wall frame according to any one of the claims 1-3, **characterized in that** the connecting members (14) have an angular shape and comprise a first portion (10) which extends in longitudinal direction of the wall frame and a second portion (20) which extends in upward direction from the first portion, in height direction of the frame.
5. A wall frame according to any one of the claims 1-4, **characterized in that** the connecting members (14) are substantially L-shaped.
6. A wall frame according to any one of the claims 1-5, **characterized in that** the connecting members (14) are arranged in columns (25) which extend in height direction of the wall frame, a plurality of columns being spaced apart in longitudinal direction of the wall frame.

7. A wall frame according to any one of the claims 1-6, **characterized in that** the connecting members (14) are connected to each other in height direction of the frame by means of a first upright profile (6) to which first end parts (31) of the connecting members spaced apart in height direction are fastened, and by means of a second upright profile (16) connecting second end parts (32) of the connecting members opposite the first end part, the first and second upright profiles being made of fibrous reinforced plastic material and being fastened to an inner face (21, 22) of respectively the first and second wall panel (1,2).
8. A wall frame according to claim 7, **characterized in that** the upright profiles (6, 16) have an angular shape, preferably an L-shape.
9. A wall frame according to claim 7 or 8, **characterized in that** the first and second upright profile (6, 16) are attached to the wall panel by means of fastening means selected from at least one mechanical connecting member, an adhesive or a combination thereof.
10. A wall frame according to claim 7 or 8, **characterized in that** the longitudinal parts (40) of the upright profiles (6, 16) and the transverse parts (10) of the connecting members (14) extend in the direction of the closest injection position (30).
11. A wall frame according to any one of the claims 1-10, **characterized in that** in the inner volume one or more climate control means are accommodated, preferably selected from a piping system containing heating or cooling fluid, phase change materials, mass thermal storage granules, insulation material.
12. A wall frame according to any one of the claims 1-11, **characterized in that** the wall frame is beam shaped and **in that** an upright profile (6, 16) is positioned in the vicinity of each upright edge (26) of the wall frame, to permit connection to a further wall frame or to a further wall panel, for example a transverse cover panel at the edge of the wall frame.
13. A wall frame according to any one of the claims 1-12, **characterized in that** the material of the wall panel comprises cement fibre board, wood fibreboard, fibrous reinforced ceramic material, fibrous reinforced vubonite, ultra high strength concrete, fibrous reinforced plastic materials, glass, plastic foam, polyurethane foam, polyethylene foam, polypropylene foam, a foam of an ethylene - propylene copolymer, phenol foam or aluminum foam.
14. A wall frame according to any one of the claims 1-13, **characterized in that** a sheet or panel of an insulating material (43) is positioned against the inner face (21) of the first wall (1), whereby the first wall panel is located on the outside of the building, the insulating sheet or panel being positioned between subsequent upright profiles (6,16).
15. A wall construction comprising at least a first and a second wall frame (13, 23) according to any one of the claims 1-14, wherein at least part of a first side of the first wall frame is positioned against at least part of a second side of the second wall frame along a contact surface area, wherein at the position of the contact surface area at least part of the first or second wall panel (1,2) is open in such a way that the inner volume (7) of the first wall frame (13) is connected to the inner volume (27) of the second wall frame (23).
16. A method for constructing a wall, wherein a wall frame according to any one of the claims 1-15 is positioned at a location where a wall is to be constructed, wherein the inner volume (7) of the wall frame is filled with a substantially fluid filling material, wherein the filling material is supplied on at least one injection position (30) using a supply member comprising at least one nozzle through which the filling material (28) is supplied in downward direction, wherein the at least one nozzle is moved at a predetermined speed in upright direction of the wall frame and wherein the at least one nozzle is kept in a position at a substantially constant distance below the upper surface of the filling material during filling, after which the filling material is permitted to harden.
17. A method according to claim 16, **characterized in that** the filling material (28) comprises a hardenable substance, preferably self compacting concrete, more preferably fibrous reinforced self compacting concrete.

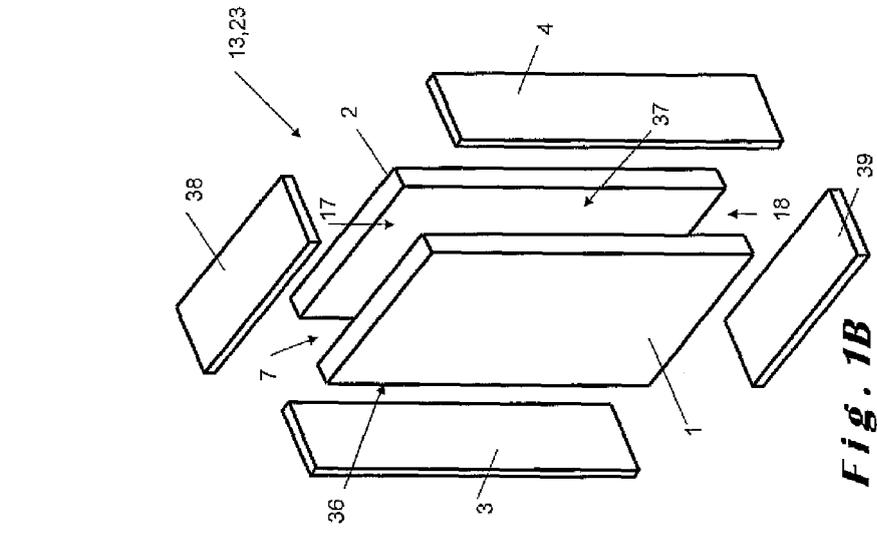


Fig. 1B

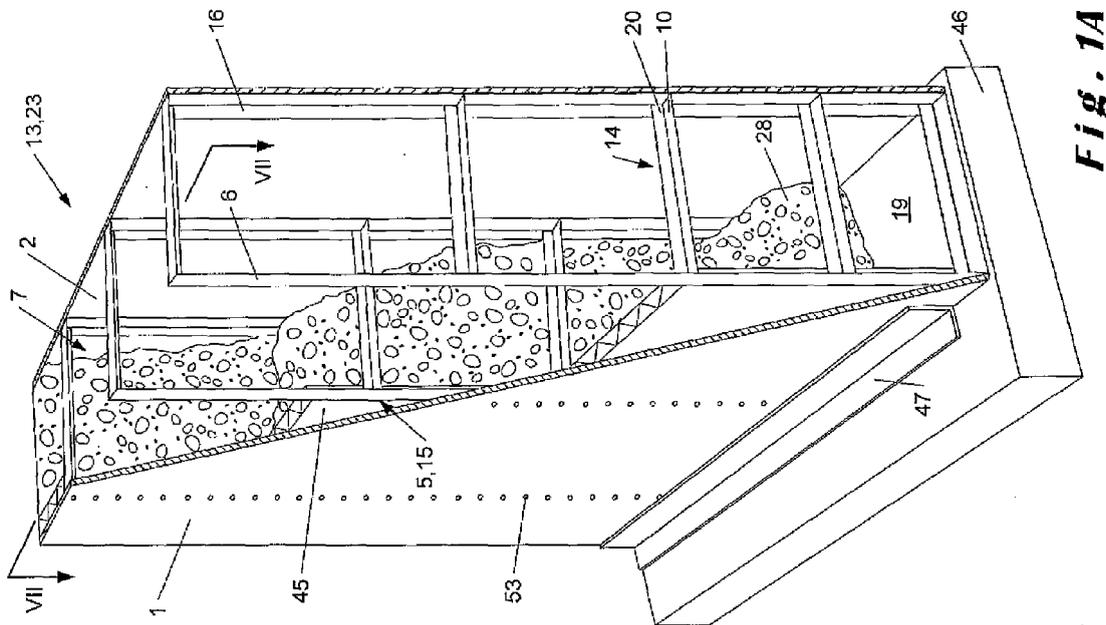


Fig. 1A

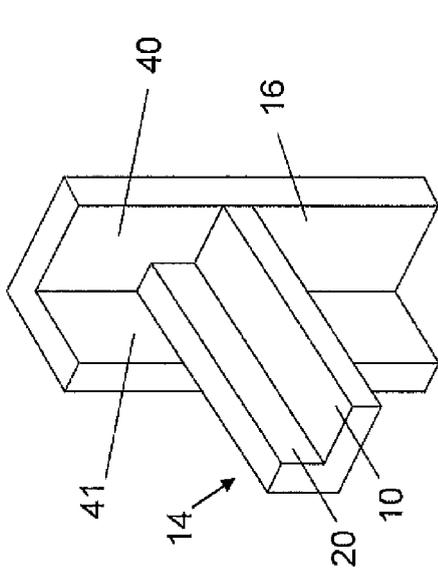


Fig. 2B

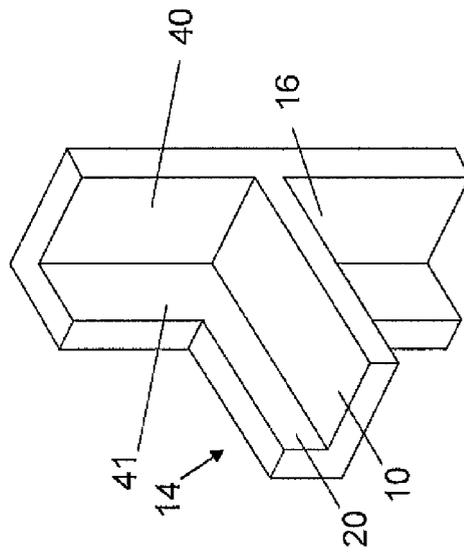


Fig. 2C

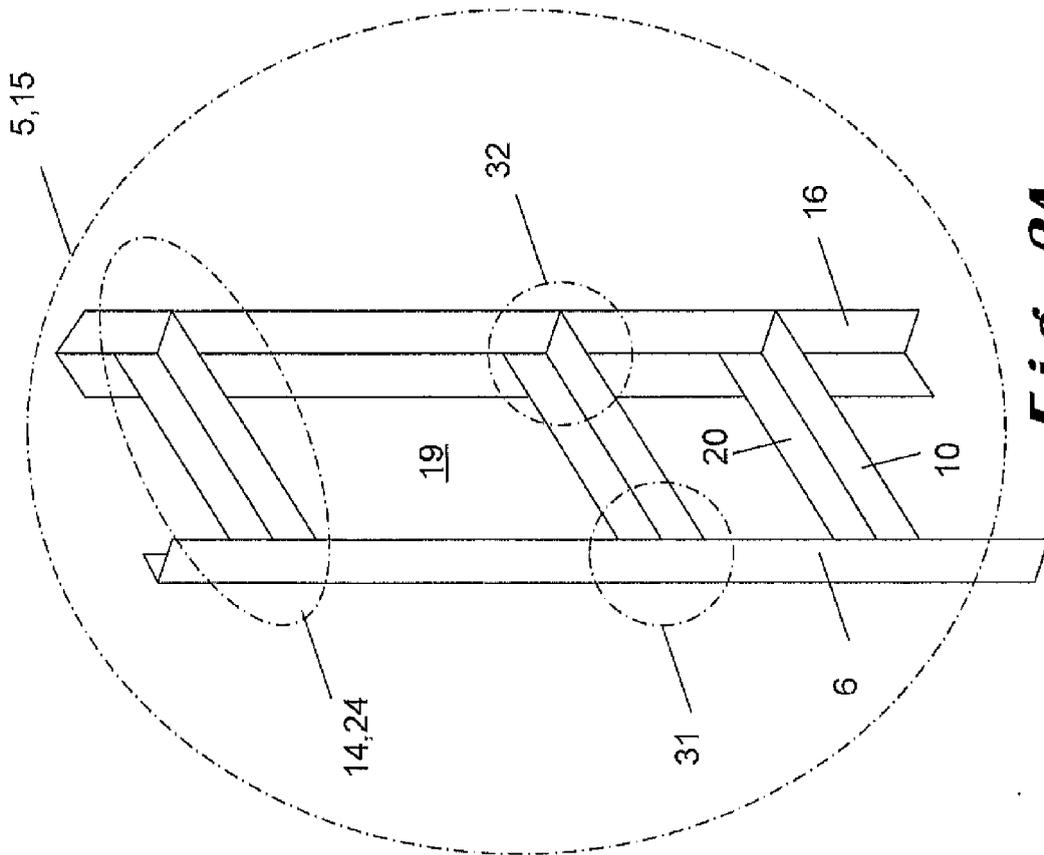


Fig. 2A

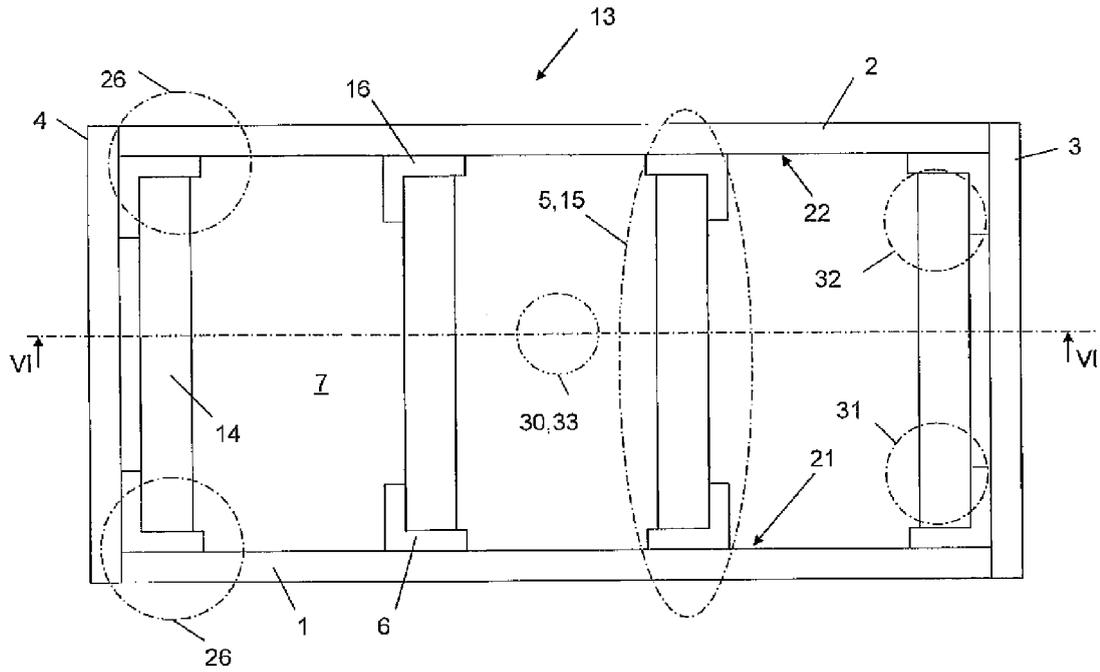


Fig. 3

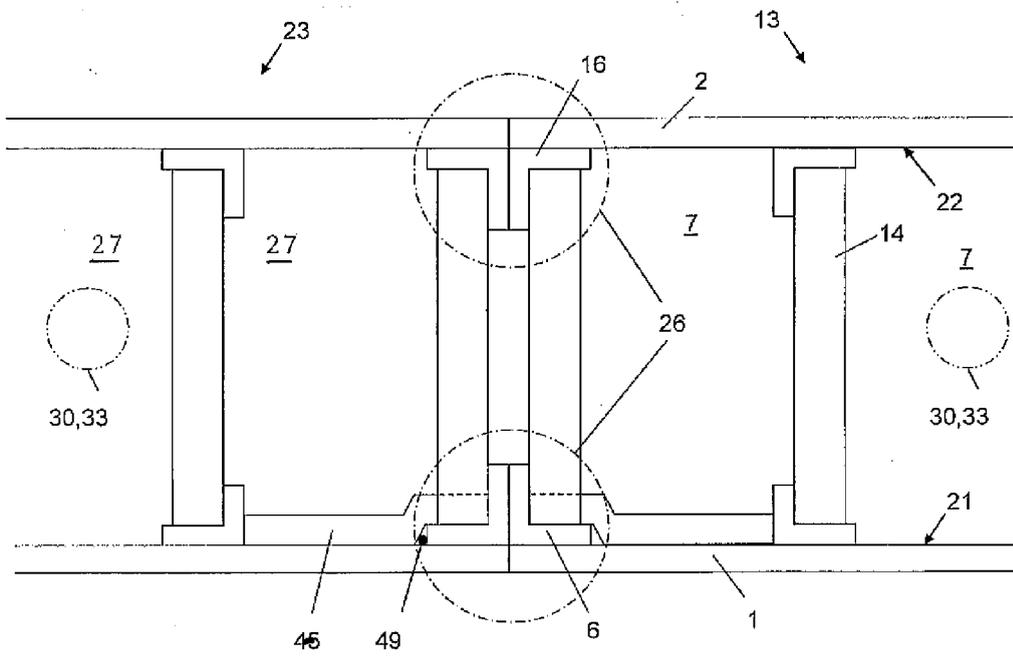


Fig. 5

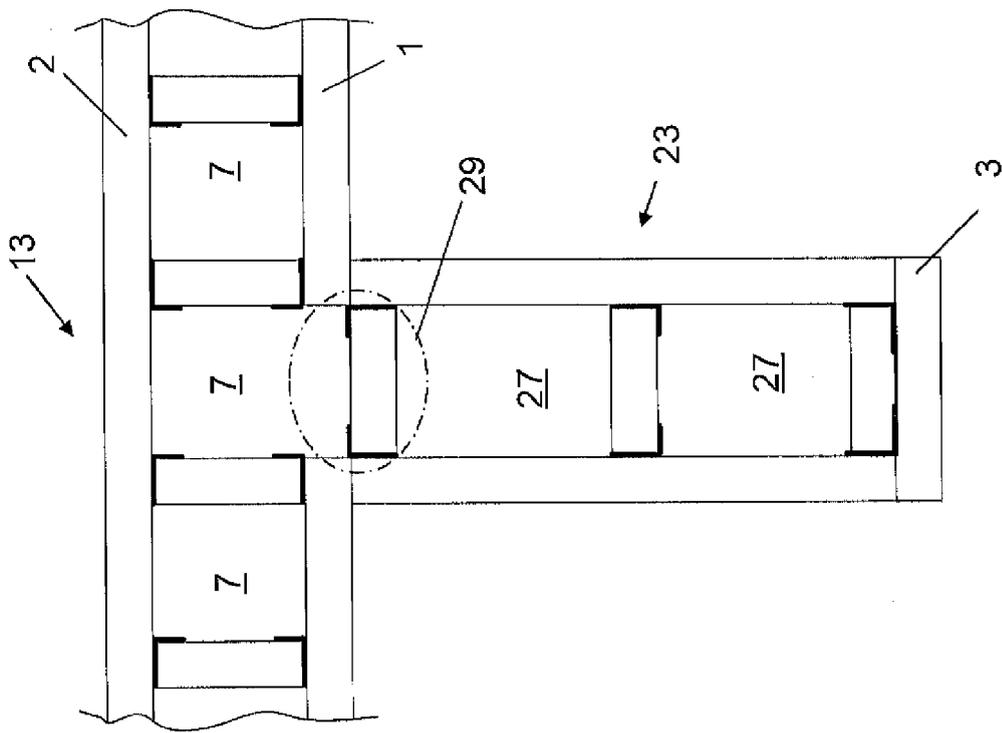


Fig. 4A

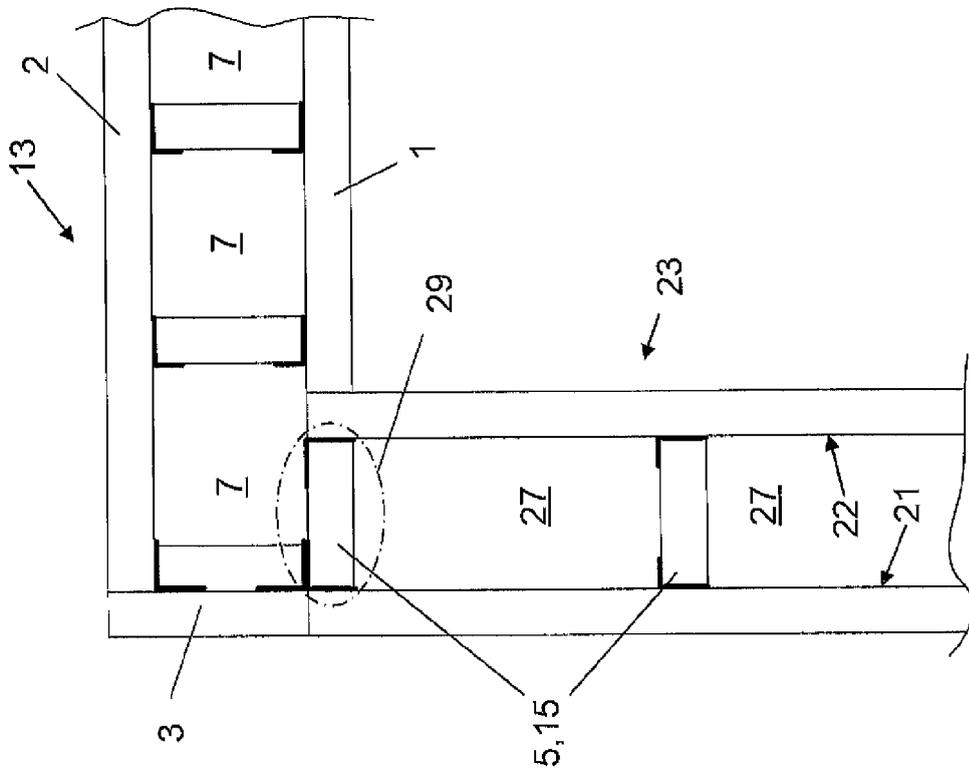


Fig. 4B

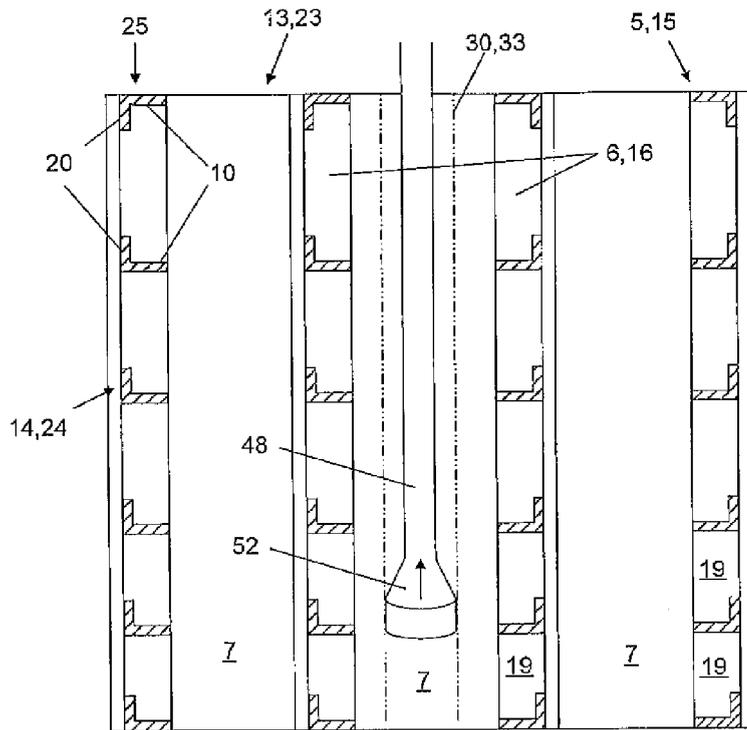


Fig. 6

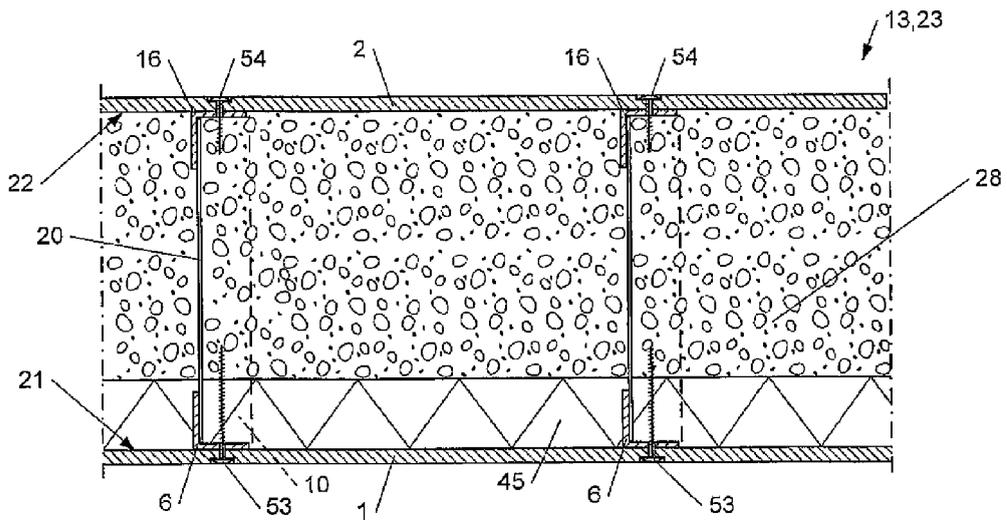


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 10 15 4246

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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