



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
01.10.2003 Bulletin 2003/40

(51) Int Cl.7: **E02D 15/08, E02D 23/08**

(21) Application number: **02076194.6**

(22) Date of filing: **27.03.2002**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**
Designated Extension States:
AL LT LV MK RO SI

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(54) **Building methods and apparatus**

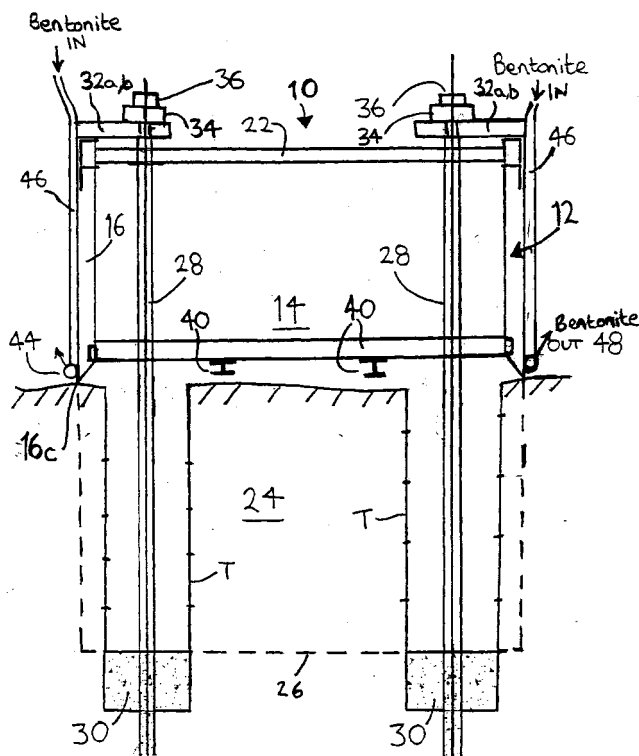
(57) A method is disclosed of constructing a chamber 10, such as a cellar, which is at least partially sunken into the ground without the prior excavation of a hole. The method includes:

- a) forming one or more ground anchors below the intended location in the ground of the chamber,
- b) providing above the intended location in the

ground of the chamber, a prefabricated and substantially hollow lateral wall structure;

c) forcing said wall structure down into said ground towards its intended location using the one or more ground anchors; and

d) excavating spoil from within a sunken portion of said wall structure so as to clear therein a space.



Ready to insert
Fig. 3

Description

FIELD OF THE INVENTION

[0001] The present invention relates to building methods and apparatus and in particular to building methods and apparatus for constructing a chamber which is at least partially sunken into the ground, such as for example a cellar.

BACKGROUND TO THE INVENTION

[0002] In constructing a sunken chamber such as a cellar, basement or garage, several problems can arise. Often the basic procedure involves pre-draining the ground, excavating a hole, laying a floor and building walls upward from that floor. The procedure may involve excavating a hole somewhat larger than the chamber will occupy both sideways and downwards, so as to provide a working area and to allow drying space as the walls are constructed.

[0003] Such an enlarged excavation necessitates prior drainage of a larger volume of the ground than the sunken chamber will occupy and time and money are spent draining sections of ground of which no use will be made other than to achieve the conventional working clearances. In addition, this may lead to subsidence problems which could necessitate underpinning, e.g. of neighbouring buildings. When working between existing buildings the building techniques which may be used are often limited to those which cause a low level of vibrations. High energy vibrations may cause structural damage in neighbouring buildings and may even result in partial collapse of these. Working methods must also be safe for the operators of equipment at the building site as well as for passers-by. Access to building sites between existing buildings may also be restricted as roads and other thoroughfares may be close and in continuous use.

[0004] Conventional excavation tends to generate more spoil than the volume occupied by the sunken chamber and leads to wasted time and further expense in removing, transporting, storing and back-filling that material. Further time is lost constructing retaining walls while waiting for material to dry in place. It is known to position spaced apart vertical shuttering on-site and to pour concrete into the space defined between the shuttering. After the concrete has been poured, it must be allowed to set or cure, which takes at least several days and often some weeks or even longer. Construction of a building having a sunken chamber with such poured concrete walls often needs to be suspended while the walls cure. Naturally, any such delay in progress also delays customer use of the property being constructed and delays payments to the builder. In order to try and speed up the process of producing a sunken chamber, it is known to provide prefabricated structures and to assemble them on site.

[0005] In US 4,539,780 upper and lower pre-cast sections are provided which are joined on a split-line running along their peripheral walls, such that the combination forms a box-type structure defining a room complete with floor, walls and roof. These sections are pre-cast off-site and are transported to site in their separate upper and lower sections, where the floor of the lower section is placed into a pre-excavated hole and is capped with the upper section. The clearance area around the sections can then be back-filled and construction can continue.

[0006] In US 4,658,551 a series of caissons are pre-cast and used in modular form to construct the walls of a sunken chamber having a pre-cast roof panel. The prefabricated wall panels and roof are assembled onto a prepared and conventional cellar floor built into the bottom of a conventionally excavated hole.

[0007] In US 5,493,838 a method is disclosed of constructing a concrete basement from prefabricated concrete panels. The panels include pre-cast footings, which are spaced around a pre-excavated hole. Walls are then added, along with a pre-cast floor. The footings, walls and floor are adapted to allegedly work together so as to resist pressure build-up from back-fill, which might otherwise encourage the walls to collapse inwardly.

[0008] In US 6,032,421 an arrangement is disclosed for producing modular cellars from pre-cast concrete sections. A pre-cast floor is laid down into a pre-excavated hole and defines a series of locating channels some of which have sloping sides. The cellar modules comprise reinforced concrete structural blocks having a floor portion and surrounding walls, each module further comprising at least one reinforced upper structural block having surrounding walls and the same shape as the lower structural block in plan view. The upper structural block is stacked on top of the lower structural block and the assembly lowered into place on the floor. To aid location between modules the floor defines slots some of which have sloping surfaces and the floor of each module is provided with locating slant surfaces which correspond to the locating slots defined in the floor.

[0009] In common with many conventional techniques for building sunken chambers, each of the arrangements proposed in US 4,539,780, US 4,658,551, US 5,493,838 and US 6,032,421 necessitates the pre-excavation of a hole with associated drainage requirements, spoil storage and back-filling. This hole is generally larger than the intended sunken chamber and must be dug out before the cellar can be put into its intended location. This requirement may not be felt as a problem so strongly when building on open ground where, for example, large machines can be used, space is not a problem and low cost labour can be employed. In more cramped building areas, however, particular problems may arise through excavation. If a cellar is to be constructed between neighbouring buildings, for example, drainage may cause subsidence which may in

turn cause problems to the neighbouring buildings and must be carefully controlled. In addition, settling of the cellar or surrounding ground may also cause subsidence affecting those buildings and/or the cellar itself and any building constructed above it. The potential for ground disturbance from cellar construction may necessitate underpinning neighbouring buildings, leading to more time and expense being lost. Storage and movement of spoil should also be kept to a minimum and due consideration must be given to keeping the construction time down for the sake of neighbouring inhabitants.

[0010] It is clear that there is a continual need to seek improvements to the placement of sunken chambers and to methods and apparatus used in their construction. In particular, it is desirable to seek improvements to sunken chambers which ease their construction in reduced spaces.

SUMMARY OF THE INVENTION

[0011] It is an object of the present invention to provide improved building methods and apparatus for sunken chambers. It is a particular object of the present invention to provide improved building methods and apparatus for the construction of sunken chambers, such as cellars and the like. It is a further an object of the present invention to provide a method and apparatus suitable for the construction of sunken chambers between existing buildings.

[0012] Accordingly, the present invention provides a method of constructing a chamber which is at least partially sunken, the method including:

- a) providing above the intended location in the ground of the chamber, a prefabricated and substantially hollow lateral wall structure;
- b) forcing said wall structure down into said ground towards its intended location;
- c) excavating spoil from within a sunken portion of said wall structure so as to clear therein a space.

The forcing step may also include forming one or more ground anchors below the intended location in the ground of the chamber, and using the one or more ground anchors to force the wall structure into the ground.

[0013] In this manner, a sunken chamber can be inserted into the ground without the prior excavation of a hole larger than the sunken chamber. The excavation which is needed is mainly dug out as the cellar is being forced into the ground and thus substantially only the volume of spoil necessary to accommodate the sunken chamber is excavated and then substantially in real time in parallel with chamber insertion.

[0014] The method may include forcing said wall structure into said ground hydraulically. The method may include forcing said wall structure into said ground by pulling said wall structure downward against the one

or more anchors fixed into said ground.

[0015] The method may include forcing said wall structure into said ground using one or more jacks connected to respective said anchors, each jack being adapted to pull downwards against a puller arrangement acting on an upper edge of said wall structure. The or each jack may comprise a screw jack, and may be fixed to a said anchor below the level of said intended cellar position and arranged to project upwardly out of said ground through the inside of said wall structure. The method may include forcing said wall structure into said ground in stages and excavating said spoil between said stages in proportion to the depth of ground penetration achieved during a previous said stage.

[0016] The method may include providing on a ground cutting portion of said wall structure a blade extending therealong and adapted to aid cutting of said wall structure into said ground. The method may include providing on said blade an outer skin of cutting material, such as for example an outer skin of tempered steel coated with an anti-friction material.

[0017] The method may include providing lubrication between said wall structure and said ground while forcing said wall structure into said ground, said lubrication comprising for example bentonite preferably distributed from a manifold in the region of a lower edge of said wall structure. The manifold may comprise a pipe, e.g. a metal pipe running around the bottom edge of the wall structure and defining lubricant distribution holes orientated substantially upwardly from the cutting edge of the blade so as to lubricate the outboard surfaces of the wall structure against friction which might arise from contact between said wall structure and the surrounding ground into which it is being inserted.

[0018] The method may include shoring across said wall structure against inward collapse, at least while forcing said wall structure into said ground. The shoring may be partially or fully temporary or permanent.

[0019] The method may include installing a floor into the bottom of said chamber space, said floor preferably incorporating at least one of shoring or reinforcing rods which are integrated into said wall structure. The floor may include a lower stabilising layer, comprising for example a sand to cement mixture in the region of a ten to one ratio. Such stabilising layer may be topped with a concrete floor and may incorporate one or more shoring beams and/or reinforcing rods.

[0020] The method may include assembling said wall structure from a plurality of panels, preferably in a modular fashion.

[0021] The present invention also provides a prefabricated chamber adapted to be at least partially sunken into the ground, said chamber comprising a substantially hollow lateral wall structure adapted to be positioned and/or assembled on-site and forced into the ground in its intended location. The chamber can therefore be inserted into the ground without prior excavation of a hole larger than the chamber itself and with most of the ex-

cavation being carried out during chamber insertion itself.

[0022] Said chamber may further comprise a blade extending along a ground cutting portion of said wall structure and adapted to aid ground cutting of said wall structure. Said blade may comprise an oblique slanted surface, preferably sloping from an inside face of said wall structure at the top of said blade towards an outer face of said wall structure at the bottom of said blade. Said blade may comprise an outer skin of cutting material, such as for example an outer skin of tempered steel coated with an anti-friction material.

[0023] Said chamber may comprise a distribution means adapted to provide a lubricant between said wall structure and said ground while said wall structure is being forced into said ground, said lubrication comprising for example bentonite. Said distribution means may be operative around a lower edge region of said wall structure and adapted to distribute therearound a said lubricant. Said distribution means may comprise a manifold extending at least part of the way around a lower outer edge region of said wall structure and may be adapted to distribute said lubricant substantially upwardly from a series of openings or nozzles, such that said lubricant lubricates against friction between said outer surface and ground material outboard of said wall structure. Said lubricant may comprise for example bentonite and may provide some sealant effect in addition to lubrication.

[0024] Said chamber may comprise a plurality of wall panels adapted to be cast on-site or off-site and then assembled into said wall structure preferably on-site. Said panels may be substantially the same and planar or may comprise different shapes, including for example substantially planar side panels and angled corner pieces. Each panel may include a housing defined therein for storage during insertion of one or more reinforcing rods which are integrated into said panel. Said housing may be openable such that, after insertion of said chamber, said chamber may be opened and the or each said rod extended into a floor layer of said sunken chamber in such a manner that the or each said rod is adapted for integration into a floor of said chamber so as to aid rigidity of the overall finished sunken chamber. Said wall structure may comprise at least one of concrete, metal or a synthetic material such as for example a plastics material or recycled waste products.

[0025] Said chamber may be adapted to be shored at least temporarily against inward collapse and preferably at least while it is forced into said ground. Said shoring may comprise shoring beams extending across an internal space of said wall structure and may for example be positioned in the region of at least the top and/or bottom edges of said wall structure. Said shoring may comprise steel beams such as rolled steel joists and may comprise a cross section such as "I", "H", "C" or similar/equivalent. Such shoring may be fixed in place, either permanently or removeably.

[0026] The present invention also provides a kit of parts for a chamber according to the invention, said kit comprising one or more lateral wall panels adapted to form said lateral wall structure and to co-operate with a forcing means adapted to force said wall structure into the ground. The kit substantially provides a chamber adapted be inserted into the ground without prior excavation of a hole larger than the chamber itself and with most of such excavation being carried out during chamber insertion itself.

[0027] Said forcing means may comprise one or more jacks adapted to pull downwards against a puller arrangement acting on an upper edge of said wall structure. The or each jack may comprise a screw jack, and may be fixed to a said anchor captured in the ground, the or each said jack arrangement being arranged to project upwardly out of said ground through the inside of said wall structure. The jacks are preferably sunk into the ground through a tubular structure prior sunk and excavated.

[0028] The jacking and/or puller arrangement may include one or more reversible portions such that the chamber can be pushed back upwards from a position into which it has been inserted. This reversing feature may prove useful in the event that the chamber is inserted too far into the ground in one or more points of its structure, the reversing arrangement being used to raise it back into its intended position in the ground.

[0029] The present invention also provides a method of producing a prefabricated chamber adapted to be forced into the ground, the method including:

- a) forming on-site or at a remote location one or more panels adapted to function as a lateral wall structure of said chamber; and
- b) forming on a ground engaging portion of the or each said panel a blade edge adapted to aid ground cutting of said wall structure.

The present invention will now be described with reference to the following drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

Figure 1 is a schematic plan view of a prefabricated chamber according to an embodiment of the present invention in position for ground installation; Figure 2a is a side view of a constituent panel of the chamber of Figure 1, seen from inside the chamber; Figure 2b is a corner joint formed from two panels according to Figure 2a; Figure 2c is a butt joint formed from two panels according to Figure 2a; Figure 3 is a side view of the arrangement of Figure 1 seen in cross-section along the line A-A and ready to be forced into the ground;

Figure 4 is the view of Figure 3 with partial insertion of the chamber;

Figure 5 is the view of Figure 4 on completion of insertion; and

Figure 6 is the view of Figure 5 on completion of installation of the sunken chamber, save that roofing and/or upward construction from ground level has yet to be done.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0031] The present invention will now be described by way of example only with reference to certain embodiments and the above mentioned drawings. The invention will be described with reference to a cellar 10, although it will be appreciated that other sunken or semi-sunken chambers such as garages may be constructed in a similar fashion.

[0032] Referring for the moment in particular to Figures 1 to 3, a cellar 10 of an exemplary embodiment comprises an upstanding lateral wall structure 12 which defines a hollow space 14 and is open top and bottom. The wall structure will typically be rectangular or a parallelepiped with at least one straight wall of over 1.5 metres in length, typically over 2m in length. The wall structure 12 may be prefabricated in one piece or assembled from several panels 16, depending for example on size, materials, convenience of fabrication on-site or off-site and associated assembly, transport and storage. In the example given, the cellar 10 is assembled by interlocking a series of flat panels 16 to form the wall structure 12, joint areas 18 between the panels 16 being sealed 18a and bolted 18b.

[0033] Use of panels 16 that are substantially planar and identical, as depicted in Figure 2a, enables modular construction with simple ordering, minimal parts inventory and benefits from reduced costs of high volume. It is also an option to provide different configurations of joining edge which, while it increases the number of different panel shapes, allows greater flexibility in cellar sizes. In addition or in the alternative, panels in the form of corner pieces may be provided but their production might increase the parts count or decrease storage and transport ease in comparison with using only flat panels 16. As can be seen in Figures 2b and 2c, the panels 16 may be through-bolted under over-lap or may be bolted at corners using threaded sleeves cast into the panels 16 during manufacture. In the alternative, other fixing means could be used such as for example sleeve anchors or other forms of clamping arrangement.

[0034] Each panel 16 preferably includes a blade 16a running preferably along its bottom, each blade 16a comprising an oblique slanting surface 16b. The slanted surface 16b slopes from the inside of the panel 16 downwards and outwards to form a cutting edge 16c along the very bottom of that panel 16. The blade 16a may be made of a metal, such as for example steel. The blade

16a may be hollow or filled with concrete and provided with an outer skin adapted for ground cutting, such as for example a tempered steel coated with an anti-friction material.

[0035] Some of the constituent panels 16 of the wall structure 12 include in selected attachment areas 20 provision for at least temporary shoring 22 against inward collapse. The shoring may conveniently comprise "I", "C" or "H" section steel beams 22 such as those known in the art as rolled steel joists (RSJ's). The beams 22 each include end brackets or features adapted for fixing to the attachment areas 20 to brace across the wall structure 12 laterally, e.g. by bolting.

[0036] Referring for the moment in particular to Figure 3, during the initial stage of cellar construction, the ground 24 forming the intended location of the cellar 10 is preferably drained to about 20 to 30 cm below the bottom of the future cellar floor level 26. One or a succession of ground anchors 30 are installed with their centres within or outside the ground plan of the chamber to be installed. As shown in Figs. 1 and 3 the locations of the centres of the ground anchors lie within the ground plan of the chamber to be installed. This is the preferred arrangement when working between two existing buildings or between one existing building and a natural impediment and when the maximum size of cellar is to be installed between the two buildings. The ground anchors may be installed by any known technique especially a low vibration technique. For example, displacement piling or bored piling, for example, auger bored piling, may be used. It is customary in such piling work to support the cylindrical hole formed in the ground by the use of temporary casings, e.g. tubular sections T inserted into the ground after a section of the tubular hole has been formed. Although preferred for safety reasons (to prevent collapse of the bored hole) a temporary tubular support need not be used if the soil allows it. The drilling work is continued until the lowermost point of the bored hole extends to a depth below the intended location of the floor of the cellar. The ground anchors may be formed by concrete, e.g. by pouring concrete into the holes formed in the ground. As is customary with piling work, the concrete may be poured through a reinforcement cage. The upper surface of the ground anchors 30 is formed at the same depth or at a depth lower than the intended floor of the cellar. When the upper surface is formed at the same depth as the floor of the cellar to be formed, these anchors are piles or mini-piles which may help to support the building to be erected above ground at the building site location. The ground anchors 30 may be formed in the region of each corner of the intended cellar, for example. The tubular sections T may be of about one metre in diameter and may comprise generally pipe-shaped sections.

[0037] A forcing means for later forcing down of a wall structure is fixed into or onto each ground anchor through each of the lowermost tubular sections T, preferably by means of an anchoring arrangement. The forc-

ing means may be in the form of one or more screw jacks 28 or could be a conventional cable anchor provided with a means for exerting a force onto the wall structure to be forced into the ground and which will form the cellar. To anchor the jacks 28 in place, they may be fixed in the lowermost section of the tubular holes in each corner of the cellar when these are filled with concrete so as to form a concrete anchor 30. The depth of each ground anchor 30 should be chosen depending upon the force required to install the wall structure. Each screw jack 28 may, for example, extend 15 meters below its respective lower most tubular section T. The number of jacks 28 will depend on the shape and size of the wall structure 12 and, in the exemplary embodiment, the cellar 10 comprises a wall structure 6 metres square and 3 metres deep for which a set of four jacks 28 positioned one each in a corner area is considered suitable.

[0038] With the intended location 24 drained, the tubular sections T in place and the jacks 28 in position, the wall structure 12 is positioned, or assembled as the case may be, above that intended location 24 with a section of threaded rod of each jack 28 protruding above the wall structure 12 in each corner. The cutting edge 16c of the or each blade 16a faces the ground. At or by this stage, the wall structure 12 may be braced laterally across the top and bottom against inward collapse by fixing an appropriate level of shoring 22, 40 in place, shown by way of example in Figure 1 as two beams 22 evenly spaced over the plan view of the wall structure 12 and a set of lower shoring beams 40 bracing across the lower edges of the wall structure 12. It will be noted that the lower shoring 40 is about 30cm up from the bottom edge of the blade 16 so as to provide a working clearance as detailed below.

[0039] A pair of pulling beams 32a, 32b are positioned on the top of wall structure 12 across each corner and in such a manner that they lie in a substantially parallel relationship passing one each side of their associated jacks 28. For insertion, the pulling beams 32a, 32b are not necessarily fixed to the wall structure 12 but lie loose on it, such that relative sliding movement can occur between the underside of the pulling beams 32a, 32b and the top edge of the wall structure 12. A respective pulling plate 34, which comprises a clearance fit over the jack thread, is then slid down over the jack thread such that one lies over the pulling plates 32a, 32b in each corner with the jack thread extending through it. A screw boss 36 is then turned down each jack thread until it contacts the top surface of the pulling plate 34. The current situation may be seen with particular reference to Figure 3.

[0040] In the next stage of cellar construction, the wall structure 12 is forced downwards into the ground towards its intended location 24. The forcing is performed hydraulically by pulling the wall structure 12 downward against the anchors 30 using downward pressure exerted by screwing down the bosses 36. The pulling is performed substantially evenly across the wall structure 12 by careful control of the amount and order in which the

screw bosses 36 are turned, i.e. in such a manner that the wall structure 12 or its constituent panels 16 do not deform, shatter, collapse or become damaged in some other way due to the compressive force being exerted to their upper edges. In some cases, e.g. soft ground, the blades 16a may prove unnecessary but when present they will be found to ease ground cutting and therefore insertion of the wall structure 12, especially into hard ground 24. The forcing step is preferably carried out with a low vibrational energy level, i.e. with no or limited pile driving equipment being used to ram the wall structure 12 into the ground.

[0041] Referring now to Figure 4, the wall structure 12 is forced into the ground 24 preferably in stages, excavating spoil from within the wall structure 12 in between such stages. It will be noted that the gradual insertion keeps the load down on the jacks 28 and relieves lateral friction between the wall structure 12 and the surrounding ground 24. This reduces the force required to insert the wall structure into the ground and therefore reduces or eliminates the use of equipment generating high levels of vibration. A suitable depth per stage of insertion may be found in the order of 30 cm, although Figure 4 shows for simplicity of illustration only one stage in the insertion process which is taking place with the wall structure 12 about halfway inserted. It will be noted that the ground 24 inboard from the wall structure 12 may be excavated below a level in line with the lower edge of the blades 16, by for example 20 to 30cm. This allows inward collapse during insertion stages of the ground around the blades 16 and along with the working clearance below the lower shoring 40 helps ensure that the lower shoring beams 40 do not contact the ground during insertion, which might otherwise generate resistance to insertion.

[0042] The staged insertion is continued until the wall structure 12 has reached its intended depth, shown in the example and in Figure 5 as level with the topsoil. In the event that the wall structure 12 has been inserted too far, the arrangement of pulling beams, 32a, 32b pulling plates 34 and bosses 36 may be reversed and used to push the wall structure 12 upwardly into alignment, e.g. with ground level. This may be performed locally in one or more corners or over the whole wall structure 12 as the case may be. It will be appreciated that, if using this arrangement to push the cellar upwardly, it may prove necessary to fix the pulling beams 32a, b to the wall structure before starting to turn the now inverted boss 36 upwardly.

[0043] Once the cellar has been fully inserted and any levelling performed, the jacks 28 are then cut off substantially level with the top of their respective concrete anchors 30, the higher tubular sections T having been removed preferably during the insertion process as they became free. The free sections of the jacks 28 are then removed, along with the associated pulling beams 32a, 32b, pulling plates 34 and screw bosses 36.

[0044] The upper shoring beams 22 may be left in

place and may conveniently further act as supports for a covering roof to the cellar 10 and/or for a structure which might be built on top. The lower shoring beams 40 may also be left in place and may be incorporated into a cellar floor 42, whose construction will now be described.

[0045] Excavation inside the wall structure 12 is then completed and extends downwards such that a stabilising layer 38 can be laid. The stabilising layer may comprise a 10:1 sand and cement mix. Optionally, one, more or all panels may include one or more housings/compartments 50 which include reinforcing rods 52. Such rods 52 may be integrated with their respective panels 16 and may be bent upwards inside the housing 50 during insertion. After insertion, the housing 50 is then opened and the rods 52 bent out into the space which will become the cellar floor 42. Concrete or a suitable equivalent is then poured into the cellar 10 such that it forms a floor 42 incorporating the bottom shoring 40 and/or reinforcing rods 52 and substantially filling the void of the housing 50. At this stage, as can be seen with particular reference to Figure 6, cellar construction is substantially complete save that capping and/or upward building has still to be done.

[0046] As can be seen in at least Figures 1, 3 and 4, before insertion the wall structure 12 is optionally fitted with a distribution means adapted to distribute a lubricant such as bentonite. The distribution means may comprise, for example, a manifold 44 in the form of a pipe which runs around and is fixed to the lower region of the wall structure 12 and is connected to a supply pipe 46 of the lubricant and/or sealant. The manifold 44 may be adapted to distribute the lubricant and/or sealant outwardly and upwardly through a series of upward facing exit holes 48 and thus reduce friction during insertion between the outboard surfaces of wall structure 12 and the surrounding ground.

[0047] With regards to cellar materials, the wall structure 12 may comprise a concrete based material, but may alternatively be made from metal or a synthetic material such as a plastic. Consideration may also be given to producing the wall structure from a recycled waste material.

[0048] Among the advantages of the present invention, it will be noted that in each embodiment of the invention, a chamber is prefabricated and at least partially sunk into the ground without prior excavation of a hole extending substantially beyond the outer limits of the prefabricated chamber. The excavation which is needed to provide the internal space for the chamber is mainly dug out as the cellar is being forced into the ground and thus substantially only the volume of spoil necessary to accommodate the sunken chamber is excavated and then substantially in real time in parallel with chamber insertion. The only excavation which is carried out prior to chamber insertion, if any, is that necessary to anchor the jacks 28. This saves time and space, along with associated costs and inconvenience of spoil transport and/

or storage. Only the required amount of spoil is excavated and can be moved only when it needs to be, rather than some time in advance. In addition, there is substantially no back-filling required around the outside of the wall structure 12, again saving time and expense but also negating any need for settling down of back-fill.

[0049] In addition, the level of drainage is also reduced saving more time and expense. The level of drainage can be controlled quite accurately and, using an arrangement according to the present invention, it is not necessary to drain far below the bottom of the stabilising layer 38. This reduction and accuracy in drainage requirements is also considered to reduce risks of subsidence affecting neighbouring structures and provides a corresponding reduction in the need for underpinning. By way of example, drainage down to only 20 to 30 cm below the bottom of the final position of the cutting edge 16c is considered adequate.

[0050] A prefabricated structure 10 according to the present invention may be provided as a substantially ready-to-assemble kit of parts or may be supplied in the form of apparatus and/or materials adapted to manufacture at least the wall structure 12 or constituent parts 16 thereof on-site or off-site at a remote location. Modular wall structure 12 is possible by varying the form, number and layout of panels 16, jacks 28 and associated additional forcing means 30, 32a, 32b, 34, 36 being adapted accordingly.

[0051] Once the wall structure 12 is set-up on site and the forcing means in place, the time taken for insertion and internal excavation is estimated to be about two days for an exemplary cellar of six metres square with three metre high walls, giving a potential total time for construction of about two weeks. Progress may vary in dependence on the type of ground and an arrangement according to the present invention is considered suitable for many configurations of sunken chamber and for most types of terrain.

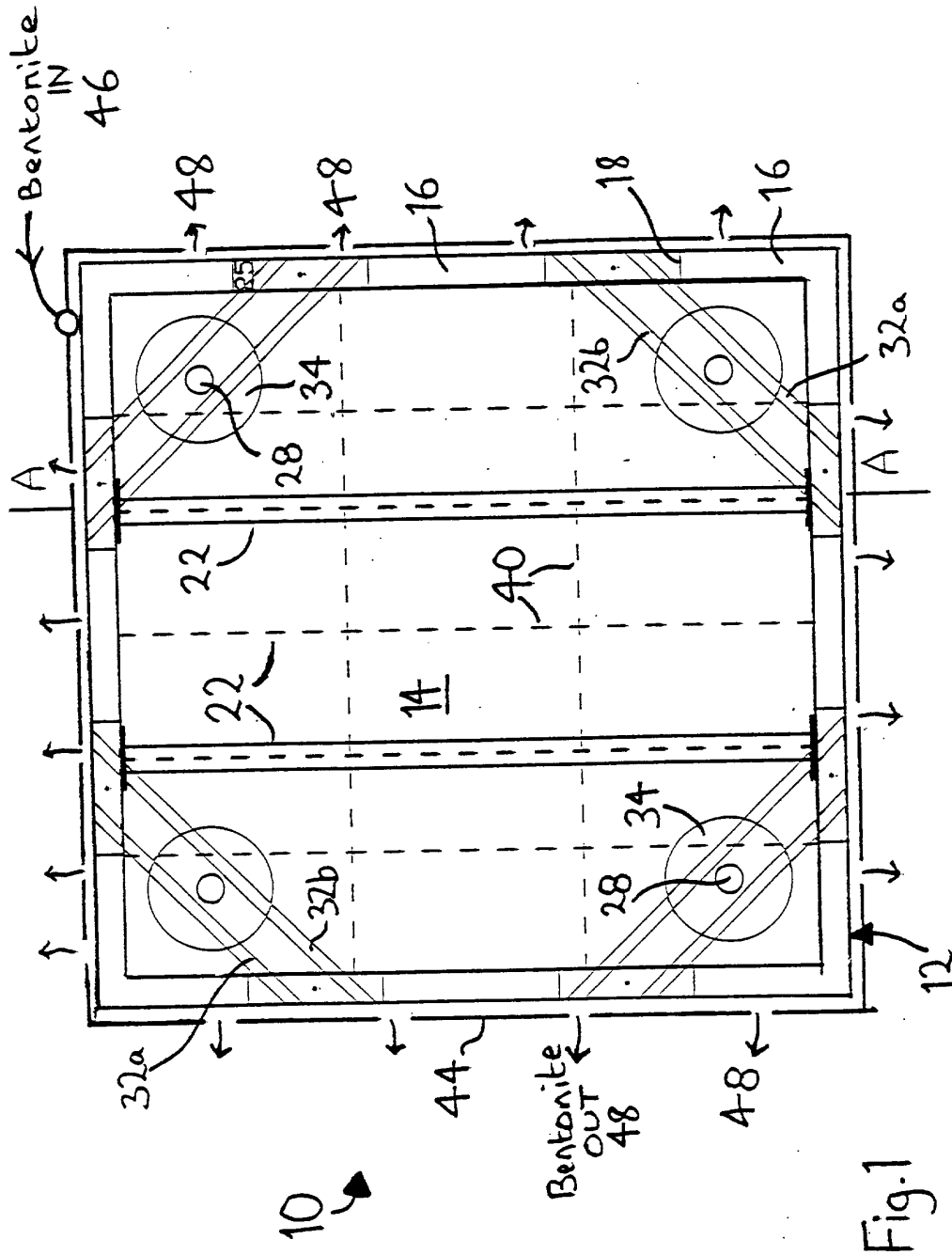
[0052] It is estimated that the present invention provides overall cost-savings of at least 25% in comparison with construction of a cellar using conventional techniques.

[0053] While the invention has been shown and described with reference to preferred embodiments, it will be understood by those skilled in the art that various changes or modifications in form and detail may be made without departing from the scope and spirit of this invention as defined in the attached claims. For instance, a large cellar may be constructed from individual units, each unit being installed in accordance with the methods described above.

Claims

1. A method of constructing a chamber which is at least partially sunken in a ground, the method including:

- a) forming one or more ground anchors below the intended location in the ground of the chamber,
- b) providing above the intended location in the ground of the chamber, a prefabricated and substantially hollow lateral wall structure; 5
- c) forcing said wall structure down into said ground towards its intended location using the one or more ground anchors; and 10
- d) excavating spoil from within a sunken portion of said wall structure so as to clear therein a space.
2. A method according to claim 1, including forcing said wall structure into said ground hydraulically by pulling said wall structure downwards against the one or more anchors in said ground. 15
3. A method according to claim 1 or claim 2, including forcing said wall structure into said ground in stages and excavating said spoil between said stages in proportion to the depth of ground penetration achieved during a previous said stage. 20
4. A method according to any preceding claim, including providing on a ground cutting portion of said wall structure a blade edge extending therealong and adapted to aid cutting of said wall structure into said ground. 25
5. A method according to any preceding claim, including providing lubrication between said wall structure and said ground while forcing said wall structure into said ground, said lubrication comprising for example bentonite preferably distributed from a manifold in the region of a lower edge of said wall structure. 30 35
6. A method according to any preceding claim, including shoring across said wall structure against inward collapse, preferably at least while forcing said wall structure into said ground. 40
7. A method according to any preceding claim, including installing a floor into the bottom of said chamber space, said floor preferably incorporating at least one of reinforcing rods which are integrated into said wall structure or shoring. 45
8. A method according to any preceding claim, including assembling said wall structure from a plurality of panels, preferably in a modular fashion. 50
9. A prefabricated chamber, such as a cellar, adapted to be at least partially sunken into the ground, said chamber comprising a substantially hollow lateral wall structure adapted to be positioned and/or assembled on-site and forced into the ground. 55
10. A prefabricated chamber according to claim 9, further comprising a blade edge extending along a ground cutting portion of said wall structure and adapted to aid ground cutting of said wall structure, said blade edge preferably comprising an oblique slanted surface sloping from an inside face of said wall structure at the top of said blade edge towards an outer face of said wall structure at the bottom of said blade edge and said blade edge preferably comprising an outer skin of cutting material.
11. A prefabricated chamber according to claim 9 or claim 10, further comprising a distribution means adapted to provide a lubricant between said wall structure and said ground while said wall structure is being forced into said ground, said lubrication comprising for example bentonite preferably distributed from a manifold in the region of a lower edge of said wall structure.
12. A prefabricated chamber according to any one of claims 9 to 11, wherein said chamber comprises a plurality of wall panels adapted to be cast on-site or off-site and preferably assembled into said wall structure on-site, each said panel preferably comprising at least one of concrete, metal or a synthetic material such as for example a plastics material or recycled waste products.
13. A kit of parts for a chamber according to any one of claims 9 to 12, said kit comprising one or more lateral wall panels adapted to form said lateral wall structure and to co-operate with a forcing means adapted to force said wall structure into the ground.
14. A method of producing a prefabricated chamber adapted to be forced into the ground, the method including:
- a) forming on-site or at a remote location one or more panels adapted to function as a lateral wall structure of said chamber; and
- b) forming on a ground engaging portion of the or each said panel a blade edge adapted to aid ground cutting of said wall structure.



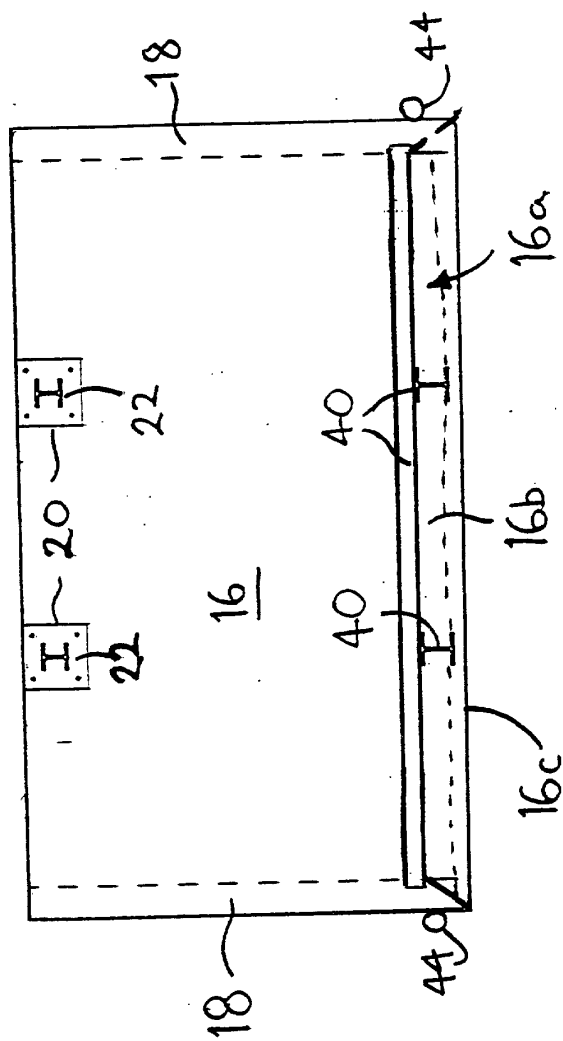
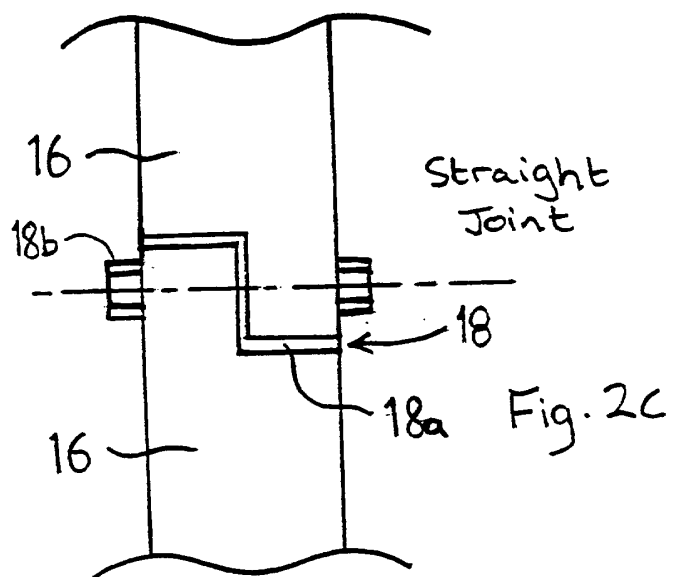
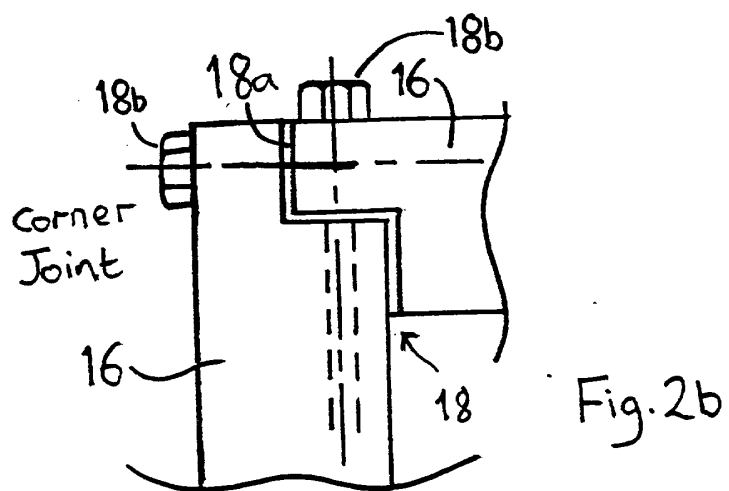
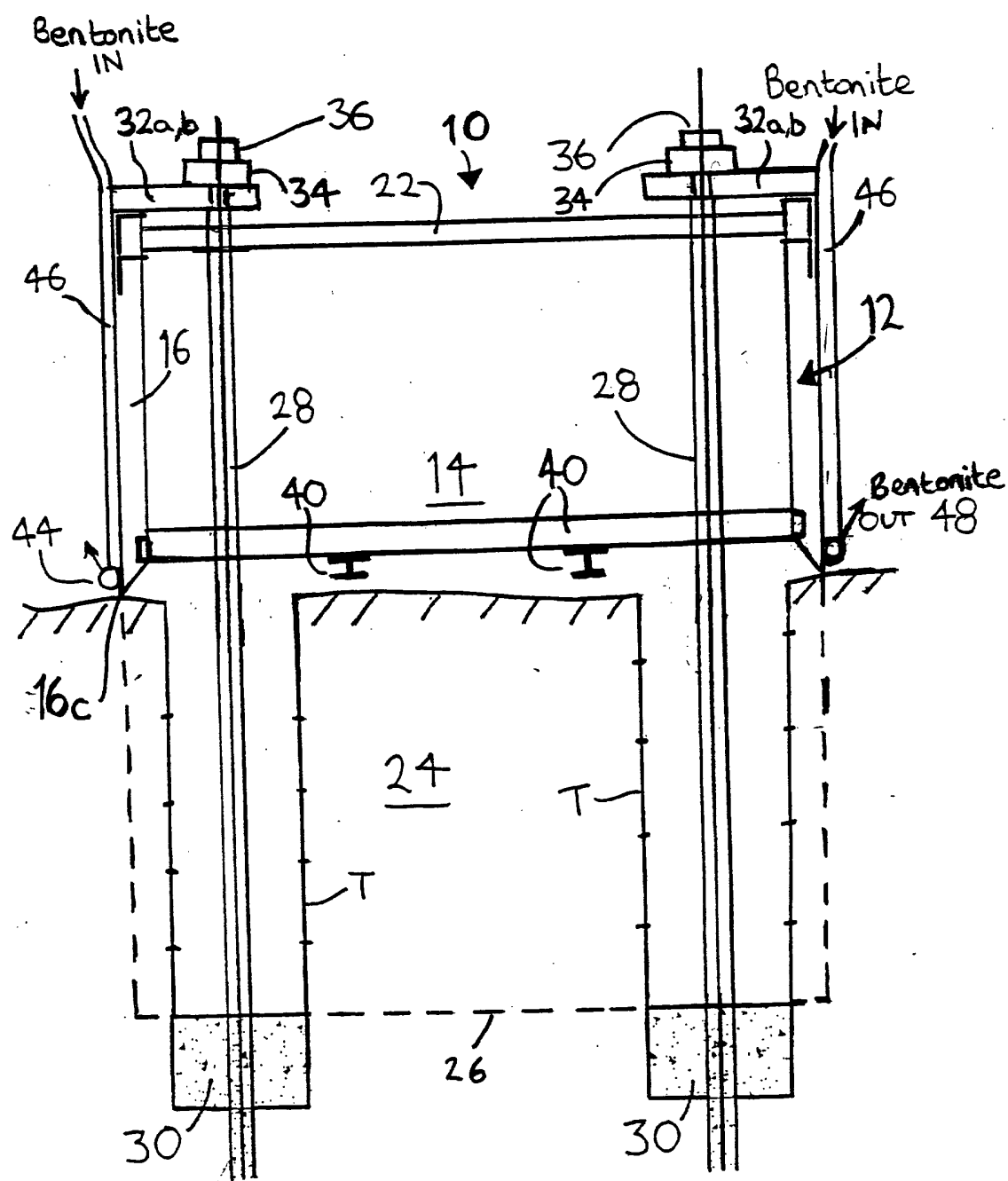


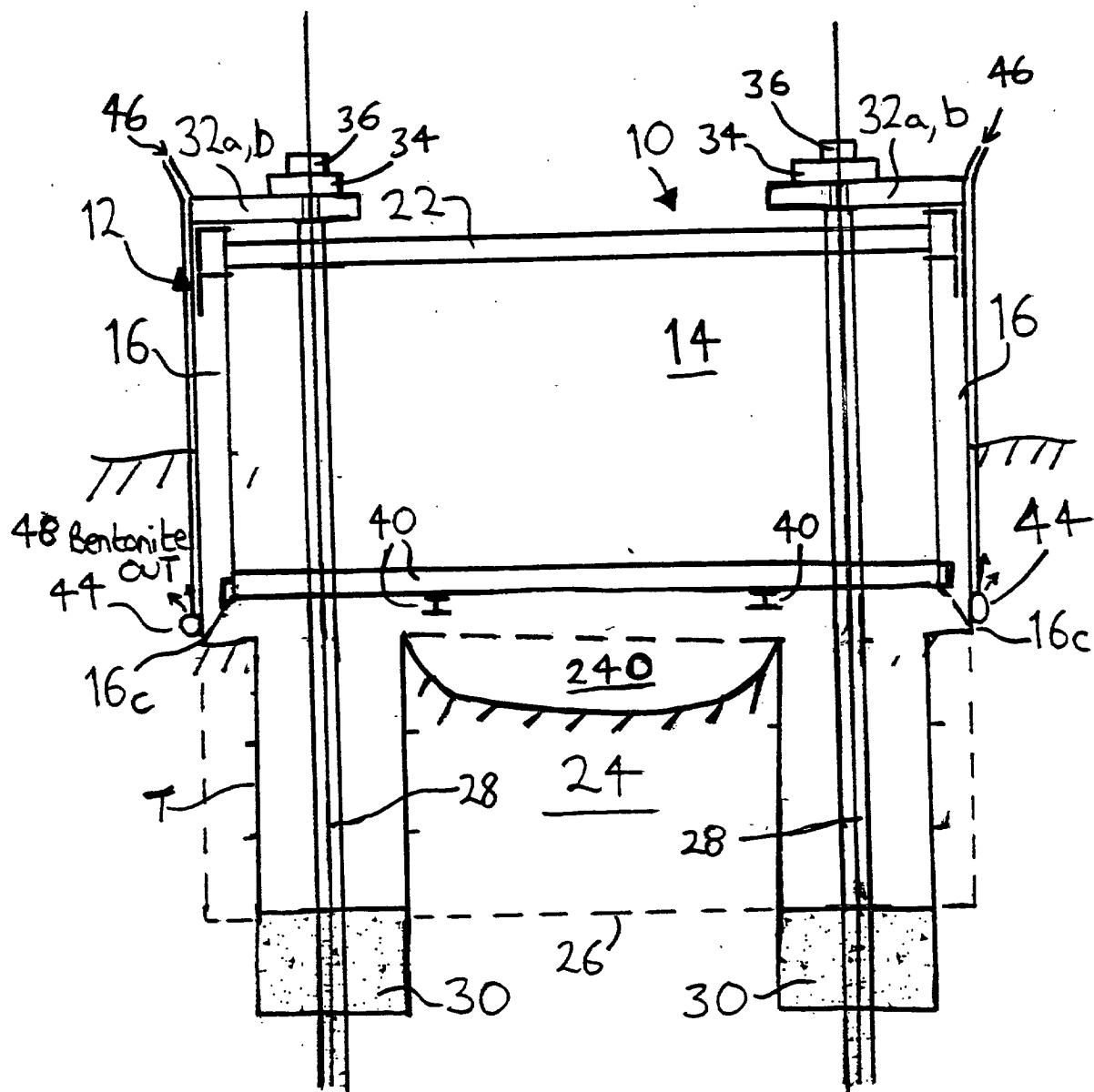
Fig. 2a





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Fig. 3



Partial insertion

Fig. 4

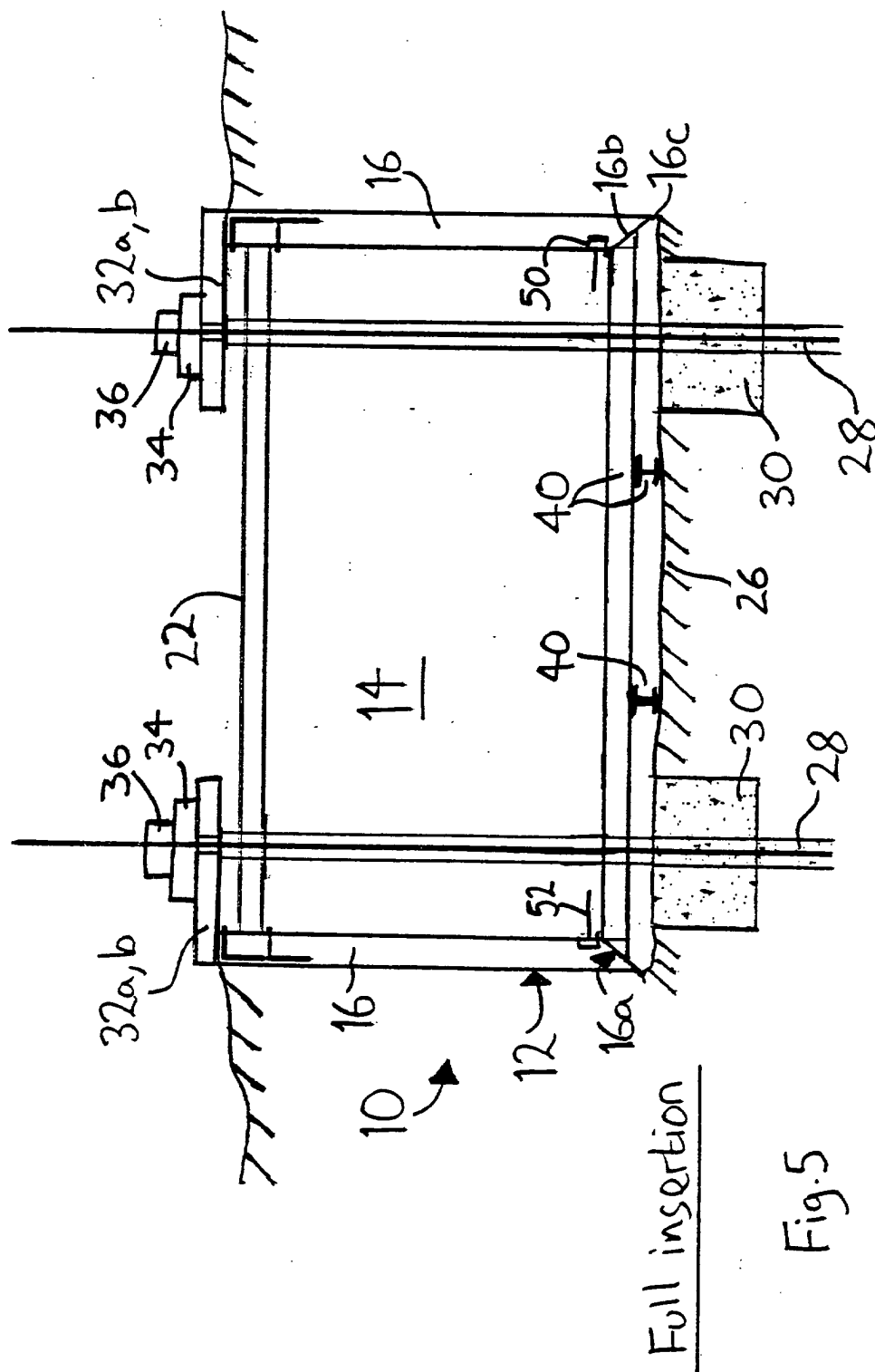


Fig.5

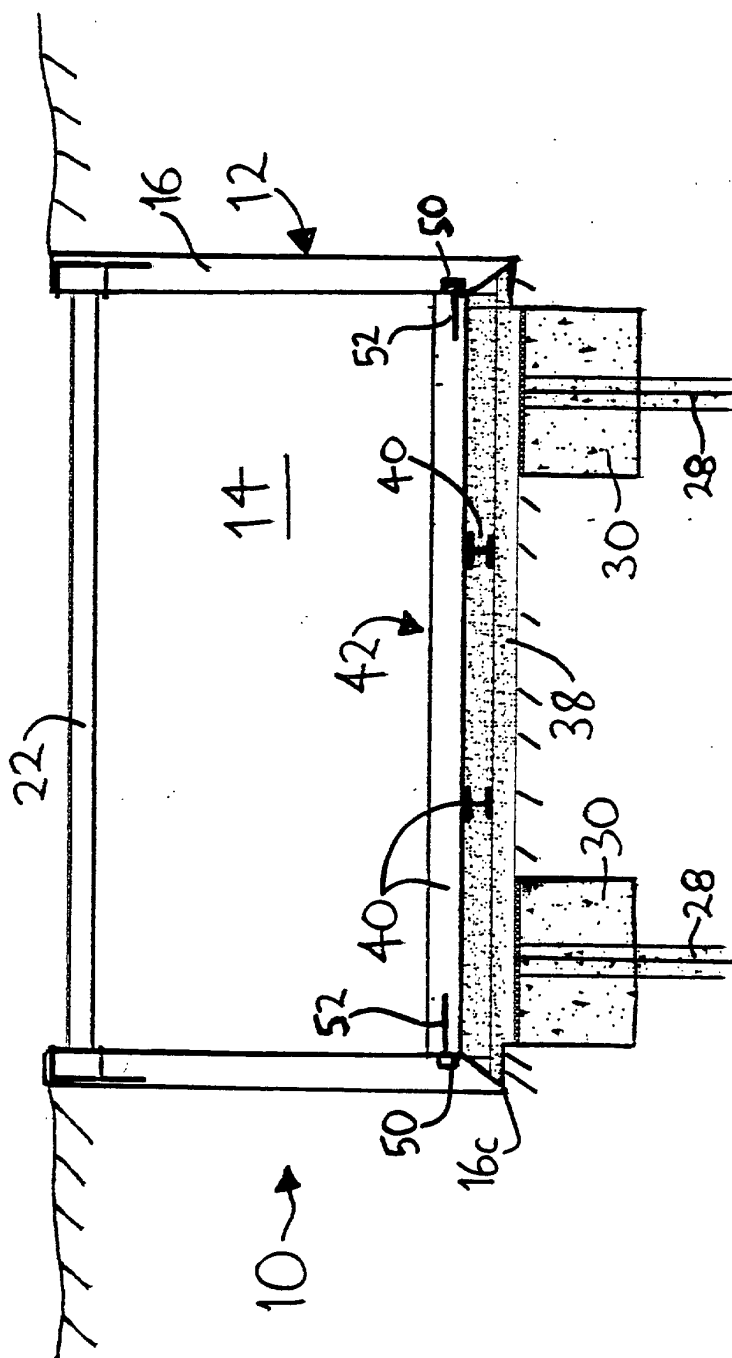


Fig. 6



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 02 07 6194

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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 28 May 2002	Examiner Kergueno, J
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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