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(54) **Foundation raft**

(57) A method of constructing a concrete foundation raft for low level beam for a building or other superstructure, the method comprising the steps of: erecting form work, which is supported by a number of piles and by a frame to which the formwork is connected; and forming concrete in the form work to form the raft or beam,

wherein at least part of the formwork comprises a substantially L-shaped cross section stainless steel or other non-corrodable metal support to form shuttering for a side of the concrete raft or beam and, subsequently, a support for the wall of the building or other superstructure.

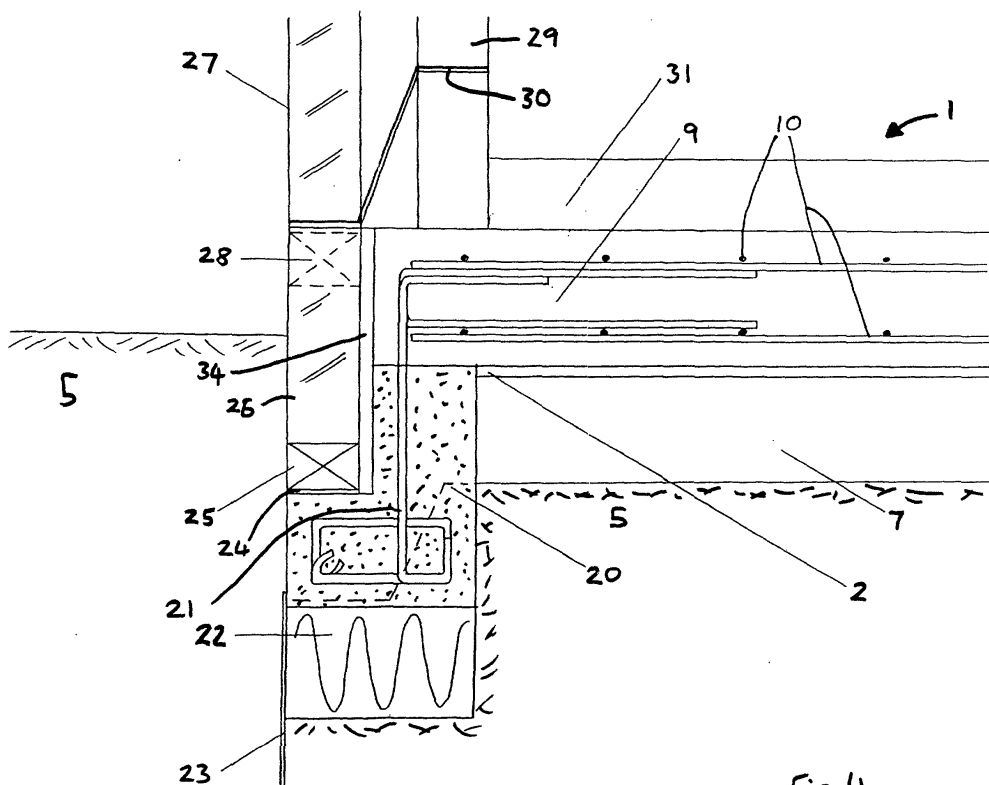


Fig 4

EP 1 310 601 A2

Description

[0001] This invention relates to a structure for use in, and a method for, constructing a concrete foundation raft or low level beam and, in particular, to foundation rafts or beams which are spaced from the ground.

[0002] When building on ground, which is liable to subsidence or heave, it is well known to erect the building or other superstructure on a raft or beam, itself supported by piles, with the underside of the raft spaced above the ground by a void or compressible material. The void or compressible material, which prevents any heave from being significantly transmitted to the underside of the raft or beam, has taken a variety of forms. Typically, a collapsible or crushable spacer, made for example of hardboard, cardboard, and/or polystyrene has been used as a temporary support. Once the foundation raft or beam has been constructed, these spacers either degrade or are designed to compress with any uplift of the ground. Generally these techniques are expensive. Collapsible material can collapse prematurely, particularly in wet weather, and compressible spacers require extra space to avoid the transmission of heave to the raft to the crushed material.

[0003] In a previous patent application, GB-A-2329651, we suggested a method of constructing a concrete foundation raft or low level beam for a building or other superstructure comprising erecting formwork, which is held spaced above the ground by at least one interposed waterproof bag that is inflated with water or other liquid, pouring concrete in the formwork to form the raft or beam and, when the concrete has set, removing the water from the bag(s) to allow the bag(s) to collapse leaving a void between the underside of the raft or beam and the ground.

[0004] While this method has a number of advantages such as providing firm support for the formwork throughout the pouring and setting of the concrete and that the method is substantially unaffected by weather, we are now suggesting an alternative to the aforementioned method.

[0005] In a further previous patent application, EP-A-1116829, we described a method of constructing a concrete foundation raft or low level beam for a building or other superstructure, comprising the steps of erecting formwork, which is supported by a number of piles and by a frame to which the formwork is connected; and pouring concrete in the formwork to form the raft or beam, wherein at least part of the frame is incorporated within the concrete to provide reinforcement of the concrete. The frame is preferably constructed of a metal, such as steel, so that the concrete is substantially reinforced.

[0006] The frame may be supported on the piles and, preferably, the formwork comprises a deck which is tied to the frame to prevent downward movement at the mid-points of the deck between the piles. The outer edges of the deck may be cut to the exact shape of the property

and to accommodate one or more downstand units.

[0007] Once the frame has been fixed and the decking secured, the reinforcement is fixed and the one or more downstand units can be positioned at the edge of the decking and may then be secured to the reinforcement and/or the frame. The one or more downstand units provide support for edge shutters which are attached to the formwork. Once the edge shutters are in place, the concrete can then be poured.

[0008] This method has a number of advantages. The frame ensures that any void between the formwork and the ground can be kept completely clear during construction while ensuring that the formwork is securely supported. As there is no direct support between the ground and the formwork, this method can be used when the ground is uneven. The provision of downstand units ensures that the sides of the formwork are supported and provide convenient attachment for the edge shutters. Additionally, the frame provides reinforcement to the concrete and means that additional reinforcement may not be needed. Of course, further reinforcement may be added if required.

[0009] The second earlier application also claimed a frame for use in constructing a concrete foundation raft or low level beam for a building or other superstructure, comprising at least one pair of elongate tubes, comprising a first and a second tube, which are arranged to be connected, in use, to a deck; a third elongate tube, substantially parallel to the first and second tubes and which is spaced from the plane in which the other two tubes lie to form, in section, a triangular arrangement; and connecting means for joining the first and second tubes to the third tube.

[0010] A third aspect of that invention, included a method of constructing a concrete foundation raft or low level beam for a building or other superstructure, comprising the steps of: erecting formwork, which is supported by a number of piles, by at least one interposed bag that is inflated with air and by one or more downstand units; pouring concrete in the formwork to form the raft or beam; and removing the air from the bag(s) when the concrete has set to allow the bag(s) to collapse, leaving a void between the underside of the raft or beam and the ground.

[0011] By using air rather than a liquid, the bags can be filled and emptied more quickly and easily.

[0012] The bag(s) can be used together with one or more usually, a pair of formers which are preferably formed from timber. These formers permitted the size of the void to be increased without the need for many differently sized bags.

[0013] We have now appreciated that the method described in our earlier patent applications GB-A-2329651 and EP-A-1116829 may be improved still further.

[0014] According to the present invention, there is provided a method of constructing a concrete foundation raft or low level beam for a building or other superstructure, the method comprising the steps of:

erecting formwork, which is supported by a number of piles and by a frame to which the formwork is connected; and

forming concrete in the formwork to form the raft or beam, wherein at least part of the formwork comprises a substantially L-shaped cross-section stainless steel or other non-corrodable metal support to form shuttering for a side of the concrete raft or beam and, subsequently, a support for the wall of the building or other superstructure.

[0015] The invention addresses three issues in one.

[0016] The angle support acts as a temporary shutter to a slab while the concrete is poured and cured. The angle, which runs around the periphery of the slab preferably includes stainless ties which extend back into the concrete slab in order to provide a permanent key so as to ensure that the angle is permanently "held" by the cured concrete.

[0017] Secondly the angle provides permanent support to the outer brickwork skin of the building. The brickwork skin would typically support a single two or three storey building and may or may not include a widened detail at the bottom to support an additional course of bricks (to a metre high - commonly known as a plinth).

[0018] Thirdly, preferably, slots are cut into the angle and a small passage is formed in the concrete and a corresponding hole cut into the timber decking to allow air to flow from the void below up through the cut of the timber decking, through the passage formed in the concrete, through the slot into the void behind the brickwork and subsequently into the atmosphere via the air bricks.

[0019] The number of ties, their thickness and their configuration will depend on the anticipated brickwork loading. The angle itself would normally be between 4 and 8 mm but typically 5 or 6 mm. Increased strength for increased brickwork loadings is provided by small gusset plates welded in the corner of the angle. These features may be easily accommodated by the bricklayer who would chop out sections of brick as would be appropriate.

[0020] Expanded metal may be provided on top of the angle, this is in turn bent down and "nailed" to the building and provides a barrier to prevent the ingress of soil and also rodents into the void. One variation on this proposal is that of forming an alternative means of venting the void, which alleviates the need for the slots. The angle sections typically 1.5 metres long are simply positioned leaving a small gap between them typically 50 to 100 mm. A sheet of thin material, typically metal, can be secured to either the front or the back face to provide temporary support for the concrete. Once the concrete is secured the timber decking is cut out and airflow automatically rises directly from the void into the cavity brickwork.

[0021] In a further alternative, a venting element, typically a telescopic vent, is inserted between adjacent angle sections and may or may not be inserted at least

partially into a recess in the concrete slab. This enables air flow to easily pass into and out of the void beneath the concrete.

[0022] An example of the present invention will now be described with reference to the method described in our earlier patent application EP-A-1116829 and the accompanying drawings, including the drawings included in that earlier application, of which:-

Fig. 1 is a schematic, vertical cross section through a foundation raft constructed according to our earlier application;

Fig. 2 is a section along line A-A of Fig. 1;

Fig. 3 is a plan view of part of the frame of Fig. 1;

Fig. 4 is a cross sectional view showing the use of a downstand unit;

Fig. 5 is a cross-sectional view showing an edge shutter support;

Fig. 6 shows a vertical section through a typical foundation raft;

Fig. 7 is a vertical section showing how the void is formed according to one aspect of the present invention;

Fig. 8 is a partially sectioned elevation of a bag for supporting the formwork;

Fig. 9 shows a plan view of a possible arrangement of the bags beneath the formwork;

Fig. 10 is a perspective view of a bag and a laterally elongate coupling device; and

Fig. 11 is a cross-sectional view showing the use of formers; and

Figs 12a and b are partial cross-sectional views showing different sized formers.

[0023] Additionally, in accordance with an example of the method of the present invention, the drawings include:

Fig. 13 which shows a cross-section of a foundation raft and building similar to that shown in Figure 4;

Fig. 14 shows further detail of a stainless steel beam incorporated therein;

Fig. 15 shows an alternative form of stainless steel support; and

Fig. 16 shows an alternative venting means.

[0024] Firstly, the method of EP-A-1116829 will be described.

[0025] As can be seen from Fig. 1, a foundation raft 1 comprises a deck 2 and a frame 3, both of which are supported by a number of piles 4. The piles 4 have been preformed in the ground 5 and the uppermost section of the piles is of a greater diameter to the remainder of the pile. The piles 4 support the foundation raft 1 away from the ground, thus creating a void 7 which can accommodate potential ground heave. A number of spacers 8 are provided between the frame 3 and the deck 2. The frame and deck are connected together through the spacers

8. The spacers are usually formed from concrete and are provided to ensure that, as the concrete 9 is poured, it can flow around the underside of the frame and fully surround the lower part of the frame. Concrete 9 is poured onto the deck 2 and surrounds the frame and any additional reinforcement 10 which may be required.

[0026] In Fig. 2, three elongate members of the frame can clearly be seen. First 11 and second 12 members are horizontally spaced and substantially parallel to each other. They lie on the upper surface of a series of spacers 8. A third elongate member 13 is spaced from the first and second members to form, in section, a triangular arrangement. The first 11 and second 12 members are connected to the third member 13 by members 14 to create the framework 3. This framework 3 is then connected to the spacers 8 and the deck 2 by means of ties 15. This tying connection can be clearly seen in Fig. 3.

[0027] Figures 4 and 5 show the arrangement at the one edge of the formwork 1 and show the provision of downstand units 20. The downstand unit 20 may be formed from concrete and it is connected to the reinforcement 10 via a steel connecting arm 21. The downstand unit 20 is connected to the reinforcement 10 prior to pouring the concrete 9. The downstand unit 20 is placed on a temporary support 22 during construction and this temporary support may be removed on completion of the construction.

[0028] A wall 23 is provided to prevent the ground 5 migrating to the underside of the downstand units. The downstand unit 20 is provided with a step 24 which supports a series of pre-cast beams 25. The beams in turn support the outer skin of brickwork 26 and 27, including air bricks 28. The inner skin of brickwork 29 is supported directly on the raft itself and a damp proof membrane 30 is incorporated within the inner 29 and outer 27 courses of brickwork.

[0029] Temporary shuttering 31 is provided and is secured to the downstand unit 20 by support detail 32. Bolts 33 can be removed to allow the removal of the shutter support 32 and then the main shutter 31 which spans adjacent units. The temporary shutters 31 are of sufficient height to form a raised boundary to the foundation raft to ensure that the concrete can be poured to the required depth. Once these edge shutters 31 are in place, the concrete 9 can then be poured.

[0030] An air void 34 is provided between the outer skin of brickwork 26 and the downstand unit 20 or concrete 9. This is vented to the atmosphere through air bricks 28.

[0031] Figure 6 shows an alternative foundation raft 50 consisting of a reinforced concrete slab 50 supporting building walls 51 and itself supported by piles 52. The piles are first put down and the slab is integrated with pile caps. A void 53 spaces the bottom of the slab 50 from the ground 54.

[0032] Figure 7 indicates in vertical section how the void 53 might be created. Thus, decking 55 forming the

bottom wall of formwork is spaced above a layer of blinding 56 on the ground 54 by an array of tubular bags 57, which may be laid out as seen in plan in Figure 9.

[0033] As Figures 8 and 9 show, each bag 57 has a closed end 58 and, at its opposite end, is connected to a hose 59 leading to a terminal 60, or a common terminal 60a in Figure 9, containing a non return valve and a tap. The hose may be a canvas hose similar to a fireman's hose. In use, a pump could be connected to the block 60 to inflate the respective bag. The hose 59 could be used to pull the bag from the void after use.

[0034] Figure 10 shows a bag 57 with a coupling device 61 having its wider, oval shaped end inserted in the end of the bag opposite the closed end 58. The size of the largest part of the coupling device can pass through a 225mm x 75mm hole. The coupling device has a narrow inlet/outlet tube 62 extending away from the bag. The tube can be connected to the hose.

[0035] Figure 11 shows the provision of a pair of timber formers 61 comprising a main body 63 and a pair of longitudinally extending raised portions 62. The bag 57 sits between the pair of formers 61 and is in the fully inflated configuration. The formers increase that the shown size of the void 53 between the declining 55 and the blinding 56.

[0036] Two differently shaped formers 61 are shown in Figures 12a and 12b. The main body 63 of each former has a different depth such that the size of the void can be varied between separate applications or to accommodate inconsistencies in the ground surface.

[0037] Turning now to Figures 13 onwards and an example of the present invention, the method shown involves the provision of a stainless steel angle 70 which acts as both a permanent shutter and support to the external brickwork 71. The angle, typically 6 mm in thickness, is first placed upon the timber decking 72 and is secured with screws or nails to the timber decking. In the permanent condition the angle is support via tie back straps 73 welded to the internal (as used) face of the angle at predetermined designed centres, the spacing and the length of the straps being determined by the loadings of the brickwork.

[0038] The void 74 is vented by providing slots 75 in the vertical face of the angle and providing formers 76 which are cast into the concrete. The formers may either be a void in their own right or a soft void forming medium which is subsequently removed. The overall result is that air is allowed subsequently to flow from underneath the void decking, up into small recesses behind the angle face (vent/void), out through the slots, into a void behind the bricks and subsequently out through to the atmosphere by air bricks spaced at centres in accordance with building regulations.

[0039] Strengthening gussets 77 may be provided at intervals along the angle as shown.

[0040] In the alternative form, shown in Fig. 15, a backing section of material (metal sheet) 77 is received between angles 70 spaced apart from one another. A

slot 78 is cut in the timber decking 72. This configuration allows the air to flow from the void 74, via slot 78, behind the brickwork 71 and to atmosphere via the air brick.

[0041] In the further alternative shown in Fig. 16, a venting element 80, inserted between adjacent angle supports 70 which are spaced apart as in Fig. 15, permits air flow from the void 74 to the atmosphere.

Claims

1. A method of constructing a concrete foundation raft for low level beam for a building or other superstructure, the method comprising the steps of:

erecting formwork, which is supported by a number of piles and by a frame to which the formwork is connected; and
forming concrete in the formwork to form the raft or beam, wherein at least part of the formwork comprises a substantially L-shaped cross section stainless steel or other non-corrodible metal support to form shuttering for a side of the concrete raft or beam and, subsequently, a support for the wall of the building or other superstructure.

2. A method according to claim 1, further including the step of providing one or more ties, extending from the support into the concrete slab.

3. A method according to either claim 1 or claim 2, further including the step of supporting an additional course of bricks on a widened detail at the bottom of the support.

4. A method according to any one of the preceding claims, further comprising the step of providing a passage through the concrete to enable the underside of the concrete to be vented through one or more slots in the support.

5. A method according to any one of the preceding claims, further including the step of providing one or more support plates in a corner of the L-shaped support.

6. A method according to claim 5, wherein the support plates are welded to the support.

7. A method according to any one of the preceding claims, further including the step of providing expanded metal on the upper end of the angle to prevent the ingress of soil or other unwanted items into a void beneath the concrete.

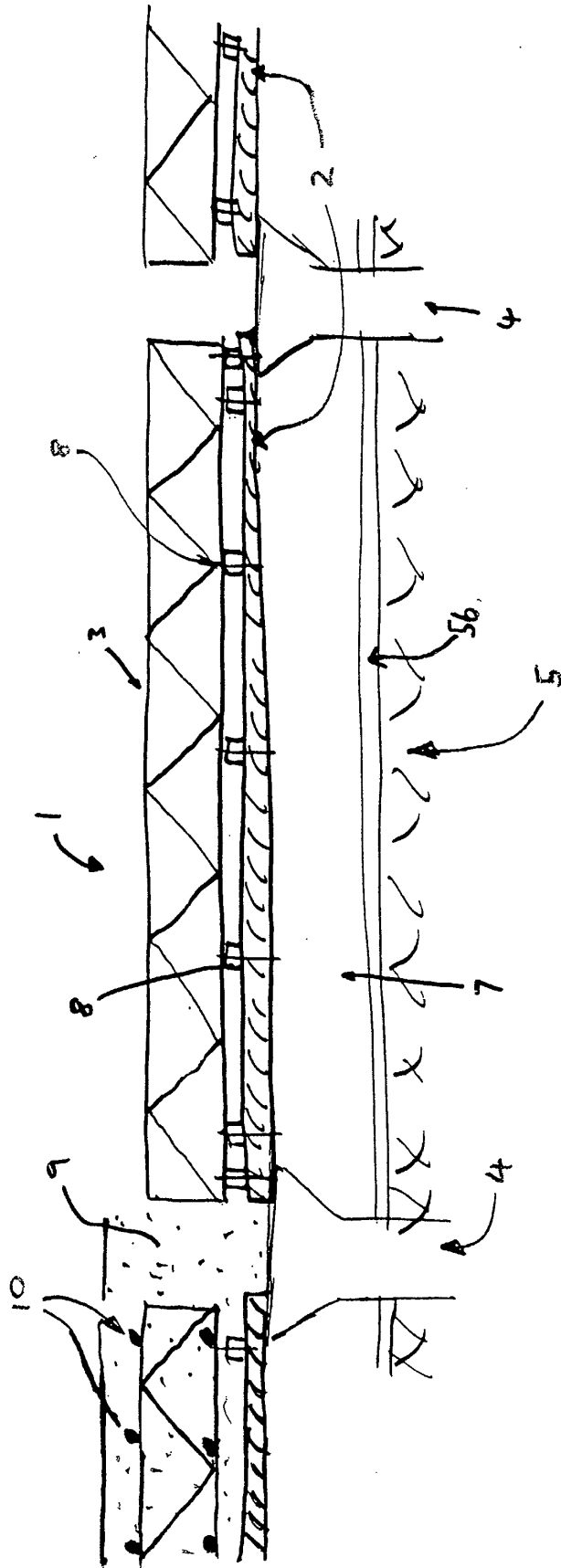
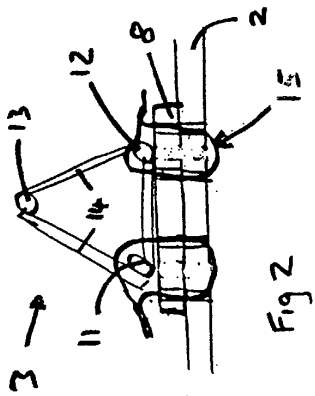
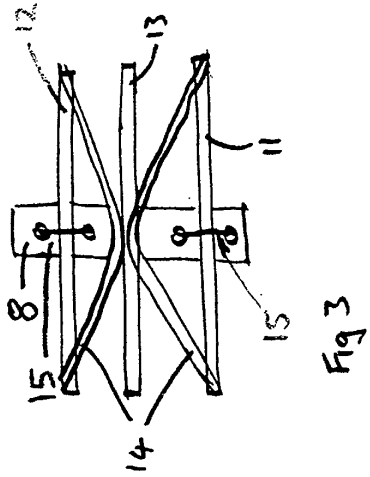
8. A method according to claim 1, wherein adjacent L-shaped supports are spaced from each other so as

to leave a gap.

9. A method according to claim 8, further including the step of fixing a sheet material between adjacent L-shaped supports so as to provide temporary support for the concrete.

10. A method according to claim 8, further comprising the step of inserting a venting element between adjacent L-shaped supports so as to provide communication between above and below the concrete.

11. A method according to claim 10, further including the step of forming a notch in the concrete slab into which the venting element is fitted.



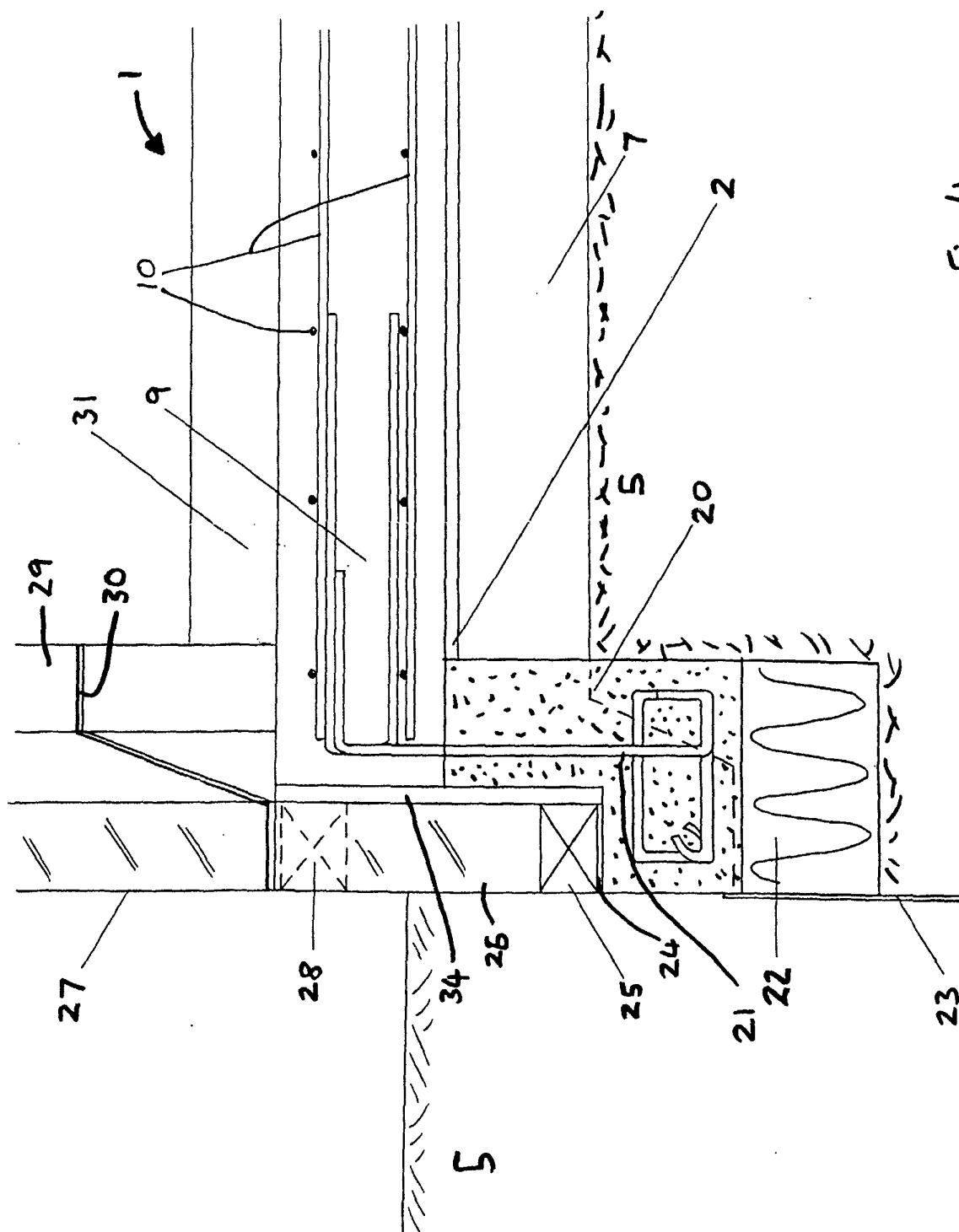


Fig 4

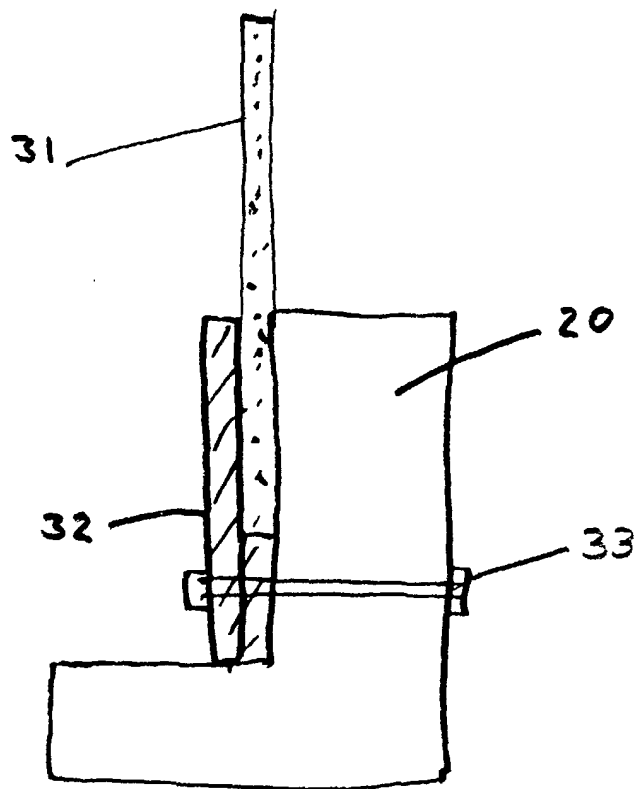
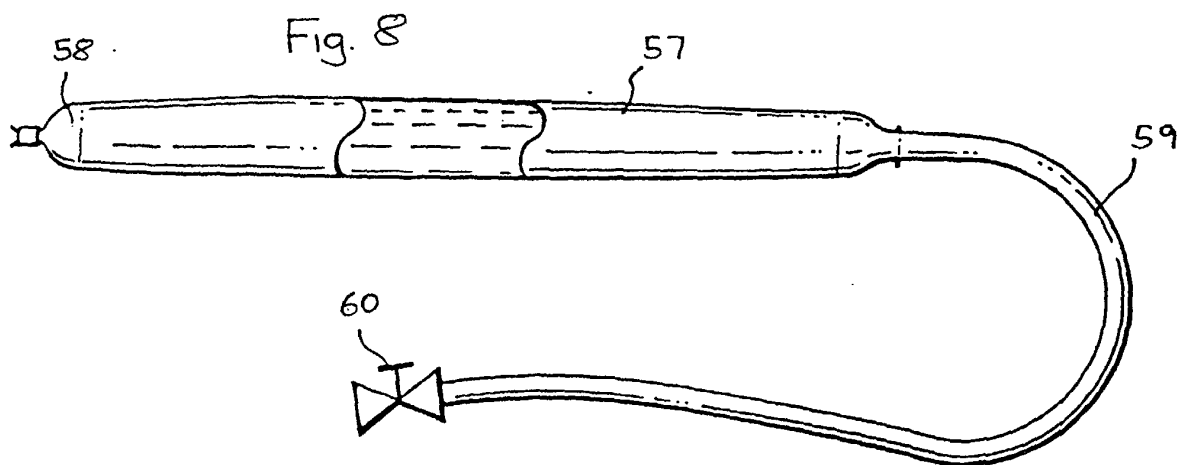
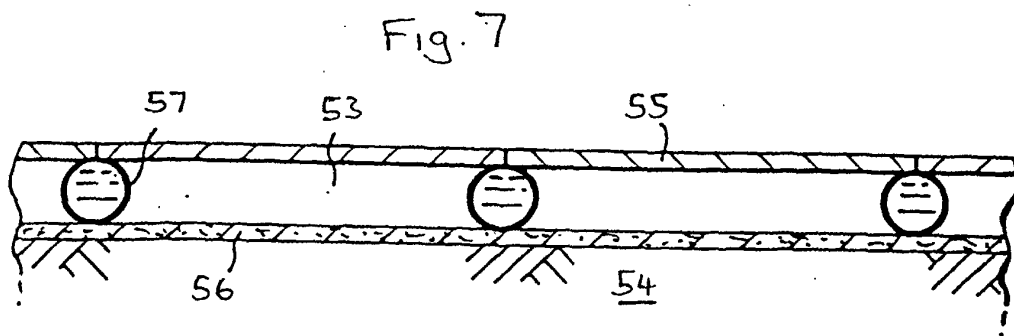
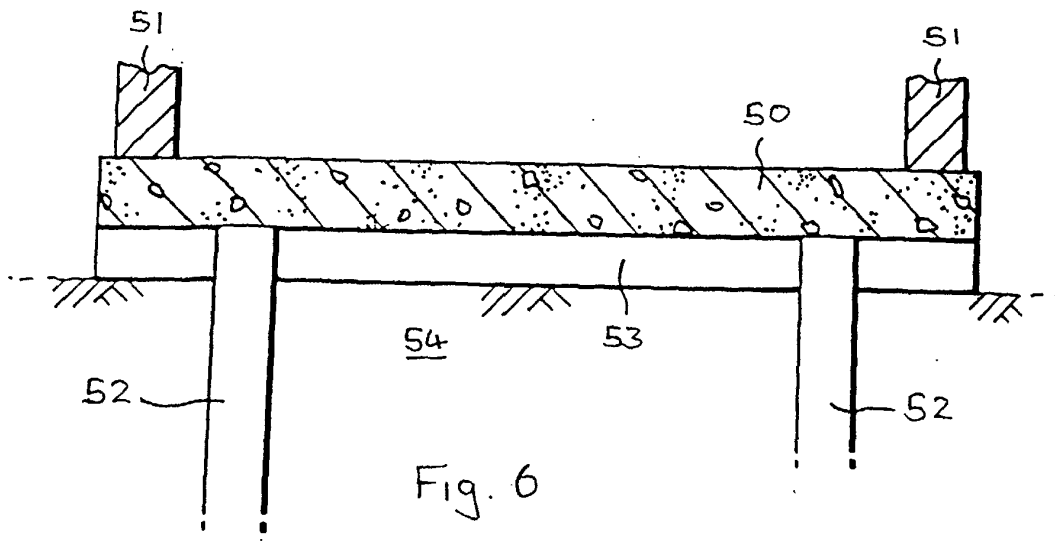


Fig 5



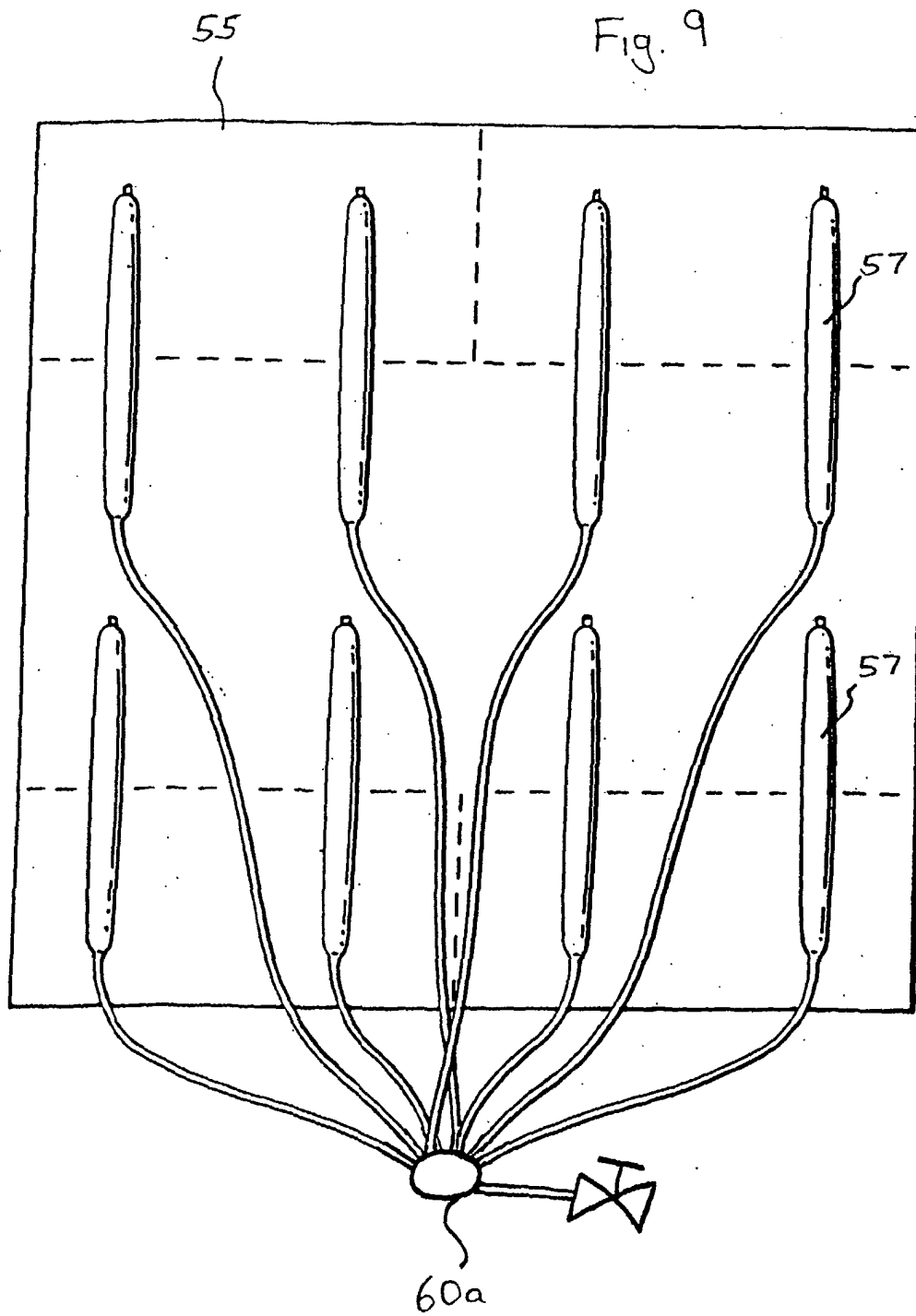


Fig. 10

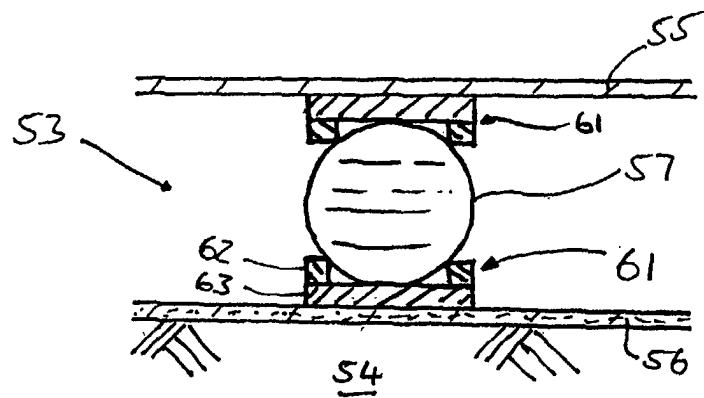
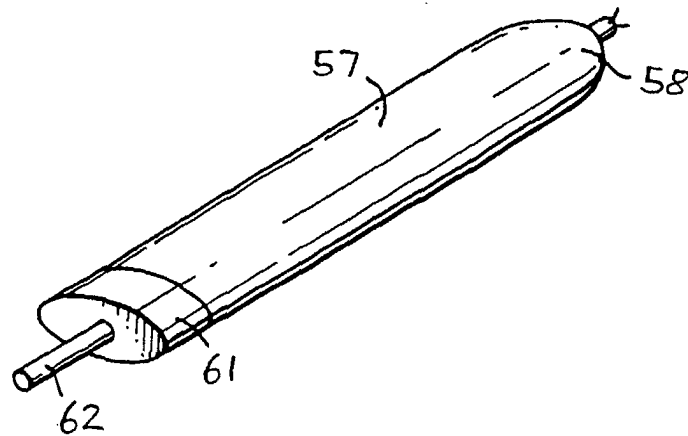


Fig. 11

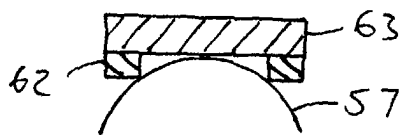


Fig. 12a

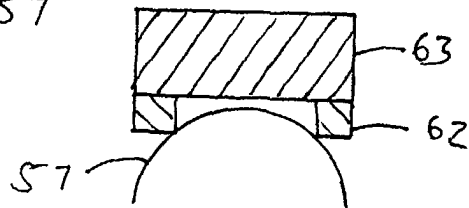
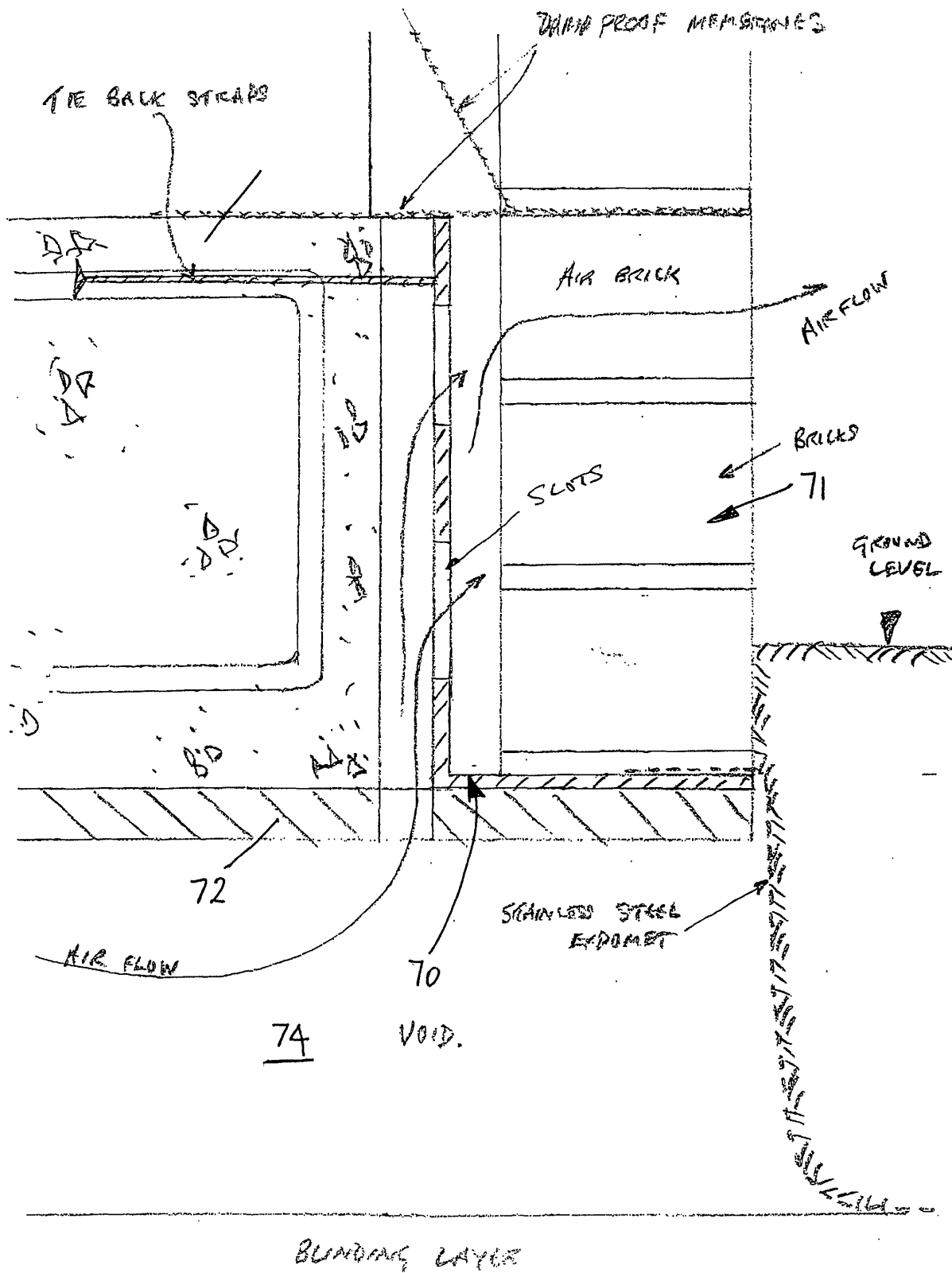


Fig. 12b

Fig. 13



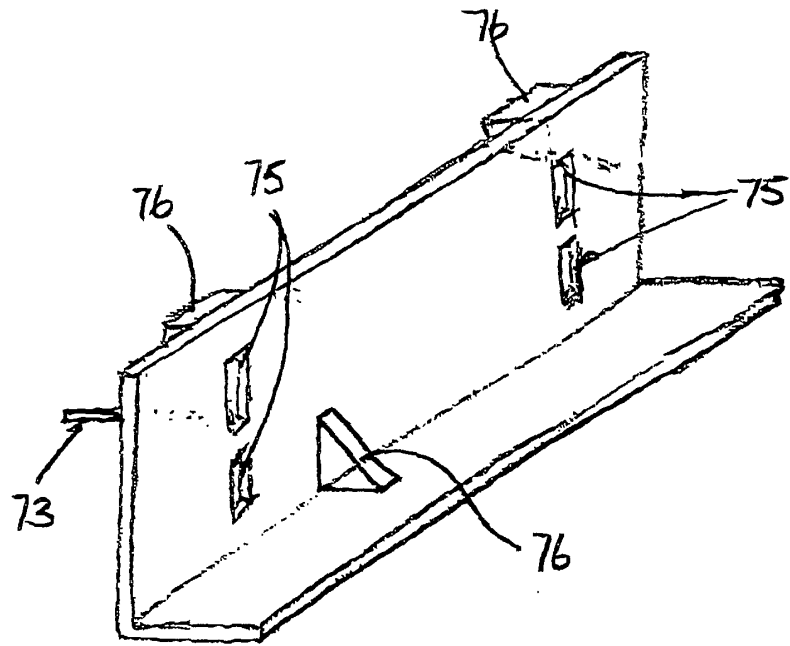


Fig. 14

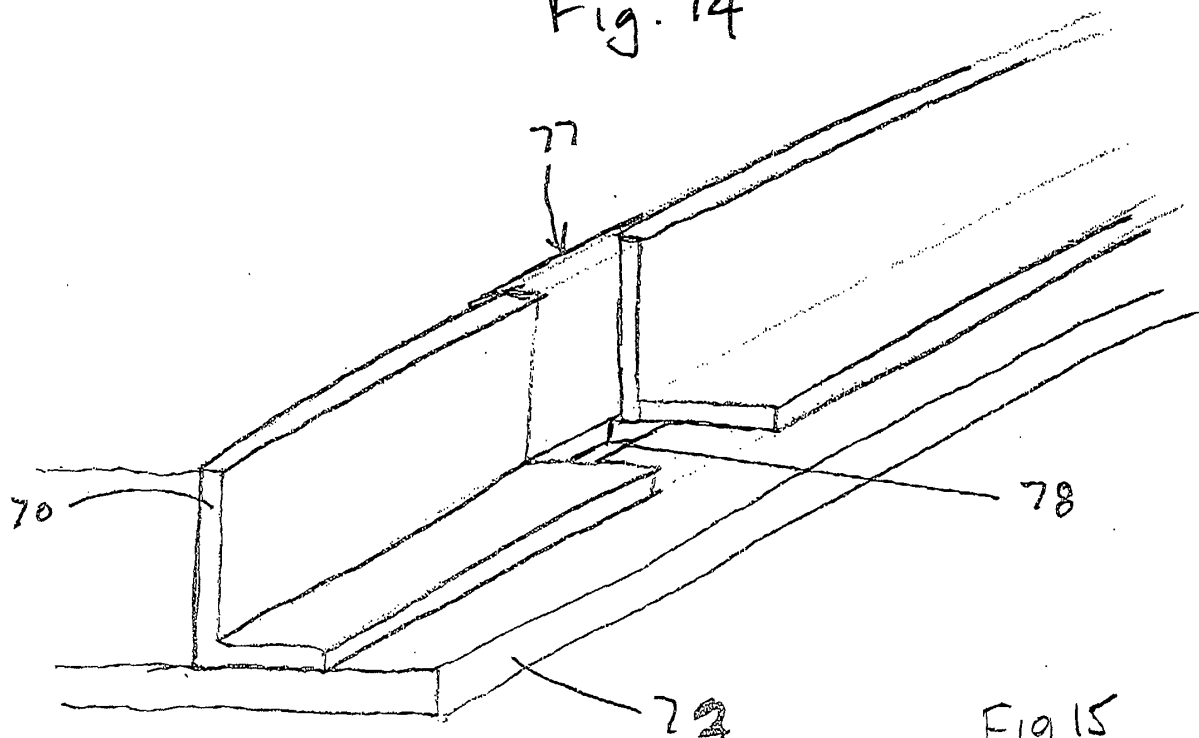


Fig 15

