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(54) Foundation

(57) A foundation arrangement comprises a channel structure 10 which spans between pile formations for support. The channel structure 10 has a first portion 16 and a second portion 18, both in the form of shallow channel sections or troughs, open from above. Settable material, such as concrete, is cast into the channel structures 16, 18 to form a beam. An aperture 54 is provided for ventilation through the channel structure 10.

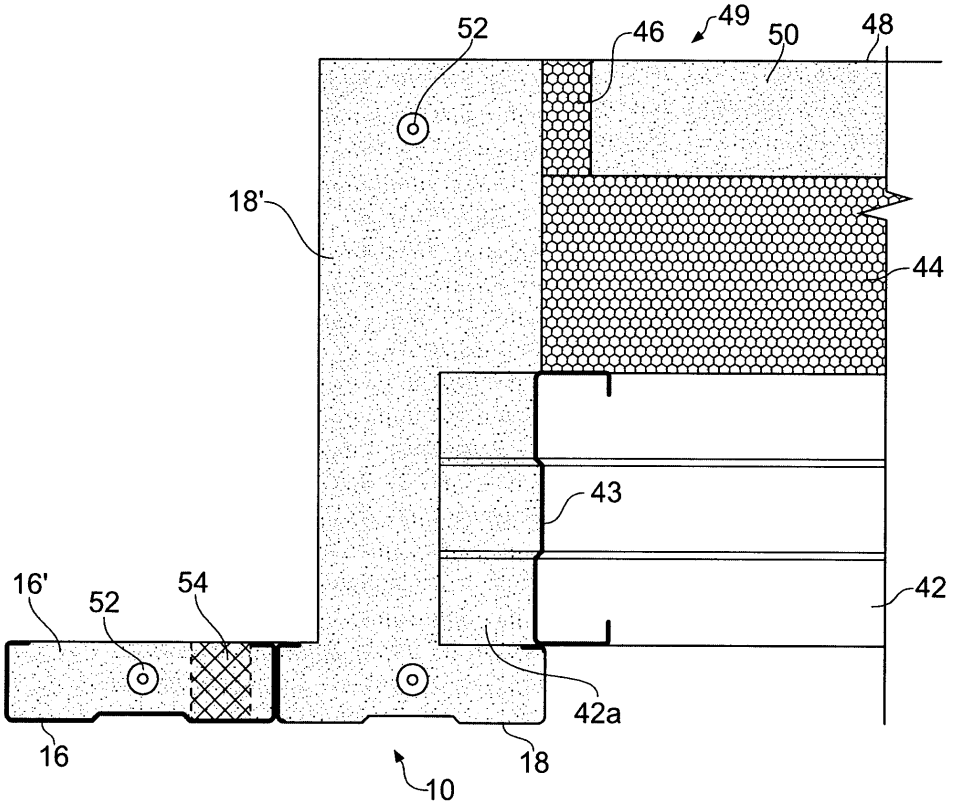

Fig. 7

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Description

[0001] The present invention relates to methods of forming foundations, and to foundations.

[0002] Examples of the invention provide methods of forming a foundation, and foundation arrangements, as defined in the accompanying claims, to which reference should now be made.

[0003] Examples of the present invention will now be described in more detail, by way of example only, and with reference to the accompanying drawings, in which:

Fig. 1 is a schematic perspective view of a channel structure;

Fig. 2 is a schematic perspective view of a temporary shutter arrangement for use with the channel structure of Fig. 1;

Fig. 3 is a schematic perspective view of the temporary shutter arrangement of Fig. 2, secured to the channel structure of Fig. 1;

Figs. 4 to 8 are vertical sections through a foundation formed in accordance with one example of the invention, at respective stages of formation; and

Figs. 9 to 14 correspond generally with Figs. 1, 2, 3, 4, 5 and 8, showing an alternative embodiment.

[0004] Fig. 1 shows a channel structure 10. In use, the structure 10 is installed to span between pile formations indicated at 12. In this specification, the terms "pile formation" and "pile" are intended to include pre-formed piles, such as concrete piles driven into the ground, and cast-in-situ piles and other building support arrangements such as stone columns.

[0005] The channel structure 10 has several through apertures 14, spaced along the length of the structure.

[0006] In more detail, the channel structure 10 includes a first portion 16 and a second portion 18, both in the form of shallow channel sections or troughs, open from above. The channels 16, 18 are formed, in one example, are galvanised steel, which may be formed by rolling. The channels 16 are attached together along respective side walls to run alongside each other, with their respective channel floors substantially co-planar.

[0007] The apertures 14 are formed in the floor of the channel 16.

[0008] Fig. 2 illustrates a temporary shutter arrangement 20, for use with the channel structure 10. The shutter 20 has a shutter board 22 and at least one support bracket 24. The bracket 24 is formed from a strip 26 bent approximately to a right angle at 28 and reinforced by a web 30. The bracket 24 may be formed of steel, for example. The bracket 24 has a downwardly extending plug in the form of a short post 32, which may be formed from a block member or length of tube attached to the strip 26, for example by welding. Apertures 34 in the post 32 allow a fixing peg (not shown in Fig. 2) to be introduced transversely of the post 32.

[0009] The size of the post 32 and the apertures 14 (Fig. 1) are chosen so that the post 32 can be accommodated as a plug with a snug fit in a chosen aperture 14. In this condition, the strip 26 rests on the channel 16, to either side of the channel mouth, with the upper leg 36 of the strip 26 standing generally vertically up from the line of the adjoining side walls of the channels 16, 18.

[0010] The shutter board 22 may be permanently fixed to the bracket 24 or temporarily held by a hook 100 (as shown) or attached by means of a spring clip secured to a part of the bracket 24 to reach over the board 22 for holding the board against the upper leg 36.

[0011] Accordingly, as can be seen from Fig. 3, the shutter board 22 can be retained temporarily in position above the adjoining channel walls, supported by a bracket 24 or a line of brackets 24, each of which is positioned with a corresponding post 32 in a corresponding aperture 14.

[0012] The apparatus which has been described can be used in a method of forming a foundation. An example method will now be described, with particular reference to Figs. 4 to 8.

[0013] Fig. 4 corresponds with the arrangement of Fig. 3. The shutter board 22 is installed above the adjoining channel walls, supported by brackets 24. The post 32 is secured in the aperture 14 by means of a fixing peg 40, transverse to the post 32. This plugs the aperture 14 and secures the shutter board 22 to the channel structure 10, for support.

[0014] The channel structure 10, with the temporary shutter 20 secured to it as described, is installed to span between piles 12, as indicated in Fig. 1.

[0015] With the channel structure 10 installed on the piles 12, components of a floor construction are introduced, as illustrated in Fig. 5. Fig. 5 illustrates a beam 42 resting at one end 42a on the channel 18 and extending away to another support bracket (not shown). The beam 42, in this example, is a channel section of the same section as the channels 16, 18, oriented with the channel floor running substantially vertically. Further lengths 43 of the same section extend between adjacent beams 42, for reasons which will become apparent. The beam 42 supports a slab of insulation 44. A short upstand 46 is provided at the edge of the slab 44, for reasons which will become apparent.

[0016] The next stage of the process is illustrated in Fig. 6. Settable material 16', 18' is introduced into the channel structure 10. The settable material 16', 18' may be a cementitious material, such as concrete. The settable material 16' fills the channel 16 except in the region of the post 32, which serves to maintain the aperture open as the settable material 16' is setting.

[0017] Settable material 18' is also introduced into the channel 18. A taller body of settable material 18' is possible in the channel 18 than in the channel 16, because

of the shuttering provided by the shutter board 22, the lengths 43, the edge of the slab 44 and the upstand 46. Thus, whereas settable material 16' in the channel 16 extends only up to the channel mouth, settable material 18' in the channel 18 extends up to floor level 48. The floor structure 49 is completed by a further slab 50 of settable material cast onto the slab 44, and separated from the settable material 18' in the channel 18 by the upstand 46, which forms a thermal break.

[0018] Reinforcing bars 52 may be provided in the settable material 16', 18'.

[0019] When the settable material 16', 18' has set sufficiently to be self-supporting (even if not reaching its final structural strength), the temporary shutter 20 is removed. This is achieved by releasing the post 32 by removing the fixing peg 40. The bracket 24 can then be removed, either carrying the shutter board 22 with it or allowing the shutter board 22 to be removed thereafter. As the brackets 24 are removed, the posts 32 leave passages in the material 16' cast in the channel 16, communicating with the apertures 14. A passage is indicated at 54 in Fig. 7, which illustrates the arrangement after removal of the temporary shutter 20.

[0020] It can be seen from Fig. 7 that the settable material 16', 18' in the channels 16, 18 forms a generally L-shaped beam, when set. In particular, the introduction of settable material 18' into the channel 18, against the temporary shutter 20, forms a beam whose height is selected to provide sufficient strength to support the load imposed by a floor structure 49.

[0021] A further stage is illustrated in Fig. 8. A double skin cavity wall 56 has been constructed. This includes an inner face 58 of blockwork or other type of structure such as a timber frame or panel type construction, built above the channel 18 and the associated settable material in the channel 18. An outer skin 60 of brickwork or other type of structure such as a timber frame or panel type construction is constructed above the channel 16. A cavity 62 is left between the inner and outer skins 58, 60 and may include cavity insulation 64. A damp proof course may be provided in the outer skin 60, approximately at the floor level 48.

[0022] The arrangement of Fig. 8 illustrates that a void 66 exists below the floor structure 49. Provision for ventilation of the void 66 exists by virtue of the passages 54 which provide communication in a direction generally transverse of the channel 16, between the void 66 and the cavity 62. A ventilation path to the exterior 68 of the building is completed by periodic apertures in the outer skin 60, which may be below the level of the damp proof course. In this example, each passage 54 is provided with an associated, inverted L-shaped vent pipe 70 which provides an enclosed shaft up from the passage 54, through the cavity 62, and out through a gap left between bricks of the outer skin 60, providing a ventilation mouth at 72, to the exterior 68. The vent pipe 70 protects the ventilation shaft from blockage, for example by debris within the cavity 62.

[0023] A skirt board 74 may be provided, below the channels 16, 18, to prevent the void 66 being backfilled.

[0024] Fig. 9 shows an alternative channel structure 10a. In use, the structure 10a is installed to span between pile formations as described above. Again, the terms "pile formation" and "pile" are intended to include pre-formed piles, such as concrete piles driven into the ground, and cast-in-situ piles and other building support arrangements such as stone columns.

[0025] The channel structure 10a has several through apertures 14a, spaced along the length of the structure.

[0026] In more detail, the channel structure 10a includes a first portion 16a and a second portion 17. The portion 16a is in the form of shallow channel section or trough, open from above. The channel structure 10a is formed, in one example, from galvanised steel, which may be formed by rolling. The second portion 17 forms a raised portion of inverted channel section running alongside the first portion 16a. A third portion 18a, in the form of a further channel portion, runs alongside the second portion 17. Accordingly, the three portions 16a, 17, 18a may be formed from a single sheet.

[0027] The apertures 14a are formed through the second portion 17.

[0028] Fig. 10 illustrates a shutter arrangement 20a, for use with the channel structure 10a. The shutter 20a is formed by slabs, sheets or blocks of insulation material, such as foamed material, fibre glass or the like. The shutter 20a provides an insulation layer (to be described). However, the thickness of the shutter is locally reduced to provide channels 80 through the insulation layer, for purposes which will be described.

[0029] In particular, a channel 80 runs horizontally along the lower edge of the shutter 20a, to be in communication with the apertures 14a. Another horizontal channel 80 runs along the top edge of the shutter 20a. The horizontal channels are connected by upward channels spaced along the shutter 20a.

[0030] Fig. 11 illustrates the shutter 20a supported on the channel structure 10a by a temporary bracket 24a. The bracket 24a is formed as a column 82 for receipt in an upward channel 80 in the shutter 20a. A crossbar 83 is then received in an upper horizontal channel 80. A clip portion 84 clips the bracket 24a to the third portion 18a. A brace member 86 braces the joint between the column 82 and clip portion 84. The bracket 24a may be formed of steel, for example.

[0031] Accordingly, as can be seen from Fig. 11, the shutter 20a can be retained temporarily in position above the channel structure 10a, supported by a bracket 24a or a line of brackets 24a.

[0032] Other arrangements are envisaged for supporting the shutter 20a, and may be used in addition to, or as an alternative to the temporary bracket 24a. For example, the channel structure 10a may be provided with upward spikes or bars 87 (indicated by broken lines in Fig. 9), fixed to the second portion 17, and on which the shutter 20a may be impaled for support. Adhesive may

be applied between the shutter 20a and the channel structure 10a. Spikes, bars or adhesive may each be used instead of, or in addition to the bracket 24 of Figs. 2 to 6.

[0033] The apparatus which has been described in relation to Figs. 9 to 11 can be used in a method of forming a foundation. An example method will now be described, with particular reference to Figs. 12 to 14.

[0034] Fig. 12 corresponds with the arrangement of Fig. 11. The shutter board 20a is installed above the channel structure 10a, supported by brackets 24a.

[0035] The channel structure 10a, with the temporary shutter 20a secured to it as described, is installed to span between piles 12, as previously described in relation to Fig. 1.

[0036] With the channel structure 10a installed on the piles, components of a floor construction are introduced, as illustrated in Fig. 13. Fig. 13 illustrates a beam 42b resting at one end 42c on the channel 18a and extending away to another support (not shown). Further lengths 43a of the same section extend between adjacent beams 42b, for reasons which will become apparent. The beam 42c supports a slab of insulation 44a. A short upstand 46a may be provided at the edge of the slab 44a, for reasons which will become apparent.

[0037] The next stage of the process is illustrated in Fig. 14. Settable material 16a', 18a' is introduced into the channel structure 10a. The settable material 16a', 18a' may be a cementitious material, such as concrete. The settable material fills the channel 16a, 18a, to either side of the shutter 20a.

[0038] A taller body 18a' of settable material is possible in the channel 18a than in the channel 16a, because of the shuttering provided by the shutter 20a, the lengths 43a, the edge of the slab 44a and the upstand (if present). Thus, whereas settable material 16a' in the channel 16a extends only up to the channel mouth, settable material 18a' in the channel 18a extends up to floor level 48a. The floor structure 49a is completed by a further slab 50a of settable material cast onto the slab 44a, and separated from the settable material 18a' in the channel 18a by the upstand if present, which forms a thermal break.

[0039] Reinforcing bars 52a may be provided in the settable material.

[0040] When the settable material 16a', 18a' has set sufficiently to be self-supporting (even if not reaching its final structural strength), the brackets 24a can then be removed, allowing the shutter board 20a to remain.

[0041] It can be seen from Fig. 14 that the settable material 16a', 18a' in the channels 16a, 18a forms two beams, when set. In particular, the settable material 18a' in the channel 18a, against the shutter 20a, forms a beam whose height is selected to provide sufficient strength to support the load imposed by a floor structure 49a.

[0042] A further stage is also illustrated in Fig. 14. A double skin cavity wall 56a has been constructed. This includes an inner face 58a of blockwork or other type of structure such as a timber frame or panel type construction, built above the channel 18a and the associated settable material 18a' in the channel 18a. An outer skin 60a of brickwork or other type of structure such as a timber frame or panel type construction is constructed above the channel 16a. A cavity 62a is left between the inner and outer skins 58a, 60a and contains the shutter 20a, now serving as cavity insulation. A damp proof course 88 may be provided for the outer skin 60a.

[0043] The arrangement of Fig. 14 illustrates that a void 66a exists below the floor structure 49a. Provision for ventilation of the void 66a exists by virtue of inverted channel profile of the second portion 17, which provides communication between the void 66a and the apertures 14a. The ventilation path passes generally transversely through the second portion 17, by means of the apertures 14a, and continues from the apertures 14a, though the channels 80, to one or more air bricks 90 at the level of the upper horizontal channel 80. A ventilation path to the exterior 68a of the building is completed by the air brick 90.

[0044] Having formed a foundation in the manner described, further construction work can continue in a conventional manner, to complete the construction of a building.

[0045] Whilst endeavouring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

Claims

1. A method of forming a foundation, in which:

   at least one channel structure is installed to span between pile formations for support, the channel structure having at least one through aperture;

   settable material is introduced into the channel structure to form a beam when set; and

   the introduction of the settable material leaving the aperture open for ventilation through the channel structure.

2. A method according to claim 1, wherein the channel structure provides a plurality of through apertures.

3. A method according to claim 2, wherein the plurality of apertures are spaced along the length of the structure.

4. A method according to any preceding claim, wherein a shutter is secured to the channel structure, before introducing the settable material.

5. A method according to claim 4, wherein at least some of the settable material is introduced against the shutter.

6. A method according to claim 4 or 5, wherein the channel structure includes a first portion in which the or each aperture is formed, and a second portion, the second portion providing a channel for receiving settable material and the shutter serving to shutter settable material introduced to the second portion.

7. A method according to claim 6, wherein the shutter extends upwardly of the second portion to allow the settable material to form a beam which extends upwardly of the second portion.

8. A method according to claim 6 or 7, wherein a floor structure is installed, to be supported by one of the portions.

9. A method according to claim 8, wherein the floor structure is supported by the second portion.

10. A method according to claim 8 or 9, wherein the settable material, when introduced, is shuttered between the shutter and the floor structure.

11. A method according to any preceding claim, wherein the shutter is left in position after the settable material has set.

12. A method according to any preceding claim, wherein the shutter is provided by insulation material.

13. A method according to claim 12, wherein the insulation material is in the form of slabs, sheets or blocks.

14. A method according to claim 11, 12 or 13, wherein the shutter defines channels providing a ventilation path through the layer provided by the shutter.

15. A method according to claim 14, wherein the shutter is placed to provide communication between the ventilation path and the aperture.

16. A method according to any preceding claim, wherein temporary support members are removably attached to the channel structure to provide support for the shutter during formation of the foundation.

17. A method according to any preceding claim, wherein an inner skin and an outer skin of a wall are provided, the skins being supported by the channel structure and settable material, and the shutter member being located between the skins.

18. A method according to any preceding claim, wherein the channel structure provides a further channel portion for receiving further settable material for forming a further beam when set.

19. A method according to claim 18, wherein the further channel portion is the second portion of the channel structure.

20. A method according to claim 18, wherein the further channel portion is a third portion of the channel structure.

21. A method according to any of claims 6 to 20, wherein an inner skin and an outer skin of the wall are provided above respective ones of the portions.

22. A method according to claim 21, wherein the inner skin is supported by the second portion.

23. A method according to claim 22, wherein the outer skin is supported by the first or third portion.

24. A method according to any preceding claim, wherein a plug is provided in the aperture prior to introduction of the settable material, and is removed after the material is set, to leave the aperture open.

25. A method according to claim 24, wherein the aperture is at a region of the channel structure to which settable material is introduced, the plug serving to maintain the aperture open as the settable material is setting.

26. A method of forming a foundation, substantially as described above, with reference to the accompanying drawings.

27. A foundation arrangement comprising:

at least one channel structure spanning between pile formations for support, the channel structure having at least one through aperture;
settable material in the channel structure to form a beam;
the aperture being open for ventilation through the channel structure.

28. An arrangement according to claim 27, wherein the channel structure provides a plurality of through apertures.

29. An arrangement according to claim 28, wherein the plurality of apertures are spaced along the length of the structure.

30. An arrangement according to any of claims 27 to 29, wherein a shutter is secured to the channel structure, before introducing the settable material.

31. An arrangement according to claim 30, wherein at least some of the settable material is introduced against the shutter.

32. An arrangement according to claim 30 or 31, wherein the channel structure includes a first portion in which the or each aperture is formed, and a second portion, the second portion providing a channel receiving settable material and the shutter serving to shutter settable material in the second portion.

33. An arrangement according to claim 32, wherein the shutter extends upwardly of the second portion, the settable material forming a beam which extends upwardly of the second portion.

34. An arrangement according to claim 32 or 33, wherein a floor structure is supported by one of the portions.

35. An arrangement according to claim 34, wherein the floor structure is supported by the second portion.

36. An arrangement according to claim 34 or 35, wherein the settable material is shuttered between the shutter and the floor structure.

37. An arrangement according to any of claims 27 to 36, wherein the shutter is left in position after the settable material has set.

38. An arrangement according to any of claims 27 to 37, wherein the shutter is provided by insulation material.

39. An arrangement according to claim 38, wherein the insulation material is in the form of slabs, sheets or blocks.

40. An arrangement according to claim 37, 38 or 39, wherein the shutter defines channels providing a ventilation path through the layer provided by the shutter.

41. An arrangement according to claim 40, wherein the shutter provides communication between the ventilation path and the aperture.

42. An arrangement according to any of claims 27 to 41, wherein an inner skin and an outer skin of a wall are provided, the skins being supported by the channel structure and settable material, and the shutter member being located between the skins.

43. An arrangement according to any of claims 27 to 42, wherein the channel structure provides a further channel portion receiving further settable material for forming a further beam when set.

44. An arrangement according to claim 43, wherein the further channel portion is the second portion of the channel structure.

45. An arrangement according to claim 43, wherein the further channel portion is a third portion of the channel structure.

46. An arrangement according to any of claims 32 to 45, wherein an inner skin and an outer skin of the wall are provided above respective ones of the portions.

47. An arrangement according to claim 46, wherein the inner skin is supported by the second portion.

48. An arrangement according to claim 47, wherein the outer skin is supported by the first or third portion.

49. A foundation arrangement, substantially as described above, with reference to the accompanying drawings.

50. Any novel subject matter or combination including novel subject matter disclosed herein, whether or not within the scope of or relating to the same invention as any of the preceding claims.

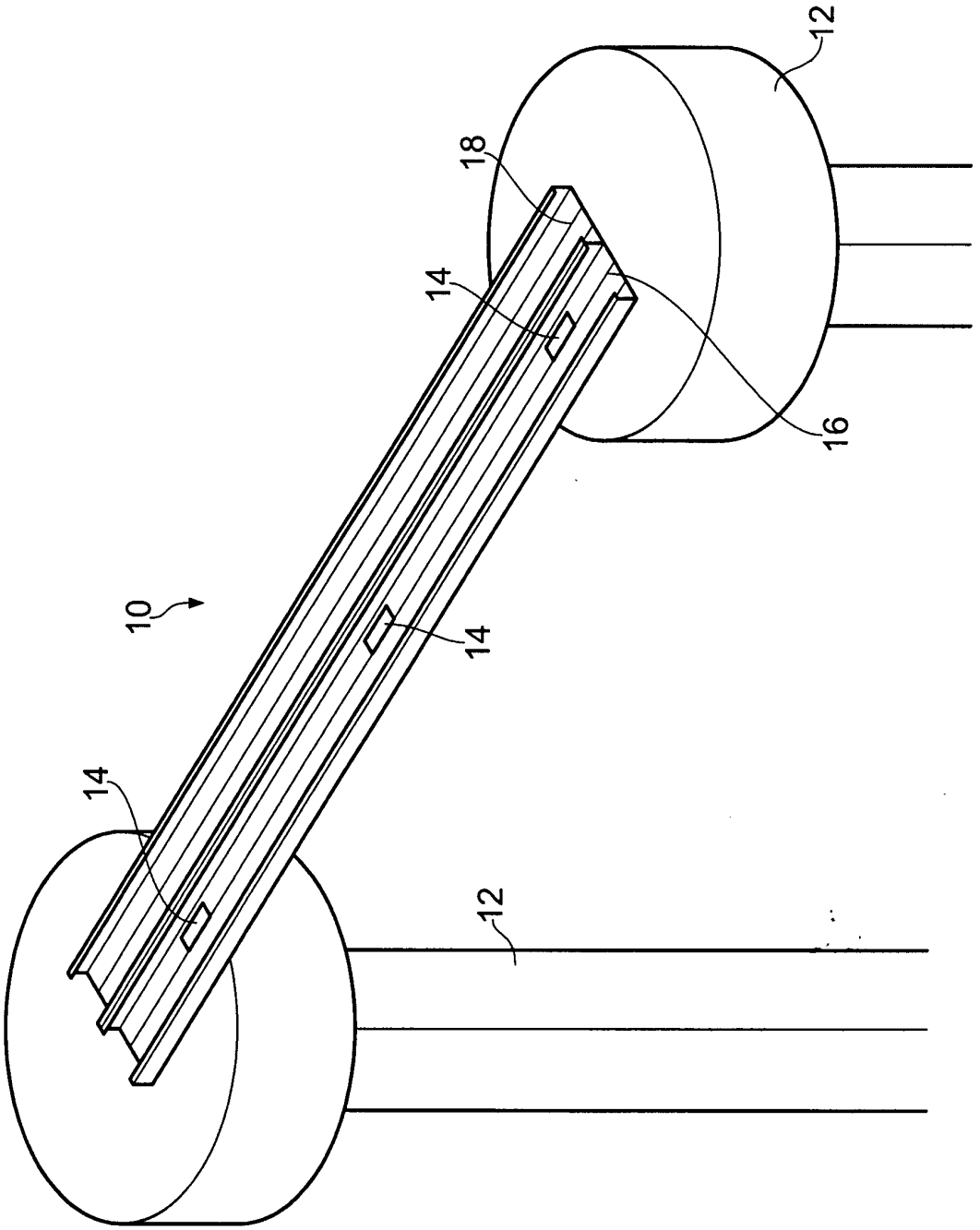

Fig. 1

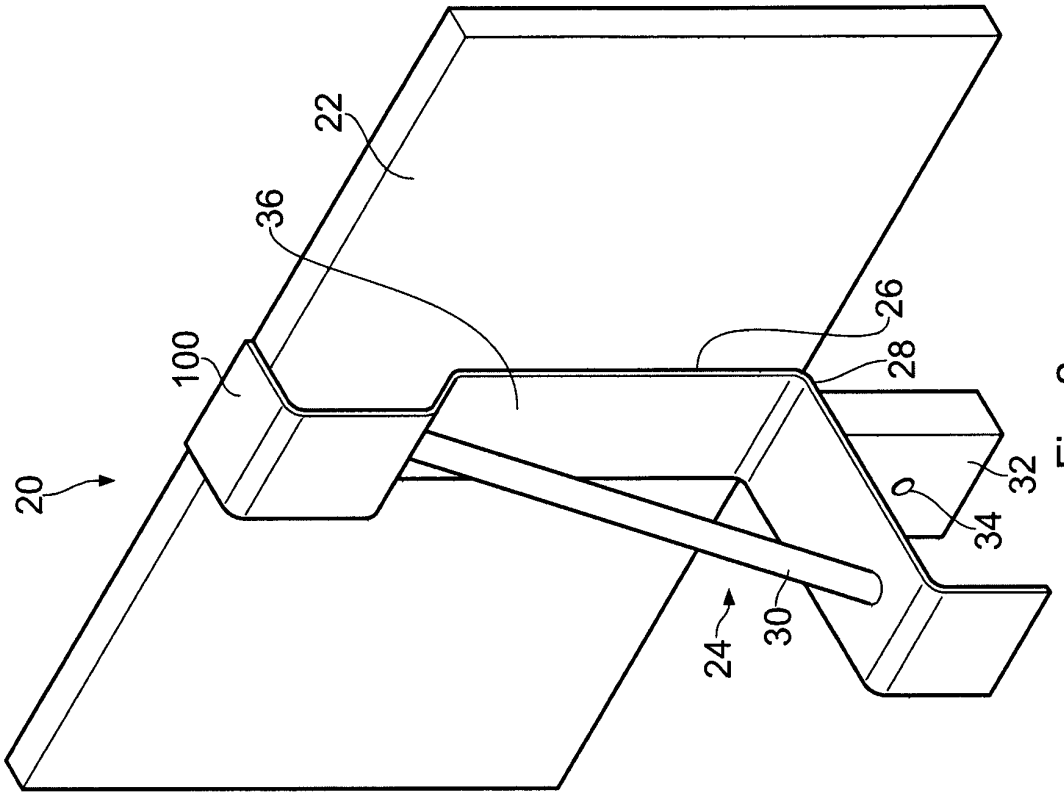

Fig. 2

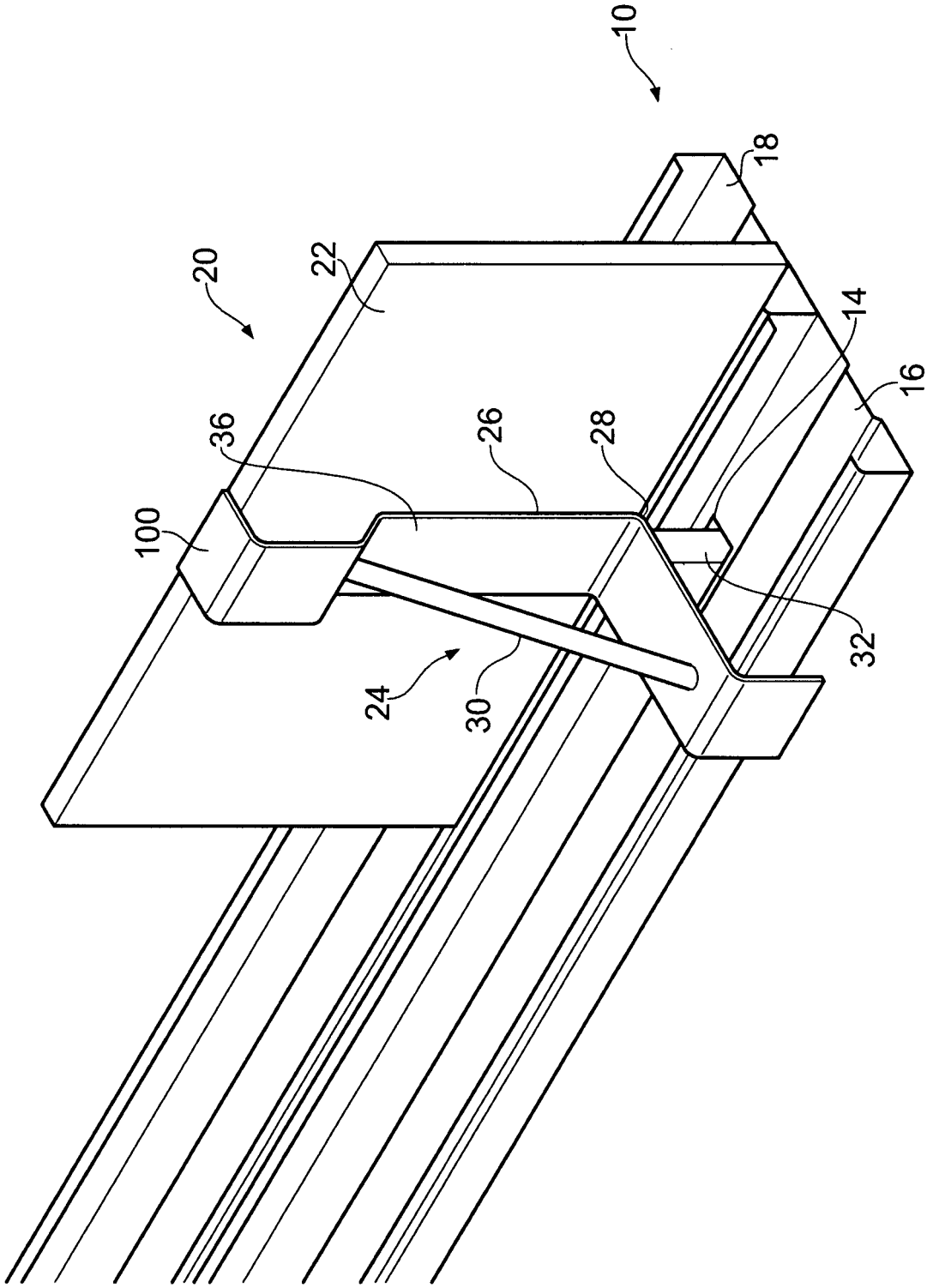

Fig. 3

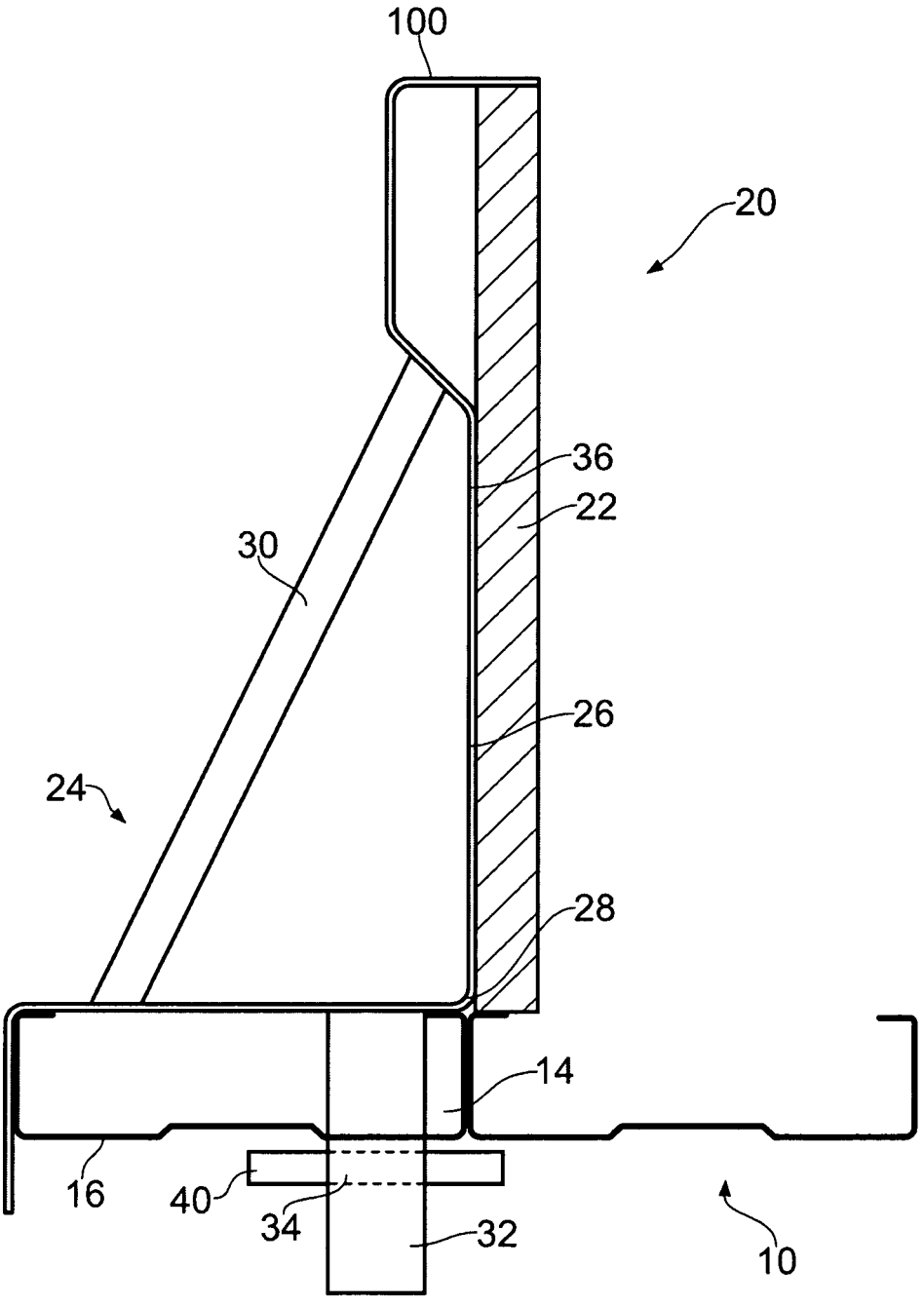

Fig. 4

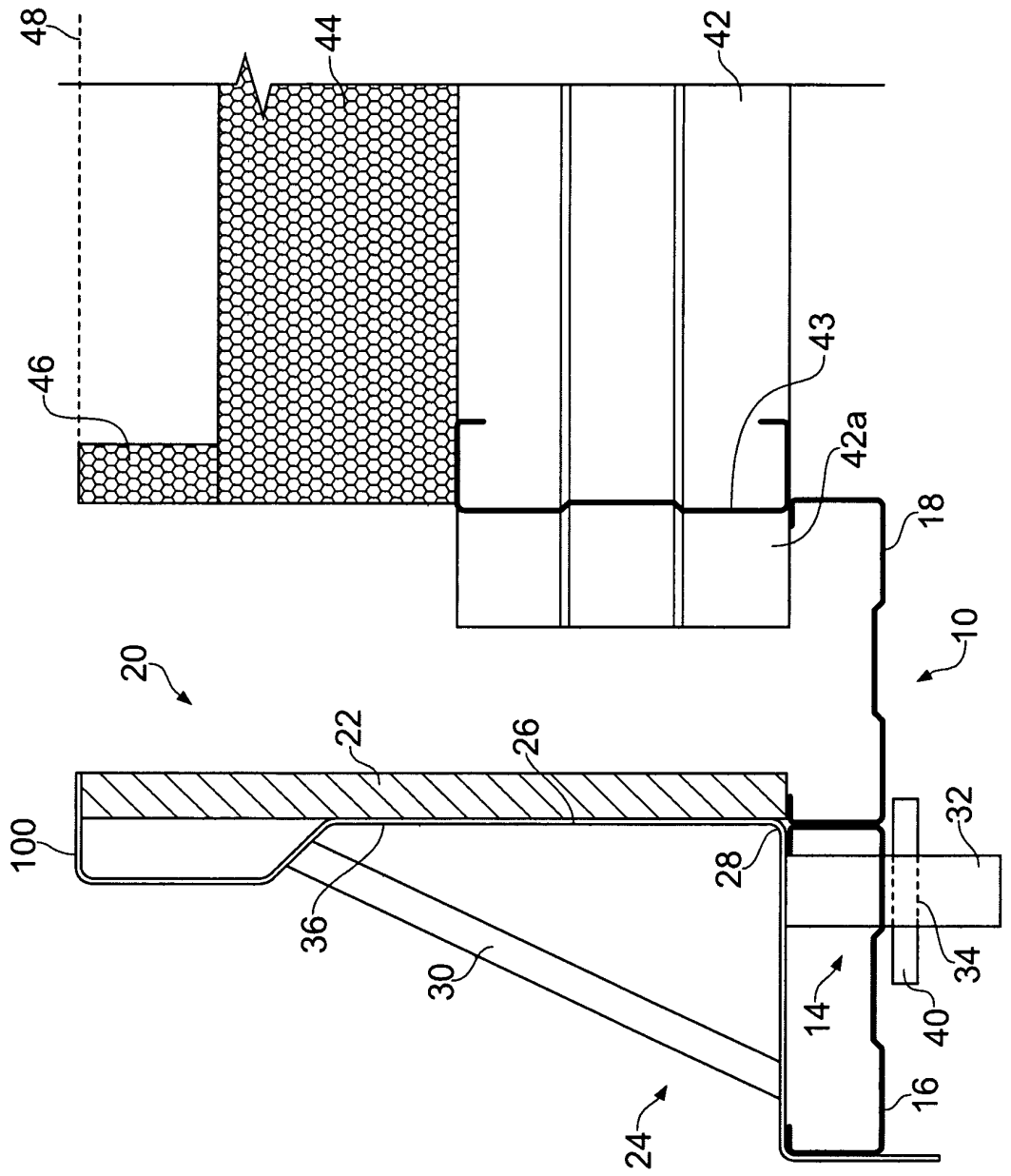

Fig. 5

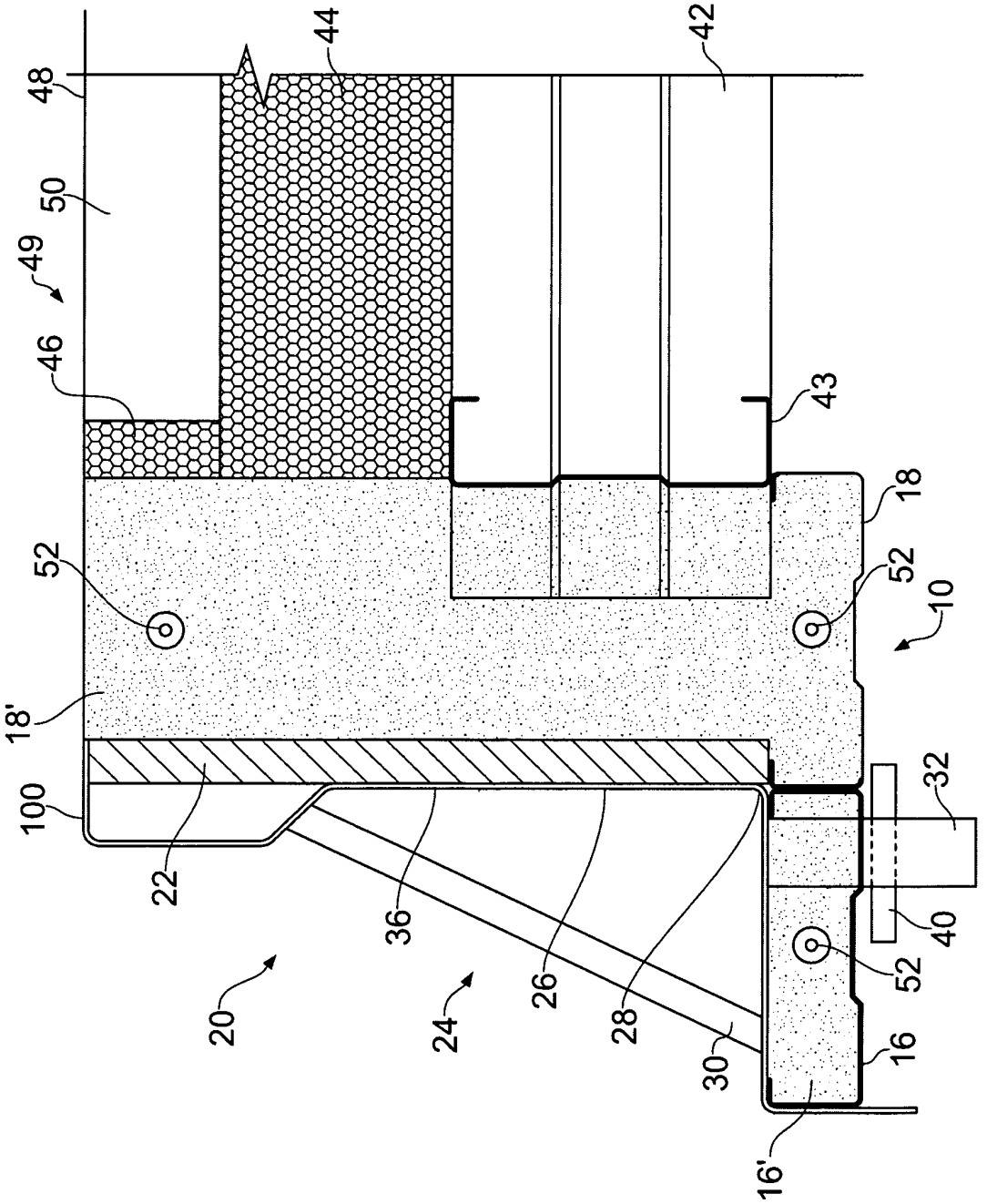
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Fig. 6

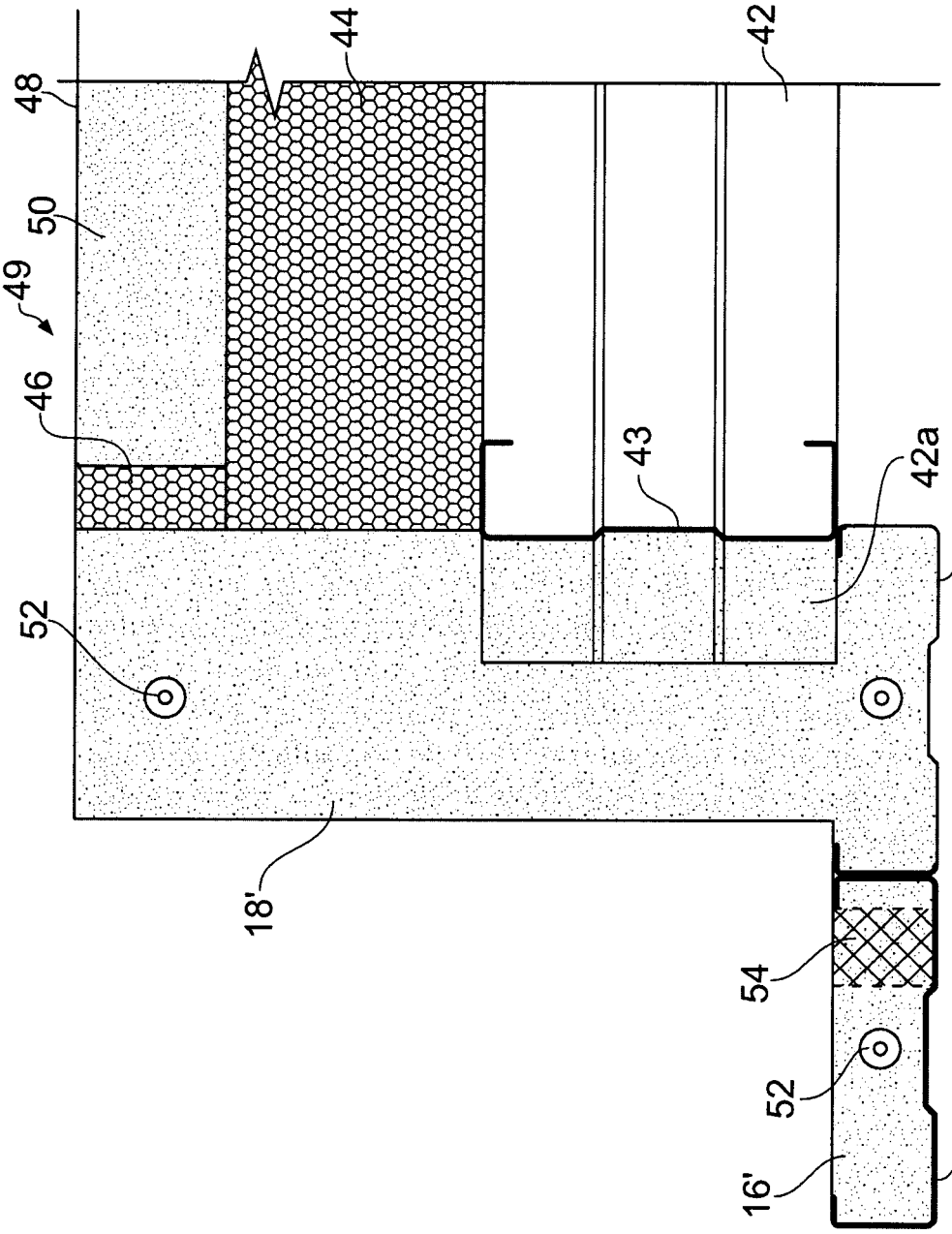

Fig. 7

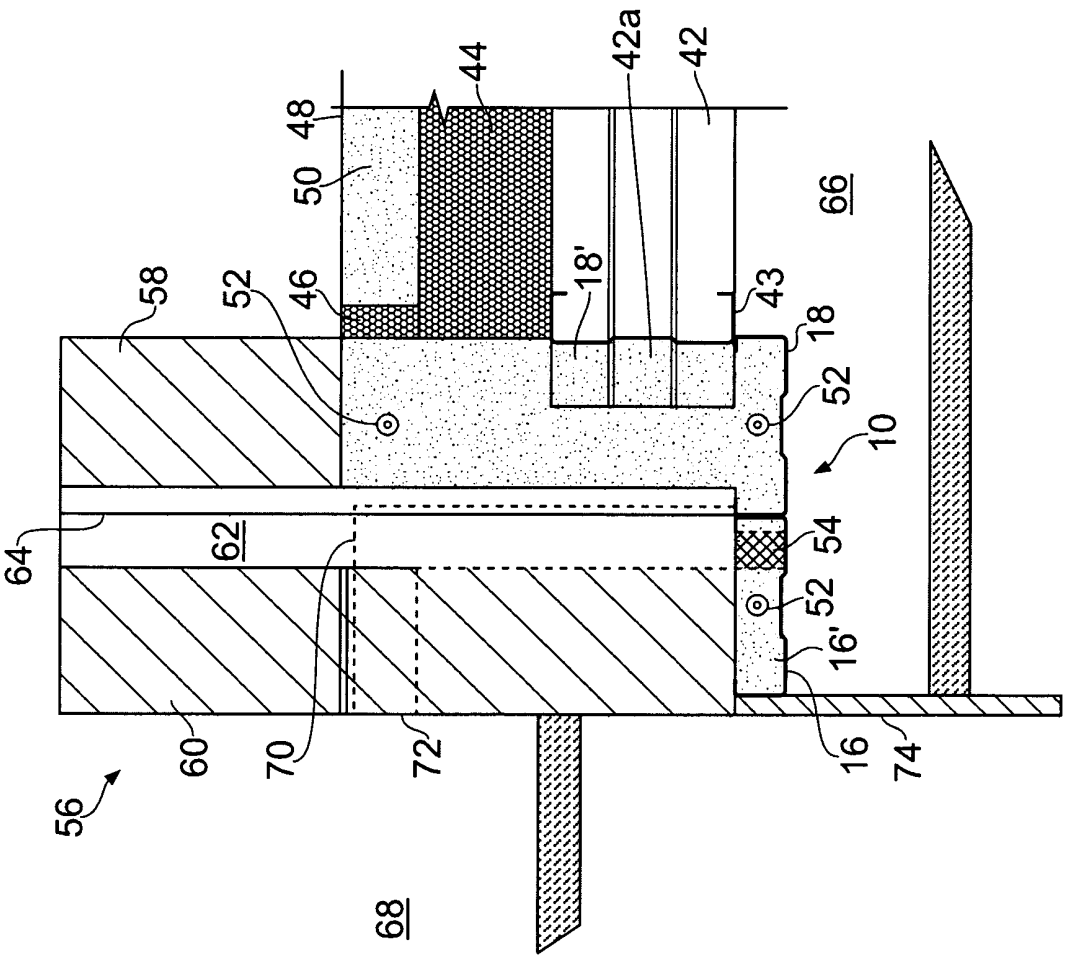
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Fig. 8

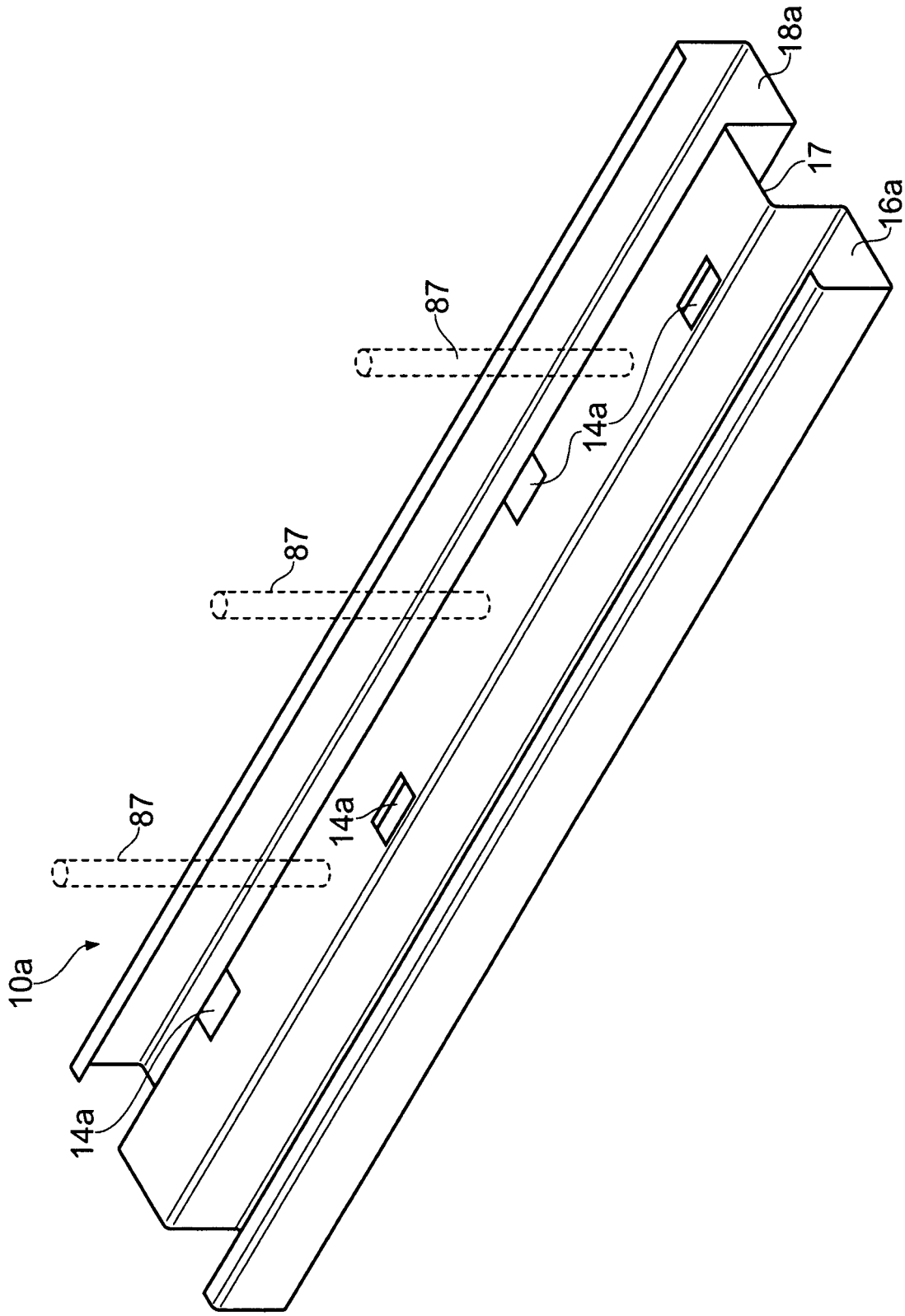


Fig. 9

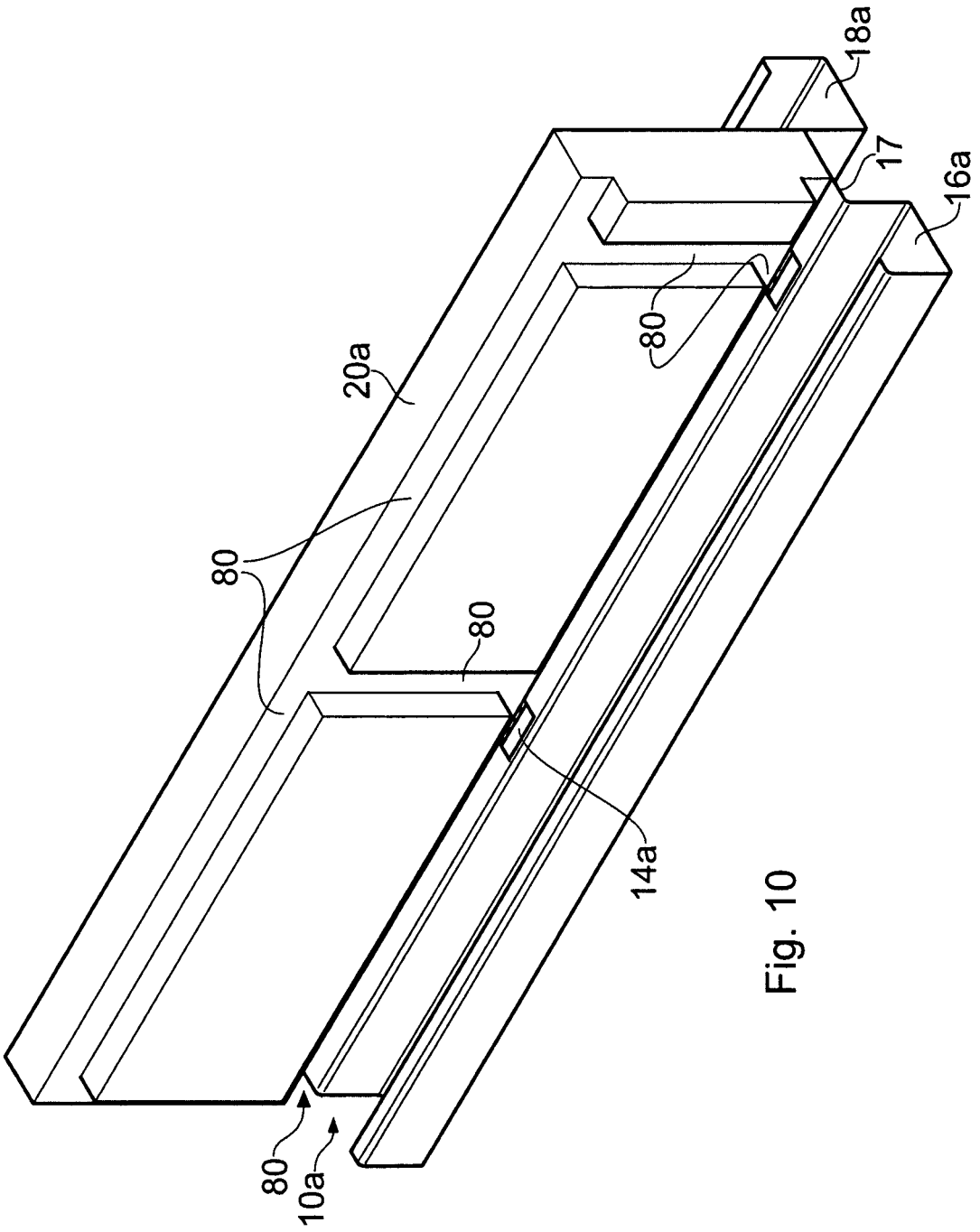


Fig. 10

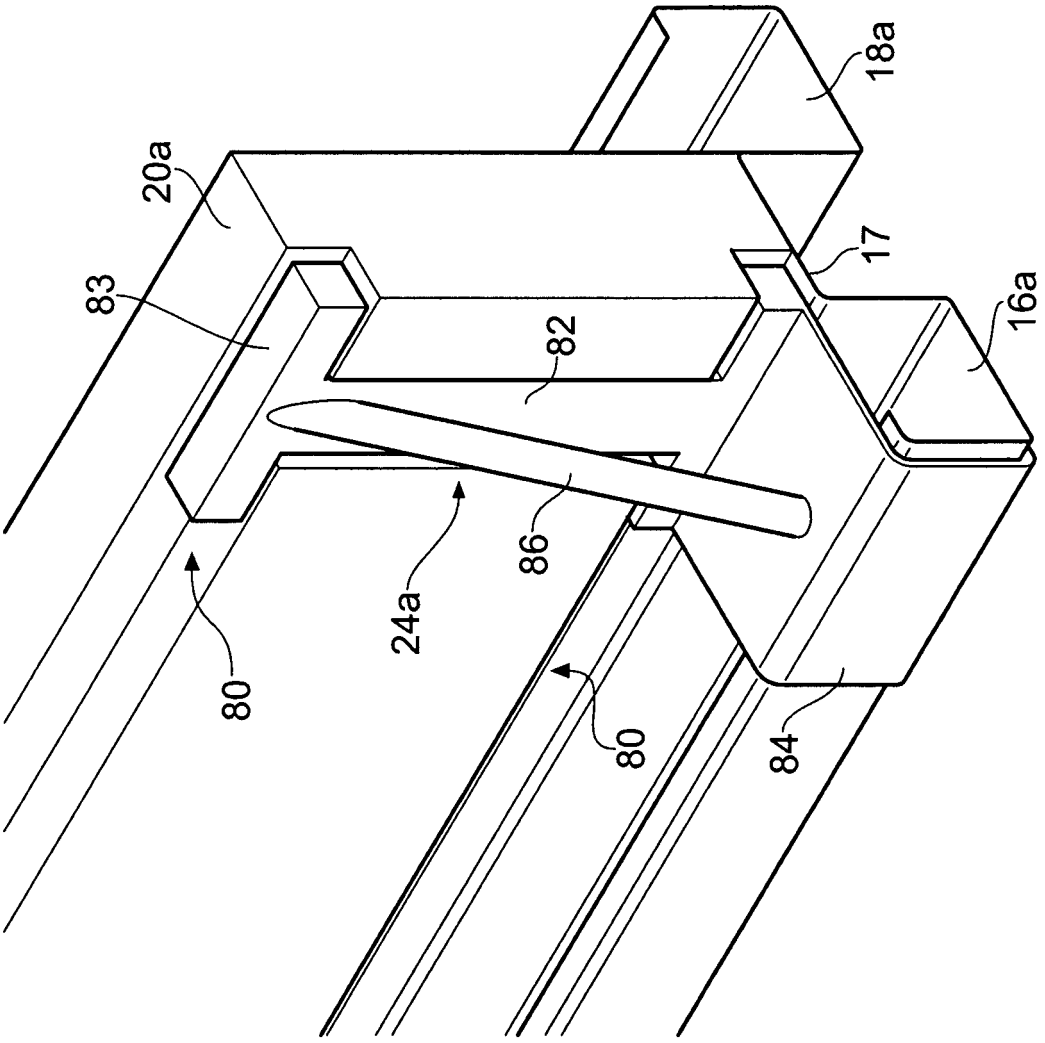


Fig. 11

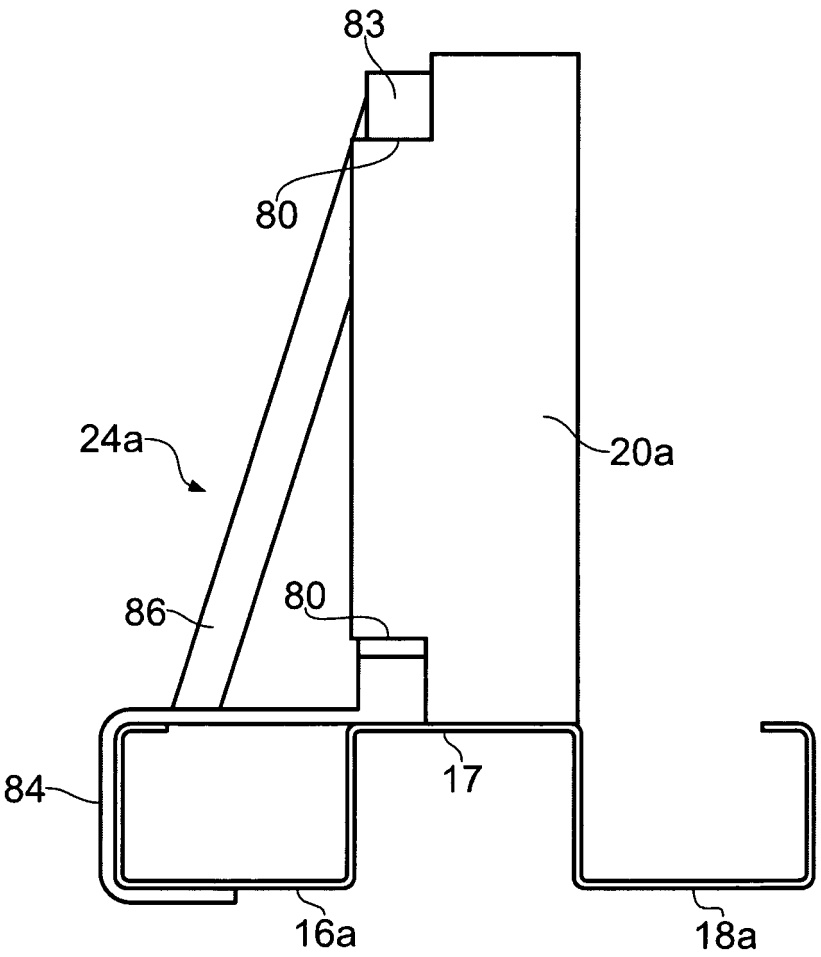


Fig. 12

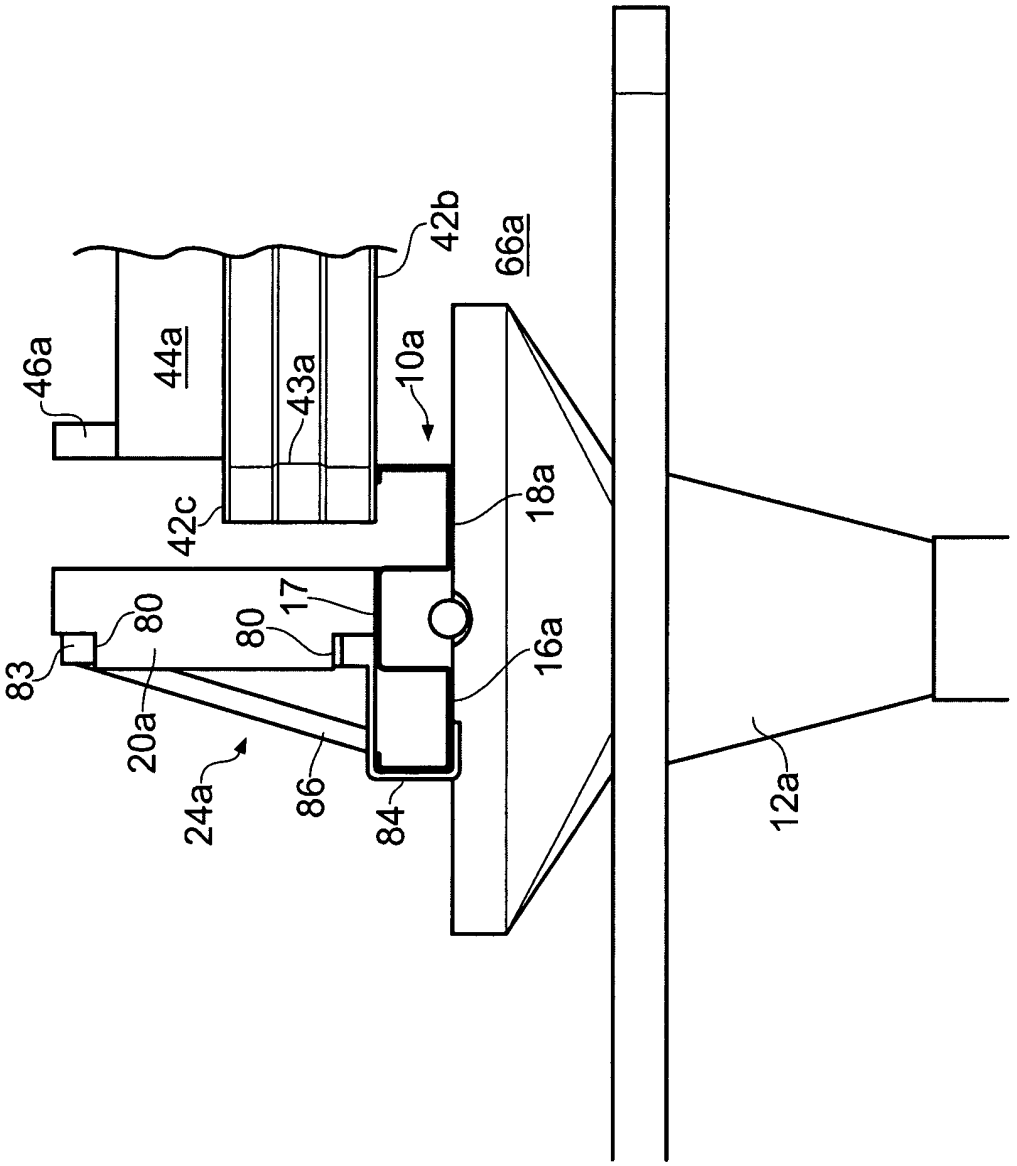
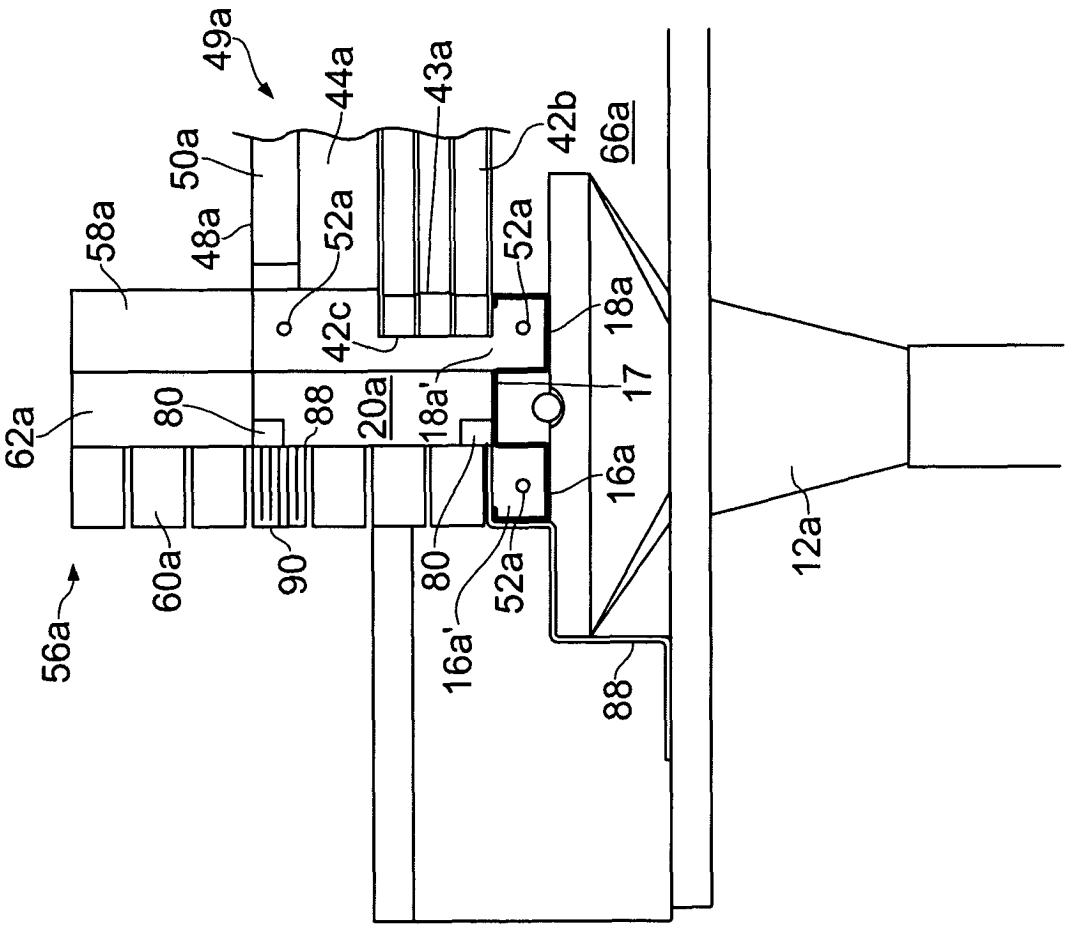


Fig. 13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52a
52a
42c
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20a
18a'
16a
56a
60a
90
80
52a
16a'
88
12a

Fig. 14