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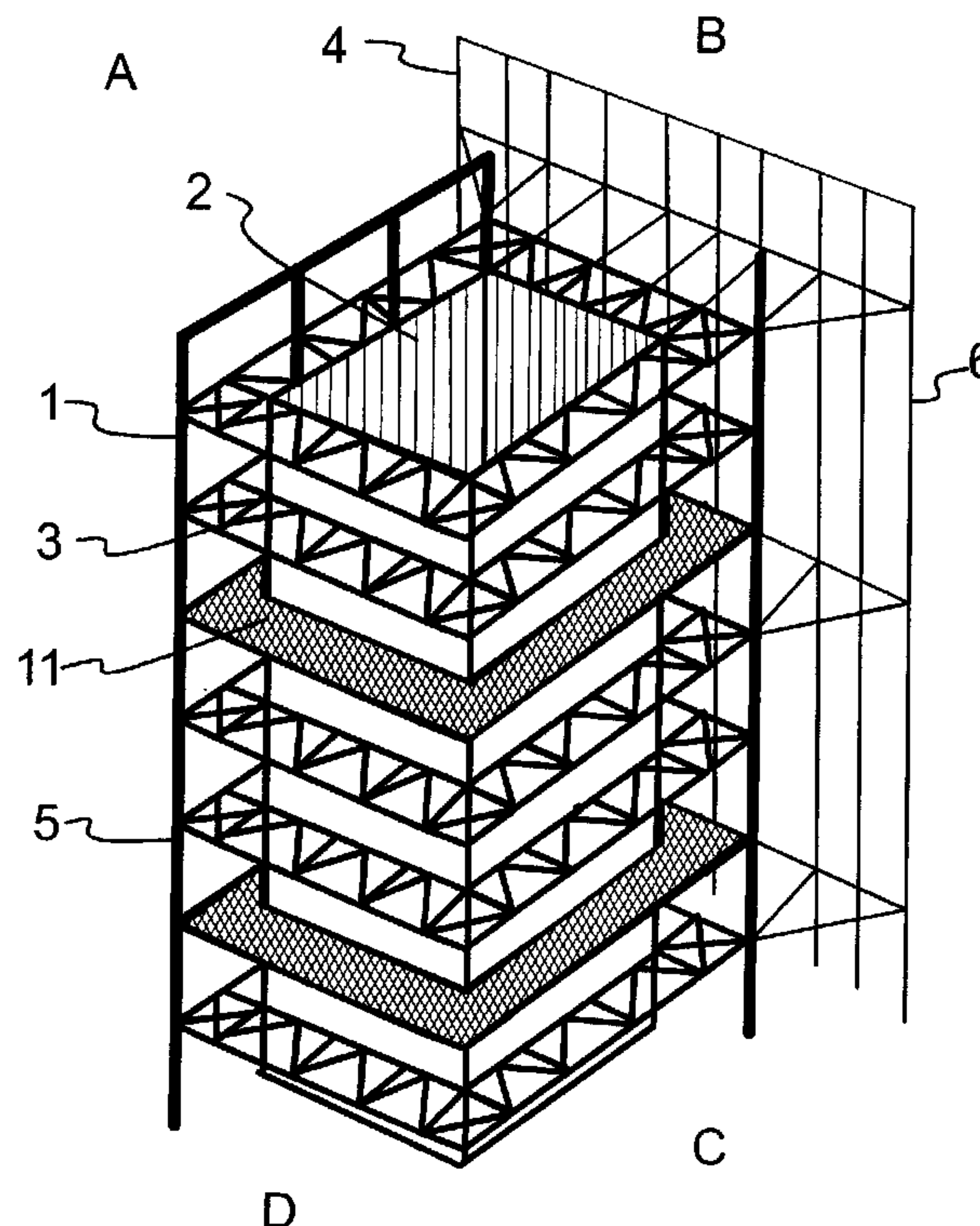
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(54) Title: A BOILER PLANT, A SUPPORT STRUCTURE AND A METHOD FOR SUPPORTING THE WALLS OF A STEAM BOILER OF A BOILER PLANT



(57) Abrégé/Abstract:

A boiler plant, which comprises a boiler (2) and a frame (1) of a boiler house surrounding the boiler. In addition, the boiler plant comprises support structures (3), by which the walls of the boiler (2) are supported laterally to the frame (1) of the boiler house. In addition, the invention relates to a support structure (3) and a method for supporting the walls of a boiler (2) of a boiler plant.



Abstract

A boiler plant, which comprises a boiler (2) and a frame (1) of a boiler house surrounding the boiler. In addition, the boiler plant comprises support structures (3), by which the walls of the boiler (2) are supported laterally to the frame (1) of the boiler house. In addition, the invention relates to a support structure (3) and a method for supporting the walls of a boiler (2) of a boiler plant.

A BOILER PLANT, A SUPPORT STRUCTURE AND A METHOD FOR SUPPORTING THE WALLS OF A STEAM BOILER OF A BOILER PLANT

5 Field of the invention

The invention relates to a boiler plant, a support structure, as well as a method for supporting the walls of a steam boiler.

10 Background of the invention

The boilers of typical boiler plants comprise tubular walls, where water and/or steam circulates. Combustion takes place inside the boiler in a furnace, and as a result of the combustion and gas flows negative
15 pressures and positive pressures may occur in different areas of the boiler. The pressure effect is directed at the walls of the boiler and the walls tend to move. For this reason, different support structures are made in the walls. Typically a support structure is a horizontal buckstay, which circles the outer wall of the boiler. Typically the
20 support ring is formed of a strong steel beam, which is attached to the wall of the boiler in a suitable manner. One known support structure solution is disclosed in US 5,557,901. The boilers of large boiler plants may be several tens of meters high, in which case several support structures are needed. Thus, a great deal of steel is needed for the
25 structures, which causes costs.

Brief summary of the invention

Now a solution has been invented for a combined horizontal support
30 system of a boiler and a boiler building for supporting the walls of a boiler without heavy ring structures. The purpose of the support is to control the pressure effects directed at the boiler wall during use and at the same time the powers directed at the boiler house.

35 To attain this purpose, the boiler plant according to the invention comprises a recovery boiler, a frame of a boiler house surrounding the

- recovery boiler, wherein the boiler plant in addition comprises support structures, by which the walls of the boiler are supported laterally to the frame of the boiler house. The support structure of a wall of a recovery boiler of a boiler plant is arranged to be attached to the wall of the boiler, wherein the support structure is also arranged to be attached to the frame of the boiler house surrounding the recovery boiler laterally. In the method according to the invention the walls of the recovery boiler are supported laterally to the frame of the boiler house by a support structure.
- 10 The different embodiments of the invention can be used in different configurations and in different environments and in connection with boilers using different boiler techniques.
- 15 The basic idea of the invention is to integrate the support structures of the boiler walls to the frame of the boiler house. This is provided in such a manner, that the boiler walls are supported laterally to the frame of the boiler house by a support structure.
- 20 In an advantageous embodiment the support structure comprises attachment areas for attaching the support structure to the boiler wall and the attachment areas allow the horizontal movement of the support structure in relation to the boiler wall. The horizontal movement tends to be created by the thermal expansion of the boiler, and the pressure effects. Preferably the support structure allows the thermal expansion, but substantially prevents movement created by the pressure effect.
- 25 In an embodiment the support structure comprises attachment structure for attaching the support structure to the frame of the boiler house and the attachment structures allow the vertical movement of the boiler wall in relation to the frame of the boiler house. In the height direction the change in the height of the boiler created by thermal expansion can be, for example, 20 to 300 mm.
- 30 In an embodiment the support structure comprises attachment structure for attaching the support structure to the frame of the boiler
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house and the attachment structures allow the support structure to turn vertically in relation to the frame of the boiler house. Thus, the boiler wall can move vertically in relation to the frame, for example, due to the effect of changed in the temperature of the boiler.

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In an embodiment a boiler plant comprises a service platform and a support structure is used as a bearing structure. Thus, separate support structures are not needed for the service platform.

- 10 The different embodiments of the above-described arrangement, taken separately and in various combinations, provide several advantages. One significant advantage of an embodiment is that the structures of a boiler house provide a multiple advantage, because they operate both as a horizontal bracing of both the pressurized frame and the building,
15 and as a structure of a service platforms.

The entire membrane wall of the boiler becomes significantly simpler in comparison to the present structure, because the horizontal support rings are eliminated, and at the same time the isolation and plating of
20 the wall become significantly simpler.

- In an embodiment the span lengths and buckling lengths of steel columns necessary in the frame of a boiler house become significantly shorter. Thus, the bending moments of the columns become smaller.
25 Buckling and transverse buckling do not significantly decrease the allowed bearing stresses either. Due to the solution the amount of steel needed for the columns decreases due to the new structure.

In an embodiment the support solution significantly increases the space for vertical pipe, duct and cable drafts and stairs in the area
30 between the outer wall lines of the house and the boiler stanchions.

- In an embodiment the total volume of the house and the side dimensions decrease due to a decrease in the dimensions of the stanchions. Thus, the boiler plant is easier to place in the environment.
35 In addition, the wind area of the boiler plant can be decreased.

In an embodiment significant cost savings are provided when horizontal support rings and their heavy fastening parts are left out of the boiler.

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A solution according to the invention is primarily intended for supporting large, tens of meters high steam boilers. The solution is especially advantageous when the boiler plant comprises service platforms. Specifically, the invention is advantageous for supporting

10 large recovery boilers. In large recovery boiler plant applications the present solution may provide significant total weight savings in the structures of the boiler pressure parts and structures of the boiler house.

15 Description of the drawings

In the following, the invention will be described in more detail with reference to the appended principle drawings, in which

20 Fig. 1 shows a frame of a boiler house and a boiler according to the invention

Fig. 2 shows a vertical cross-section of an embodiment of a support structure

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Fig. 3 shows a horizontal cross-section of the embodiment according to Fig. 2 on level F3-F3, i.e. seen from above

Fig. 4 shows a detail of a support structure in a vertical cross-section

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Fig. 5 shows a part of the embodiment according to figure 4 in a top view

Fig. 6 shows an embodiment of a support structure

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For the sake of clarity, the figures only show the details necessary for understanding the invention. The structures and details that are not necessary for understanding the invention but are obvious for anyone skilled in the art have been omitted from the figures in order to
5 emphasize the characteristics of the invention.

Detailed description of the invention

Figure 1 shows only those parts of a boiler plant that are necessary for describing the invention. These are the frame 1 of a boiler house, a
10 boiler 2 and a support structure 3. In addition, other structures are required in the boiler plant, *inter alia* for supplying fuel and air, and for processing flue gases. In addition, there are often different structures for use and maintenance work. In figure 1 the frame 1 of the boiler
15 plant is for clarity shown only on one side, i.e. side A, even though the frame in practice is on each side. Correspondingly, the support structure 4 of an outer screen is shown only on side B of the boiler house, even though such a frame is advantageously on every screened side. Sides C and D of the boiler house do not show the
20 frame 1 of the boiler house, nor the screening frame 4, in order to shown the location of the support structures 3 more clearly. The frame 1 of the boiler house comprises vertical boiler columns 5. The screening frame 4 comprises vertical outer wall columns 6. In figure 3, which shows a horizontal cross-section of the embodiment according to
25 Figure 2 on level F3-F3, i.e. seen from above, can be seen the location of the screening frame 4, the frame 1 and the support structure 3 around the boiler 2 in an embodiment. Thus, the above-mentioned structures surround the boiler 2 horizontally on each side A, B, C and D. Figure 2, in turn, shows that the screening frame 4 can be attached
30 to the frame 1 by a differently dimensioned spacing than the support structures 3.

The frame 1 of the boiler house is a support structure, to which the other structures of the boiler plant can be attached. For example, it is
35 possible to suspend the boiler 2 from the upper part of the frame 1 above the boiler. The frame 1 is generally made of steel beams and

- columns. The frame 1 generally comprises vertical, horizontal and diagonal beam and columns parts. For example, a boiler plant with a boiler 2 that is 18 x 18 meters in its bottom area, in an application comprises boiler columns 5 with a six meter spacing. Horizontal truss beams 3, in turn, are placed with approximately a 3 meter spacing. The stanchions are supported vertically with a significantly denser spacing than in traditional boiler plant houses, where horizontal bracing levels are typically every 12 meters (10...18 m) vertically.
- 10 The walls of a boiler 2 of a boiler plant are typically membrane walls, where a medium can be circulated. Due to the great height of the wall, in order to reach a sufficient bracing and pressure endurance, support structures 3 supporting the wall 2 of the boiler laterally are necessary. In the example according to figure 1 the walls of the boiler 2 are
- 15 supported laterally to the frame 1 of the boiler house by support structures 3. The support structures 3 are advantageously formed in such a manner that they allow the thermal expansion of the walls of the boiler 2.
- 20 In high boilers 2 the height direction distance of the adjacent support structures 3 can be 2 to 5 meters, advantageously 3 to 3 meters. Preferably the distance of the support structures is selected to correspond to the spacing of the horizontal beams of the frame 1. Thus, the support structure 3 is substantially located on the same level
- 25 as the horizontal beam of the frame 1. The distances of the support structures 3 may also vary. For example, the support structures 3 may be positioned more densely in those areas, where a larger load is directed, for example, due to pressure fluctuations.
- 30 It is advantageous to place the support structures 3 on a horizontal plane on all walls. In some cases it may be necessary to place support structures 3 only on some of the walls, but still, a support structure 3 can be placed between the frame 1 of the boiler house, preferably the boiler stanchions 5, and the wall of the boiler 2.

The support structures 3 can be provided in various ways. In one application the support structure 3 is substantially as wide as the wall of the boiler 2. In one application the part of the support structure 3 placed against the boiler 2 wall substantially has the width of the boiler wall and the part located further away from the wall is wider. For example, figure 3 shows such an embodiment, where the ends of the support structure 3 are in a angle of approximately 45° in relation to the wall line, in which case the ends of the support structures placed on adjacent walls are parallel.

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In an embodiment the support structure 3 is a truss structure. In one case the truss structure is formed of two beams located parallel to the wall of the boiler 2, between which there are diagonal beams. In addition, the truss structure may comprise beams that are perpendicular to the wall of the boiler. The beams are connected to each other in a suitable manner, such as, for example, by welding and/or with bolted joints. Preferably the beams are, for example, rectangular pipes, in which case the strength in relation to their weight is advantageous.

20

The support structure 3 can be connected to the boiler 2 wall in different ways. In the example, the support structure 3 comprises attachment areas 7, to which areas the wall of the boiler 2 is connected from the attachment points 8 on the boiler walls in the height direction. The distance between the adjacent attachment areas 7 and attachment points 8 depends on the application. Advantageously the distance between the attachment areas 7 and the attachment points 8 is 0,5 to 2 meters horizontally, preferably approximately 1 meter, and of the boiler the above-mentioned 2 to 5 meters, preferably 3 to 4 meters. The dimensioning is affected by, inter alia, the bracing of the walls of the boiler 2 and pressure loads.

In the example the attachment areas 7 of the support structure 3 comprise flanges. The attachment points 8 of the boiler walls, in turn, also comprise flanges. In addition to, or instead of the flanges the attachment areas 7 and the attachment points 8 may comprise different

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brackets, cavities, grooves, dents, pins, possibly springs, or other solutions suitable for connecting. Now, flanges are used as an example, because they have been found advantageous as they provide versatile application possibilities.

5

The overall dimensions of the wall of the boiler 2 change due to the effect of temperature, especially in the corner areas. In the height direction the change in the height of the boiler 2 can be, for example, 20 to 300 mm. Laterally the change in the width of the boiler 2 can be, for example, 5 to 30 mm. It is advantageous to take into account the changes in the dimensions of the boiler 2 walls in the support structure 3 and/or its attachment to the boiler wall.

The vertical changes in the dimensions of the boiler 2 can be taken into account, *inter alia*, by attaching the support structure 3 by means of hinges or articulations to the boiler and the frame 1. Thus the hinge/articulation enables the movement of the boiler 2 wall in relation to the frame 1. One such an attachment structure 9 is shown in figure 4. In the example the attachment structure 9 is between the support structure 3 and the frame 1 of the boiler house and it allows the vertical turning of the support structure in relation to the attachment structure 9.

In order to take the vertical change into account, the support structure 3 can originally be placed diagonally, in which case it is substantially horizontal when the boiler 2 operates. In one embodiment, where the boiler 2 is suspended from above, the lower support structures 3 of the support system are more diagonal than the upper support structures when the boiler is cold. When the boiler 2 is hot, all the support structures 3 are substantially horizontal when the lower part of the boiler has moved more in relation to the frame 1 than the upper part.

The support structure 3 can originally be placed horizontally as well, in which case it is slightly diagonal when the boiler 2 operates.

For example, when the attachment point of a 3000 mm wide support structure 3 and/or one edge of the platform changes 50 mm in height

direction, the inclination of the support structure and/or the platform changes about one degree.

5 The horizontal changing of boiler 2 dimension can be take into account in different ways in the support structure. For example, the support structure 3 may allow the movement in relation to the support structure caused by the thermal expansion of the boiler 2 wall. Different solutions allowing the movement can be provided in the support structure 3 and advantageously movement into a certain direction only is allowed. For
10 example, different slide solutions can be used, where the wall of the boiler 2 may move in relation to the support structure 3 on a certain path defined by the slide. In an embodiment the thermal expansion of the boiler 2 wall is taken into account by elongated holes 10 of the attachment area 7 of the support structure 3 and/or the flanges of the
15 attachments points 8 of the boiler, such as shown, for example, in figure 5. The holes 10 are advantageously diagonal in the direction of change of the dimensions, in which case the hole 10 enables the movement of the wall of the boiler 2 in relation to the frame 1. Figure 6 shows how the inclination of the holes 10 may change depending on
20 what point of the boiler 2 wall they are located at. In the example the direction of movement allowed by the attachment area located in the middle of the boiler wall is mainly perpendicular to the wall, while on the edge areas movement in the direction of the wall is allowed in addition to the perpendicular movement. When the hole 10 is diagonal
25 in relation to the wall of the boiler 2, the hole prevents a sudden perpendicular movement of the wall, i.e. such a movement typically caused by a pressure effect.

30 In addition, other functions may be connected to the support structure, or it may be used to for other purposes besides supporting. In one embodiment the support structure 3 operates as a bearing structure for service platforms 11. Figure 1 shows a boiler plant, where two support structures 3 operate as a bearing structure for service platforms 11. Thus, a suitable platform may be placed on the support structure 3,
35 such as, for example, a grate or a plate, which enables moving in the area. In addition, the service platform 11 may comprise the necessary

auxiliary and shielding structures, such as rails, attachment points and toe mouldings. The service platform 11 may circle around the boiler 2 being placed on its every wall. It is also possible to make a partial service platform 11, in which case the service platform may be, for example, on one or more walls of the boiler 2 and/or only on a part of the boiler wall. Advantageously the service platform 11 is at the location of the target to be serviced.

Due to the support structure the isolation and cladding of the membrane wall of the boiler 2 becomes simpler in comparison to the solutions with buckstays. Since the boiler 2 wall is substantially straight, its outer surface can be isolated and cladded relatively simply. Only holes at the attachment points 8 are needed in the cladding. Sheet metal cladding is typically used as cladding. Figures 4 and 5 show one manner for placing the insulator 12 and the cladding 13.

The support structures 3 can be formed in the construction phase at the construction site. Advantageously the support structures 3 are ready modules, which are attached to the boiler 2 wall and the frame 1 of the boiler house at the construction site. Thus, the time used in constructing the boiler house can be decreased. Figure 6 shows a support structure module 3, which comprises attachment areas 7 and attachment structures 9. The attachment areas 7 are for attaching the support structure 3 to the wall of the boiler 2. The attachment structures 9 are for attaching the support structure 3 to the frame 1 of the boiler house. The attachment areas 7 advantageously enable the horizontal movement of the support structure 3 in relation to the wall of the boiler 2, for example in order to allow the thermal expansion of the boiler wall. The attachment structures 9 advantageously enable the vertical movement of the boiler wall 2 in relation to the frame 1 of the boiler house. For example, the attachment structures 9 allow the vertical turning of the support structure 3 in relation to the frame 1 of the boiler house. It is possible to form the support structure 3 of several modules as well, in which case the support structures around large boilers can be manufactured elsewhere and transported easily to the

construction site, where they are assembled into a larger support structure.

By combining, in various ways, the modes and structures disclosed in
5 connection with the different embodiments of the invention presented
above, it is possible to produce various embodiments of the invention
in accordance with the spirit of the invention. Therefore, the above-
presented examples must not be interpreted as restrictive to the
invention, but the embodiments of the invention may be freely varied
10 within the scope of the inventive features presented in the claims
hereinbelow.

Claims:

1. A boiler plant, which comprises
 - a recovery boiler,
 - 5 - a frame of a boiler house surrounding the recovery boiler,wherein the boiler plant in addition comprises support structures, by which the walls of the boiler are supported laterally to the frame of the boiler house.
- 10 2. The boiler plant according to claim 1, wherein the support structure comprises attachment areas for attaching the support structure to the wall of the recovery boiler and the attachment areas allow the horizontal movement of the support structure in relation to the boiler wall.
- 15 3. The boiler plant according to claim 1, wherein the support structure comprises attachment structures for attaching the support structure to the frame of the boiler house and the attachment structures allow the vertical movement of the wall of the boiler in relation to the frame of the boiler house.
- 20 4. The boiler plant according to claim 1, wherein the support structure comprises attachment structures for attaching the support structure to the frame of the boiler house and the attachment structures allow the vertical turning of the support structure in relation to the frame of the boiler house.
- 25 5. The boiler plant according to claim 1, wherein the support structure is also a bracing structure, which braces the boiler house horizontally.
- 30 6. The boiler plant according to claim 1, wherein the boiler plant comprises a service platform and the support structure is a part of the bearing structure of the service platform.
- 35 7. A support structure of a wall of a recovery boiler of a boiler plant, which structure is arranged to be attached to the wall of the boiler,

wherein the support structure is also arranged to be attached to the frame of the boiler house surrounding the recovery boiler laterally.

5 8. The support structure according to claim 7, wherein the support structure comprises attachment areas for attaching the support structure to the wall of the recovery boiler and the attachment areas allow the horizontal movement of the support structure in relation to the boiler wall.

10 9. The support structure according to claim 7, wherein the support structure comprises attachment structures for attaching the support structure to the frame of the boiler house and the attachment structures allow the vertical movement of the wall of the boiler in relation to the frame of the boiler house.

15 10. The support structure according to claim 7, wherein the support structure comprises attachment structures for attaching the support structure to the frame of the boiler house and the attachment structures allow the vertical turning of the support structure in relation to the frame
20 of the boiler house.

11. The support structure according to claim 7, wherein the support structure is arranged to brace the boiler house horizontally.

25 12. The support structure according to claim 7, wherein the support structure is arranged to function as a support structure of a service platform.

30 13. A method for supporting the walls of a recovery boiler of a boiler plant, which boiler plant comprises at least a frame of a boiler house and a recovery boiler, wherein the walls of the recovery boiler are supported laterally to the frame of the boiler house by a support structure.

35 14. The method according to claim 13, wherein the support structure is used as a support structure of a service platform.

15. The method according to claim 13, wherein the support structure is used to brace the boiler house horizontally.

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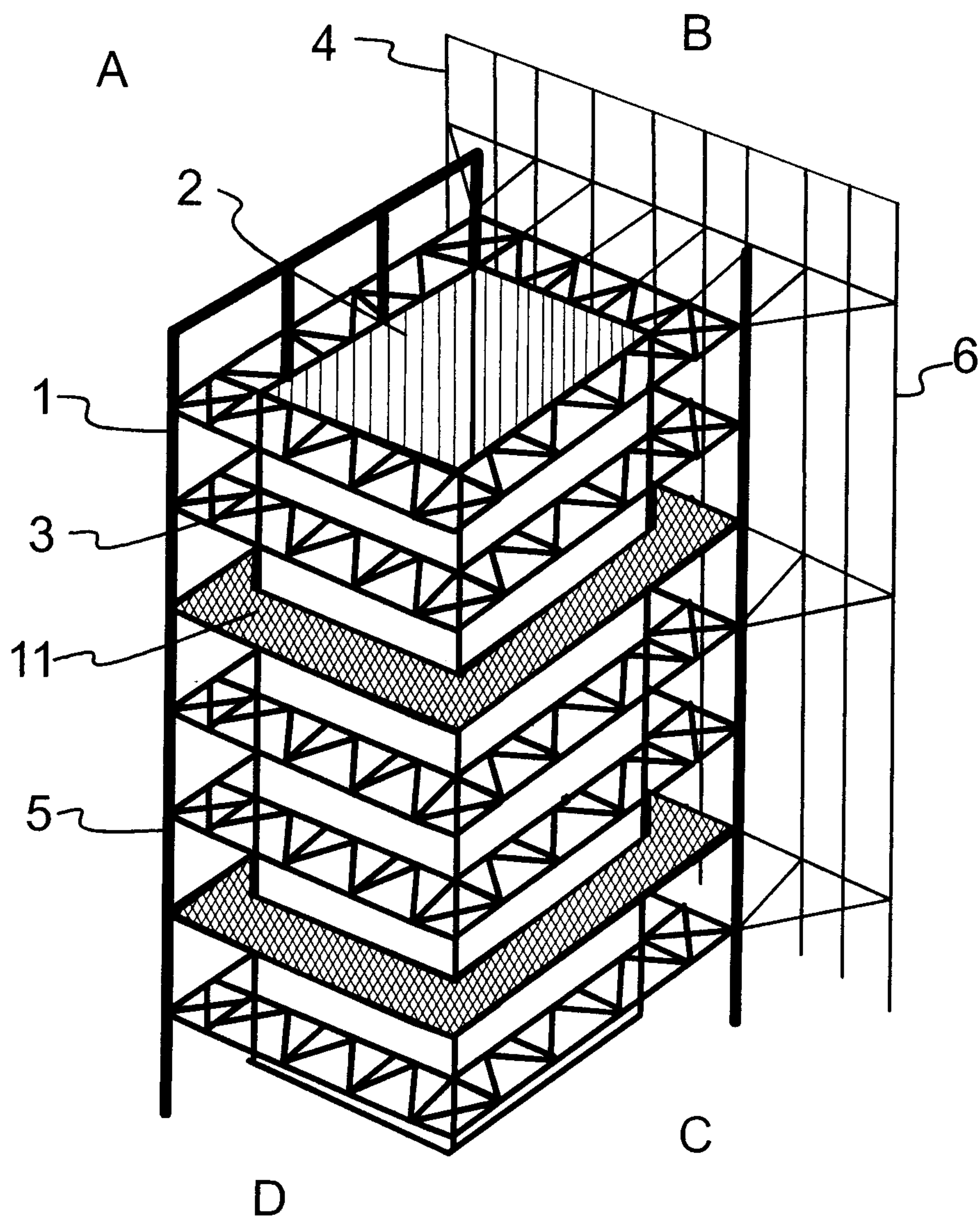


Fig. 1

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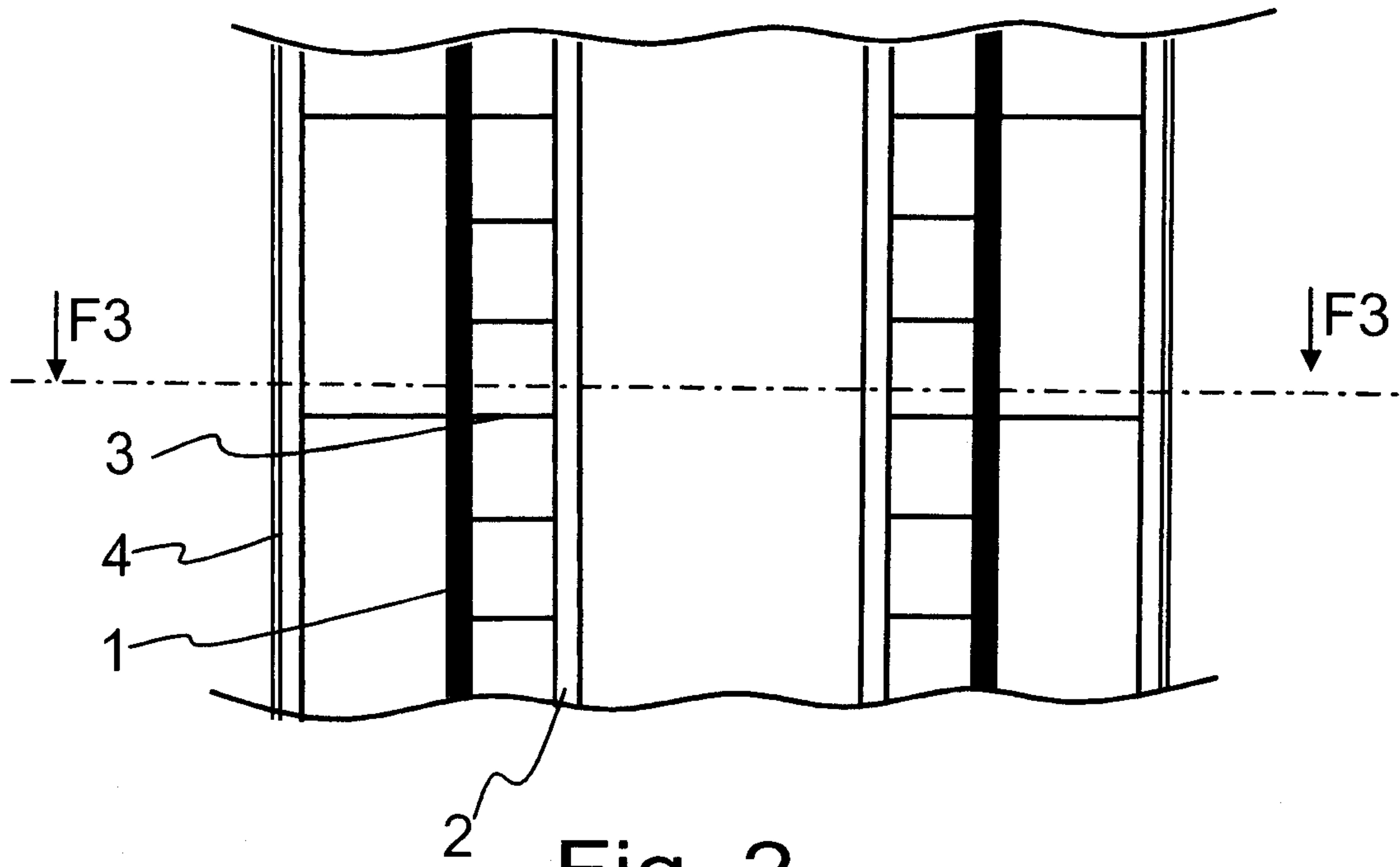


Fig. 2

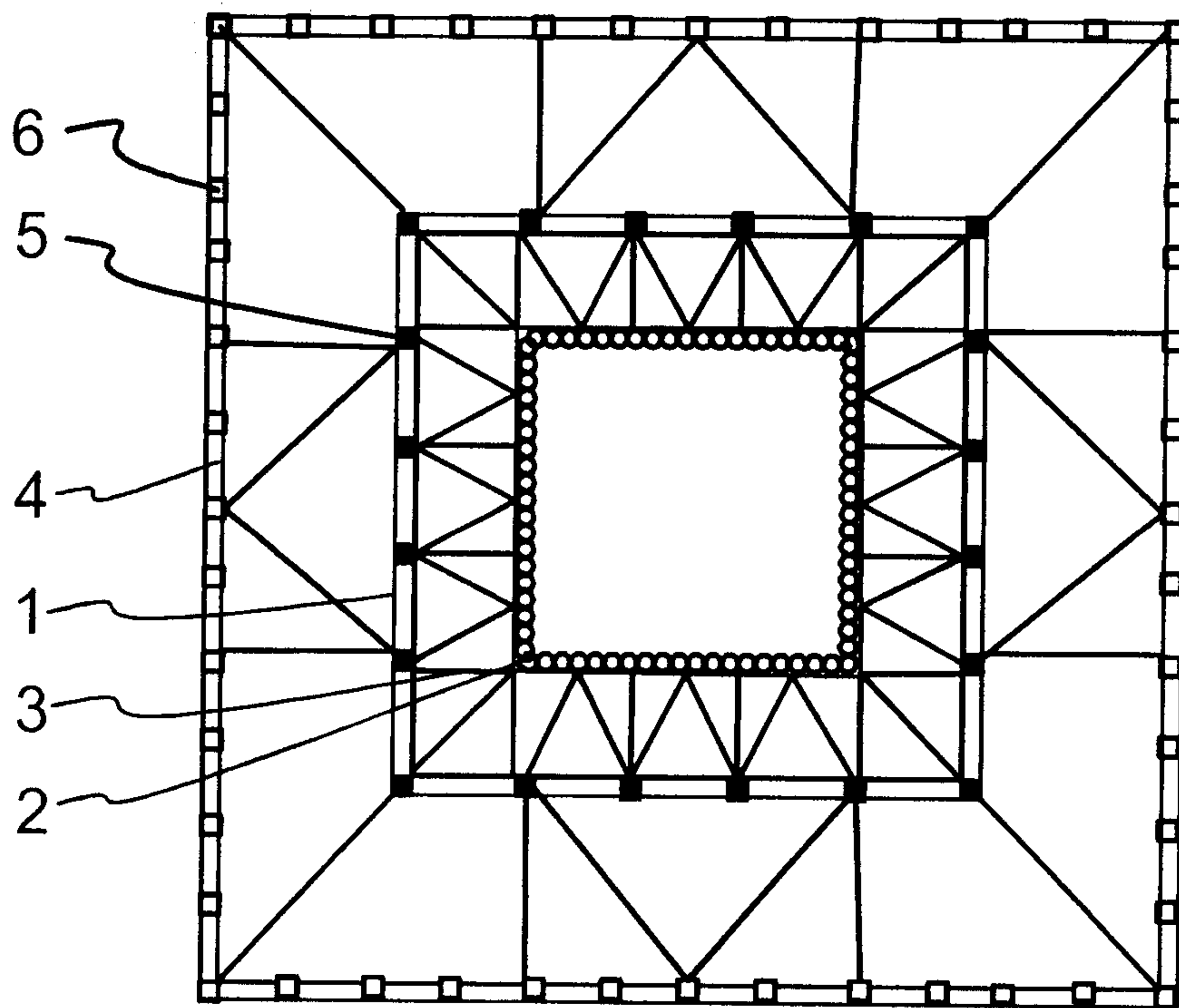


Fig. 3

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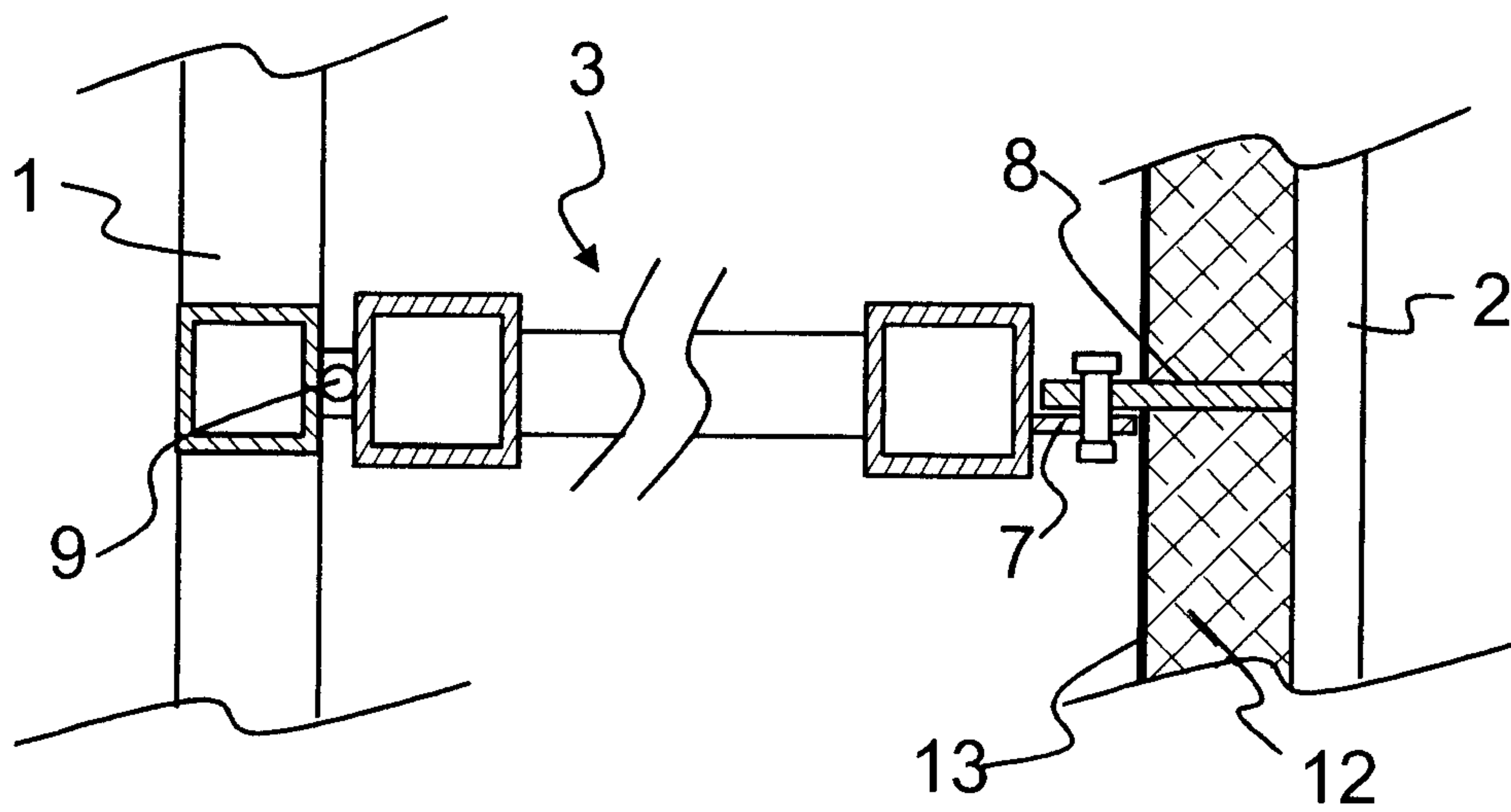


Fig. 4

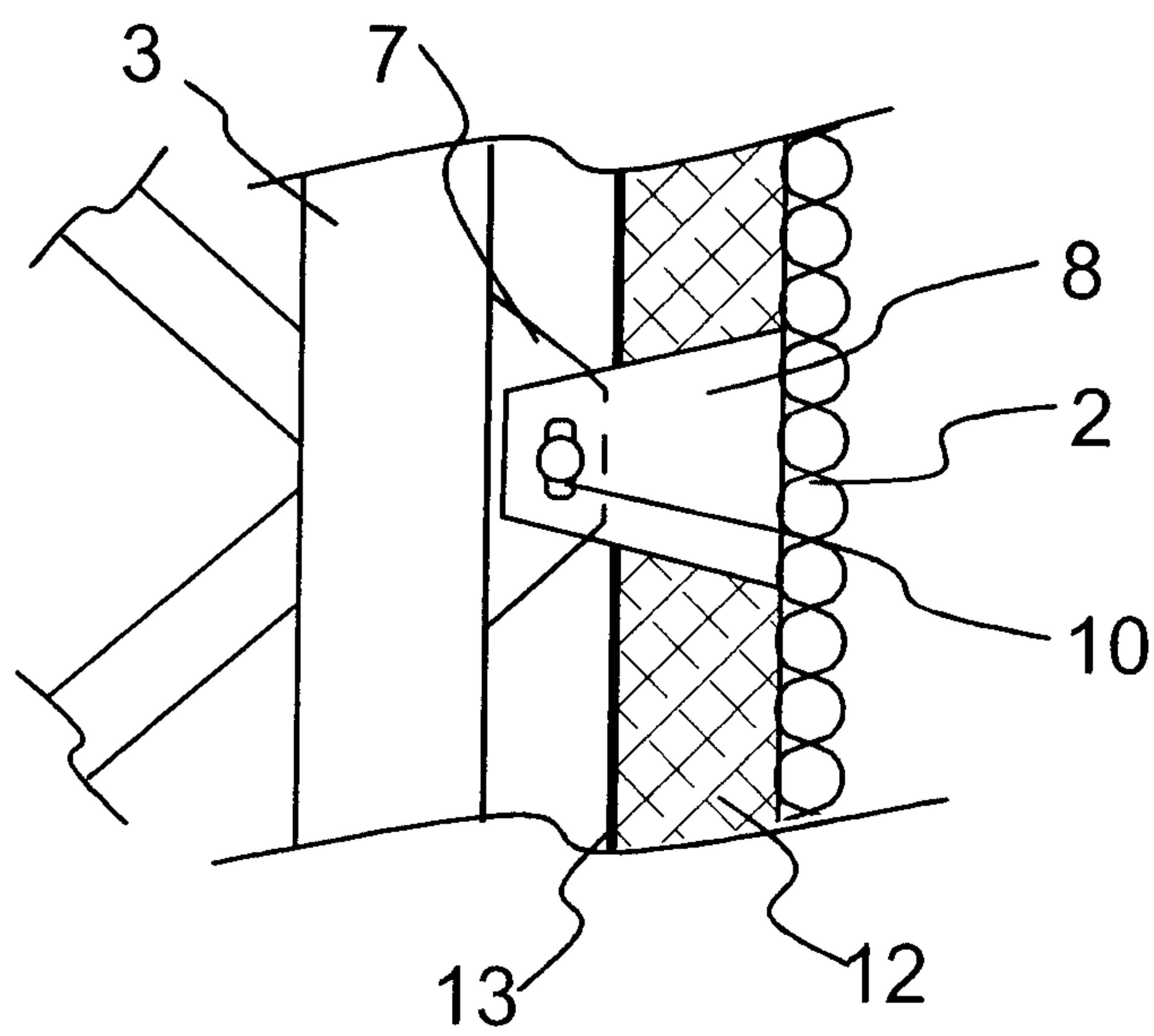


Fig. 5

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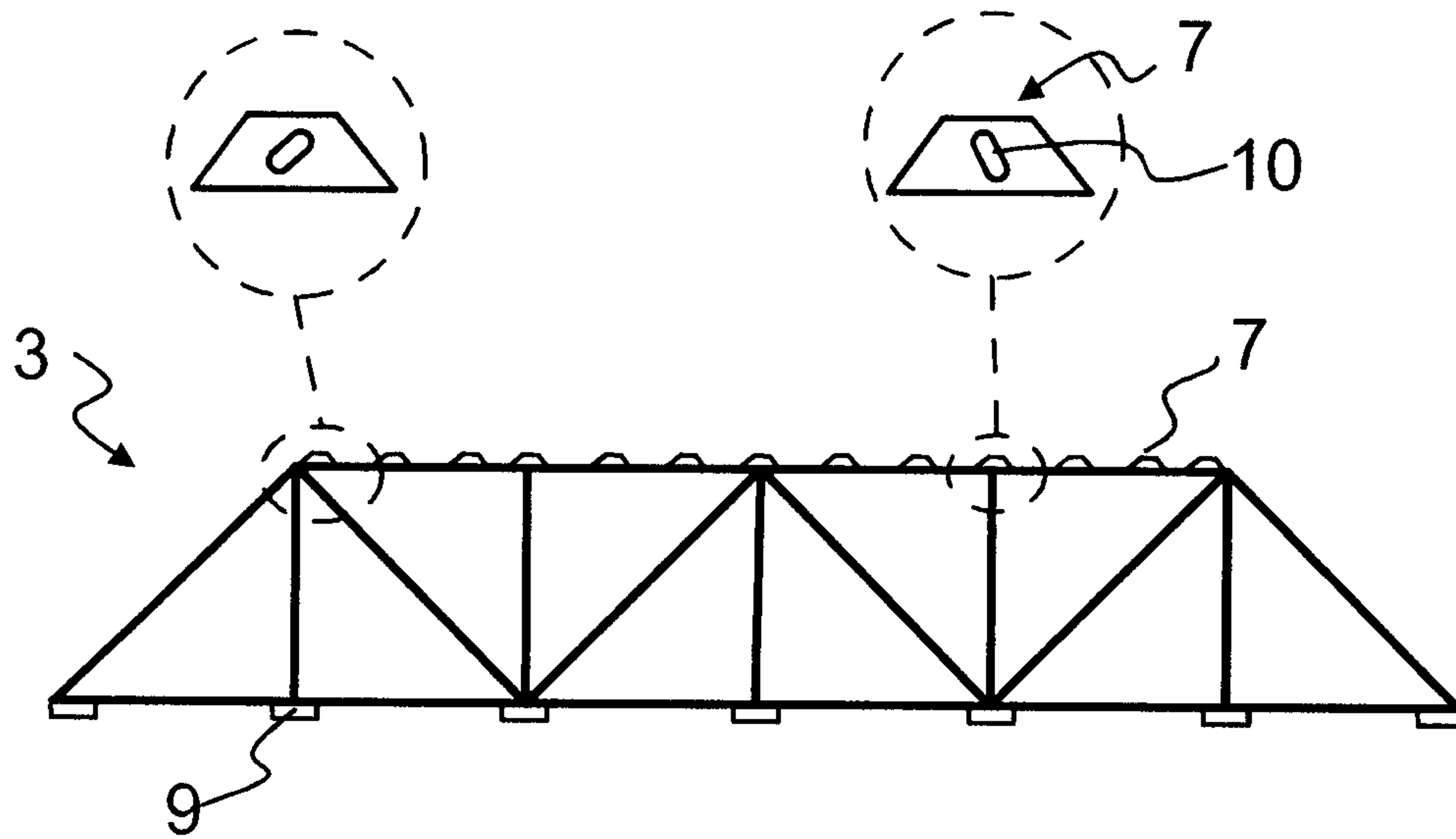


Fig. 6

