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(72) Inventeurs/Inventors:
ZAN, LEONARDO, IT;
CRESCENZI, FRANCESCO, IT

(73) Propriétaires/Owners:
ENI S.P.A., IT;
SNAMPROGETTI S.P.A., IT;
ENITECNOLOGIE S.P.A., IT

(74) Agent: ROBIC

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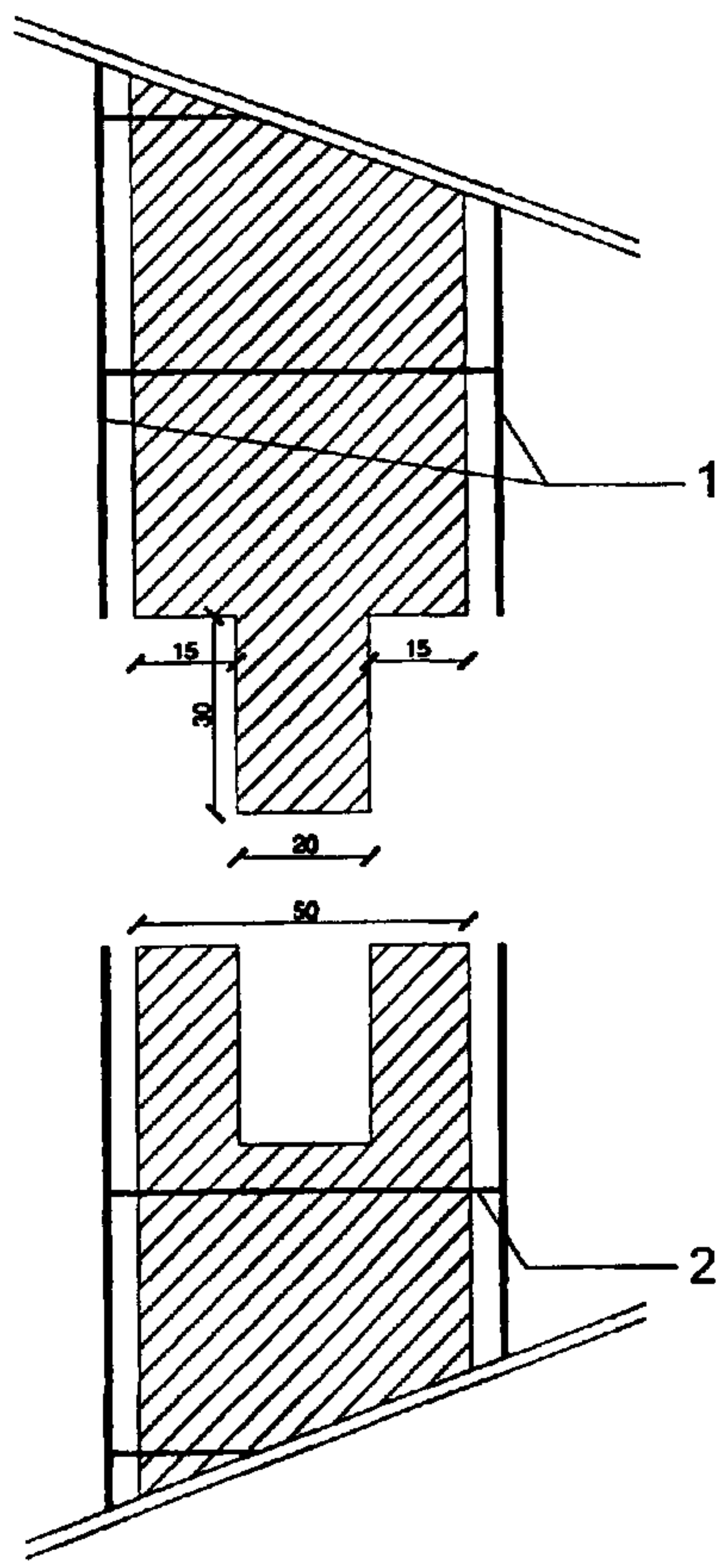


(57) Abrégé/Abstract:
A process is described for the zero emission storage of sulphur, using a storage tank made up of one or more levels, characterized in that said storage tank, having an impermeable bottom, essentially consists of reinforced EPS (expanded polystyrene) panels.

Abstract

A process is described for the zero emission storage of sulphur, using a storage tank made up of one or more levels, characterized in that said storage tank, having an impermeable bottom, essentially consists of reinforced EPS (expanded polystyrene) panels.

PROCESS FOR THE ZERO EMISSION STORAGE OF SULPHUR

The present invention relates to a process for the zero emission storage of sulphur by making use of suitable panels.

Sulphur, obtained in the liquid state from hydrocarbon fields through the Claus process, is currently stored as large dimensional blocks (in the order of hundreds of meters). These blocks are formed using aluminum panels which are removed after solidification of the sulphur (Pouring), thus leaving huge volumes of material exposed to the atmosphere.

These storage methods of the known art create various environmental problems relating to:

- structural yielding, material collapse and direct erosion with the consequent removal of fine particles;
- formation of sulphuric acid by the action of bacteria, with a polluting effect on the soil and water table.

We have now found a process that makes use of suitable panels, which allows the problems relating to the technologies of the known art currently adopted for sulphur storage, to be overcome.

The object of the invention is a process for zero emission storage of sulphur, using a storage tank having one or more levels, said storage tank comprising:

an impermeable bottom; and

reinforced expanded polystyrene EPS panels;

said reinforced EPS panels having plastered inner and outer walls; and

said reinforced EPS panels consist of an expanded polystyrene sheet sandwiched between two electro-welded networks made up of horizontal and vertical galvanized or stainless steel wires, said networks being connected by galvanized or stainless steel orthogonal wires.

More specifically, the object of the invention is a process for zero emission storage of sulfur, using a reinforced EPS storage tank having one or more levels and impermeable bottom, the process comprising:

preparing a bottom suitable for sustaining upper loads;

preparing an impermeable storage tank bottom, equipped with collecting containers for rain and percolated water;

positioning and interconnecting reinforced EPS panels to form a first level of the storage tank;

plastering the inner walls of said EPS panels;

pouring liquid sulfur until the first level of the storage tank is filled;

covering horizontal surfaces of the sulfur exposed to an atmosphere using materials preventing exposure of the sulfur to an atmosphere; and

plastering outer walls of the storage tank.

The invention and its advantages will be better understood upon reading the following description made with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a sectional view of a detail of the male-female joint of the prefabricated panels where (1) are wire nettings and (2) is the wire for seams.

Figure 2 shows binding to an upper panel, by plain detail of the edge of the sulphur storage tank, where (3) is the outer electro-welded network, (4) is the angle consisting of the electro-welded network folded for connecting the outer wall of the panels and (5) is the angle of the electro-welded network folded for connecting the inner wall of the panels (in contact with the sulphur).

Figures 3 and 4 show two different connections between vertical panels where (2) is the wire for seams, (3) is the outer electro-welded network and (6) is the outer electro-welded network in contact with sulphur.

Figure 5 shows connections between angular elements and metallic networks of panels where (2) is the wire for seams, (3) is the outer electro-welded network and (6) is the outer electro-welded network in contact with sulphur.

DESCRIPTION OF PREFERRED EMBODIMENTS

Preferably, the process according to the invention is characterized in that it comprises the following steps of:

- preparing a bottom suitable for sustaining upper loads;
- preparing an impermeable storage tank bottom, equipped with collecting containers for rain and percolated water;
- positioning and interconnecting the reinforced EPS panels for forming a first level of the storage tank;
- plastering the inner walls of said panels;
- pouring liquid sulphur until the first level of the storage tank is filled;
- optionally further positioning and interconnecting reinforced EPS panels for forming further levels of the storage tank, followed by plastering the inner surfaces of said panels and subsequent pouring liquid sulphur until each further level of the storage tank is filled;
- covering horizontal surfaces of sulphur exposed to an atmosphere, by means of suitable materials; and
- plastering outer walls of the storage tank.

The plastering of the inner/outer walls of said panels is preferably effected with mortar cement or epoxy resins.

The covering of the horizontal surfaces of sulphur is preferably effected:

- by means of reinforced polystyrene,
- by means of polyethylene (PE) sheet;or
- by putting them in contact with soluble inorganic salts having concentrations ranging from 0.4 N to saturation, and possibly subsequently shielded by a suitable covering.

The light modular panels consist of reinforced expanded polystyrene, preferably a slab of expanded polystyrene (EPS) sandwiched between two electro-welded networks made of horizontal and vertical stainless or galvanized steel wire.

The two electro-welded networks are connected by galvanized or stainless steel wires, perpendicular to the net surfaces: in this way a framework is produced, which blocks both the joint rotations and relative longitudinal and transverse movements between the two electro-welded networks, thus creating a plate effect which provides the element with a considerable non-deformability.

The weight of said panels preferably ranges from 4 to 15 kg/m^2, more preferably from 4 to 10 kg/m^2, which allows easy handling and positioning of the panels.

The panels are preferably made "singly" (EPS sheet between two electro-welded and interconnected networks), but can also be made "doubly" (two single panels connected with electro-welded steel wires, at a distance preferably ranging from 8 to 25 cm).

The density of said panels preferably ranges from 15 to 25 kg/m^3, more preferably from 20 to 25 kg/m^3.

The polystyrene contained in the panels can be suitably shaped into corrugated and/or Greek-key plates, having a thickness preferably not less than 4 cm.

The steel or stainless steel wire preferably has a breaking point ftk ≥ 540 N/mm^2 (Fe B 44 k).

The thickness of the horizontal, vertical or orthogonal wieres is preferably equal to or higher than 3 mm, more preferably equal to or higher than 4 mm.

The networks preferably have square meshes equal to or less than 10 x 10 cm.

The electro-welded network can be possibly folded to connect the angular fixing elements to the tank edges.

With respect to covering the horizontal surfaces of the sulfur by putting them in contact with inorganic salts, it should be noted that this has already been described in patent application IT-MI2003A000882 which claims a method for inhibiting the acidification of water which comes into contact with materials containing sulfur in reduced form or with elemental sulfur, susceptible to oxidation on the part of Thiobacilli, which comprises putting these materials in contact with soluble inorganic salts at concentrations ranging from 0.4 N to saturation.

Inorganic salts, at the above concentrations, exert a bacteriostatic action on the Thiobacilli, preventing the lowering of the pH which remains close to neutrality.

In order to obtain the necessary effect for inhibiting acidification, inorganic salts can be used which are harmless from an environmental point of view, such as chlorides, sulfates, nitrates of mono or bivalent cations at concentrations ranging from 0.4 N to saturation.

NaCl is preferably used, at a concentration ranging from 0.5 equivalents/litre to saturation.

If the salt concentration is brought, by dilution, to levels lower than those necessary for inhibition, the acidification is normally re-established. In order to obtain the desired effect, it is therefore necessary to maintain the concentration of the solution in contact with the

Thiobacilli at the established levels. For these storage systems, it is advisable to prevent the salt from being washed away from the surface of the sulfur by protecting it with an adequate covering.

This can be possibly achieved with an impermeable material, which is effective in preventing the salt from being washed away, bearing in mind, in the engineering phase, the possibility of the accumulation of toxic gases.

Alternatively, a low cost covering can be produced with inert granulated materials having a suitable thickness, possibly containing small quantities of hydraulic ligands to prevent their erosion. Said covering is permeable to gases and effective for preventing the salt from being washed away.

For this purpose, materials of the type: sand, gravel, pozzolan, have proved to be effective materials and, as ligands, lime or cement. Alternatively, soil or excavation materials can be used.

An example is provided, which represents an embodiment of the present invention, but which should not be considered as limiting its scope.

Example

The following example relates to the storage of 10 m^3 of sulfur by the production of a tank with reinforced expanded polystyrene panels according to the invention.

- Preparation of the panels

The prefabricated panels have the following properties (see figure 1, which shows a sectional view of a detail of the male-female joint:

- Density of the polystyrene: 20 kg/m^3;
- Thickness of the polystyrene: 50 mm;
- Shape of the polystyrene: Greek-key profile;
- Thickness of the joint: 20 mm;
- Height of the joint: 30 mm;
- Vertical wire diameter: 6 mm;
- Horizontal wire diameter: 6 mm;
- Wire diameter for seams: 4 mm;
- Metallic network mesh dimensions: 8 x 8 cm.

Two simple panels having a height of 1200 mm and a length of 3000 mm; the polystyrene is shaped into Greek-key sheets with joints of the male-female type for the vertical connections and at the edges; the internal steel network (which will come into contact with the sulfur) is of the stainless steel type, the outer steel network is of the galvanized type, the steel for the seams is of the stainless steel type. The internal metallic network is folded at a right angle for a length of 30 cm approximately, the outer network is extended with respect to the polystyrene head by about 30 cm to allow the subsequent binding with the upper panel (see figure 2). Said panels are inserted into the ground for a depth of about 50 cm and form the first two side walls of the tank.

The panels for the vertical completion of the sulfur storage tank are produced with the same two characteristics described above, with the only difference that the height of each panel is equal to 600 mm, superimposition is obviously effected between two panels of the same type.
(Figures 3 and 4 represent two different connections between vertical panels).

Sixteen folded electro-welded networks are also supplied (total width 60 cm, width of each single fold 30 cm) to produce the angular elements for fixing to the edges of the tank.

The height of the metallic networks pressure-folded is:

- 8 networks: approx. 70 cm;
- 8 networks: approx. 60 cm

These steel networks have a square mesh 8 x 8 cm, a diameter of the horizontal and vertical wires of 6 mm; the steel used is as follows:

- for 4 networks: stainless steel for the connection of the internal part of the modules in contact with the sulfur;
- for 4 networks: galvanized steel for the connection of the internal part of the modules in contact with

the sulfur;

- for 8 networks: galvanized steel for the connection of the outer part of the modules not in contact with the sulfur.

The connections between the angular elements and metallic networks of the panels are effected by binding or with metal clips (see figure 5).

- Setting up

The setting up of the panels is effected as follows:

a. digging to a depth of 50 cm and a width of 30 cm along the perimeter of the storage tank;

b. laying of the wall panels having a height of 1200 mm inside the excavation previously effected and their interconnection to the edges by binding the angles to the existing electro-welded networks; the connection is effected so that the male-female type joints present at the edges adhere as much as possible thus preventing leakage of the liquid sulfur;

c. joining to the base with a jet of concrete resistant to sulfate attack (exposure group XA2 or XA3 according to regulation UNI-EN206);

d. upon the hardening of the concrete, the first 30 cm of sulfur are introduced, in the liquid state;

e. this is followed by the subsequent laying of the remaining panels having a height of 600 mm, said panels are connected in relation to their type along the superimposition lines of the networks on one or both of the sides with bindings in wire or with metal clips, also activating the reinforcing networks envisaged at the angles, the connections are effected so that the male-female type joints adhere as much as possible to avoid leakage of the liquid sulfur;

f. once the storage tank has been completed, jets of liquid sulfur are applied in layers of 30 cm up until the predicted storage of about 10 m^3.

The four side walls of the storage tank are internally and externally plastered with mortar cement or resins having a thickness of about 1 cm to obtain the sealing of both the connecting joints and discontinuities present in the walls corresponding to the orthogonal connections between the two metallic networks.

WHAT IS CLAIMED IS:

1. A process for zero emission storage of sulfur, using a reinforced EPS storage tank having one or more levels and impermeable bottom, the process comprising:

preparing a bottom suitable for sustaining upper loads;

preparing an impermeable storage tank bottom, equipped with collecting containers for rain and percolated water;

positioning and interconnecting reinforced EPS panels to form a first level of the storage tank;

plastering the inner walls of said EPS panels;

pouring liquid sulfur until the first level of the storage tank is filled;

covering horizontal surfaces of the sulfur exposed to an atmosphere using materials preventing exposure of the sulfur to an atmosphere; and

plastering outer walls of the storage tank.

2. The process according to claim 1, wherein the plastering is effected with mortar cement or epoxy resins.

3. The process according to claim 1, wherein the covering of the horizontal sulfur surfaces includes:

covering the horizontal sulfur surfaces with reinforced polystyrene,

covering the horizontal sulfur surfaces with polyethylene (PE) sheets,

treating the horizontal sulfur surfaces with soluble inorganic salts having concentrations ranging from 0.4 N to saturation, and optionally subsequently shielding the horizontal sulfur surfaces with a suitable covering.

4. The process according to any one of claims 1 to 3, wherein the reinforced EPS panels have a weight ranging from 4 to 15 kg/m^2.

5. The process according to claim 4, wherein the reinforced EPS panels have a weight ranging from 4 to 10 kg/m^2.

6. The process according to any one of claims 1 to 5, wherein the EPS panels are produced singly by means of an EPS sheet between two electro-welded and interconnected networks.

7. The process according to any one of claims 1 to 6, wherein the EPS panels have a density ranging from 15 to 25 kg/m^3.

8. The process according to claim 7, wherein the EPS panels have a density ranging from 20 to 25 kg/m^3.

9. The process according to any one of claims 1 to 8, wherein polystyrene in the panels is specifically shaped into corrugated and/or Greek-key sheets having a thickness of not less than 4 cm.

10. The process according to any one of claims 1 to 9, wherein the panels further include galvanized or stainless steel horizontal, vertical or orthogonal wire which has a breaking point ftk equal to or greater than 540 N/mm^2 (Fe B 44 k).

11. The process according to any one of claims 1 to 9, wherein the panels further include horizontal, vertical or orthogonal wires which have a thickness equal to or greater than 3 mm.

12. The process according to claim 11, wherein the horizontal, vertical or orthogonal wires have a thickness equal to or greater than 4 mm.

13. The process according to claim 6, wherein the electro-welded networks have square meshes equal to or less than 10 x10 cm.

14. The process according to claim 6, wherein the electro-welded network is folded for the connection of angular elements for fixing to the edges of the tank.

15. The process according to any one of claims 1 to 14, further comprising:

positioning and interconnecting further EPS panels to form further levels of the storage tank; and

plastering inner surfaces of said further EPS panels and subsequent pouring of liquid sulfur until each further level of the storage tank is filled.

Fig. 1

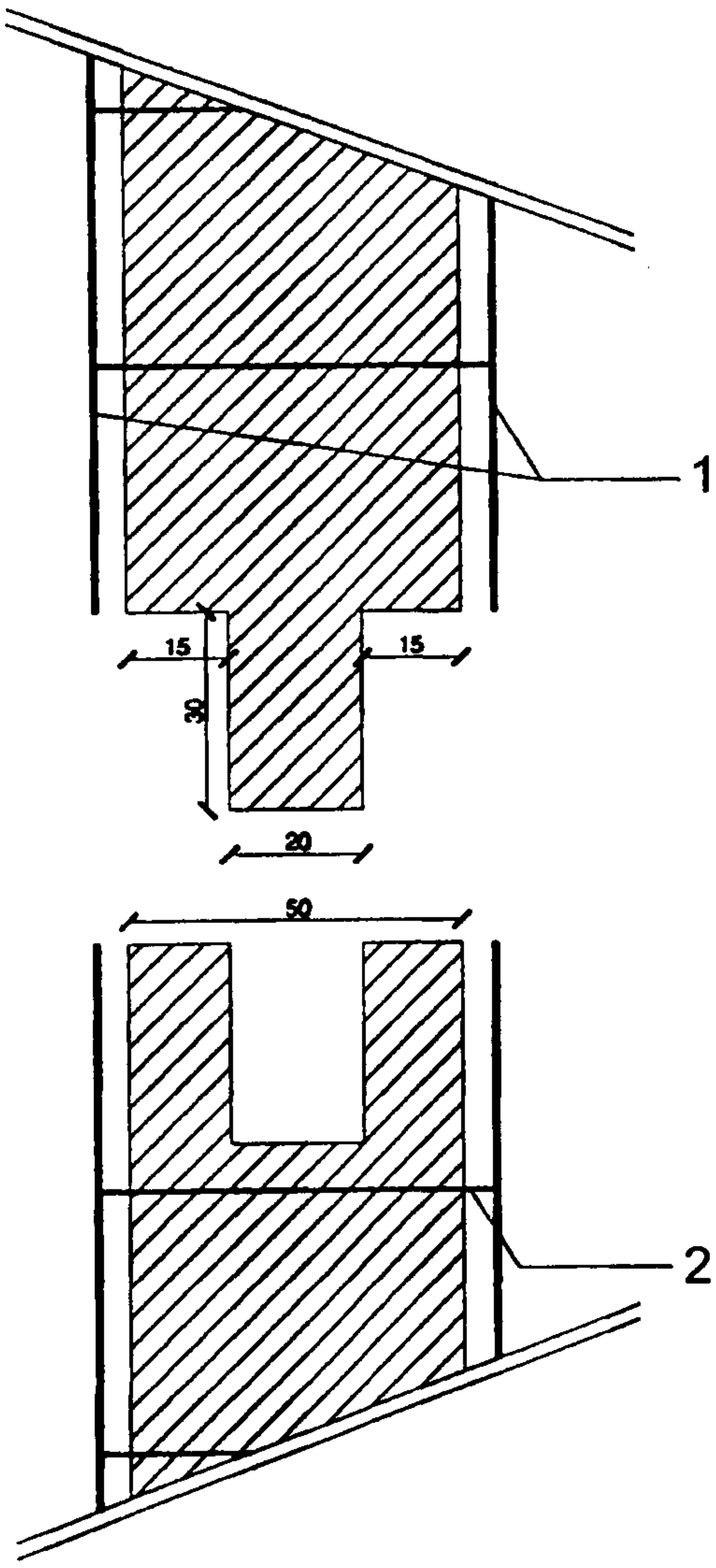


Fig. 2

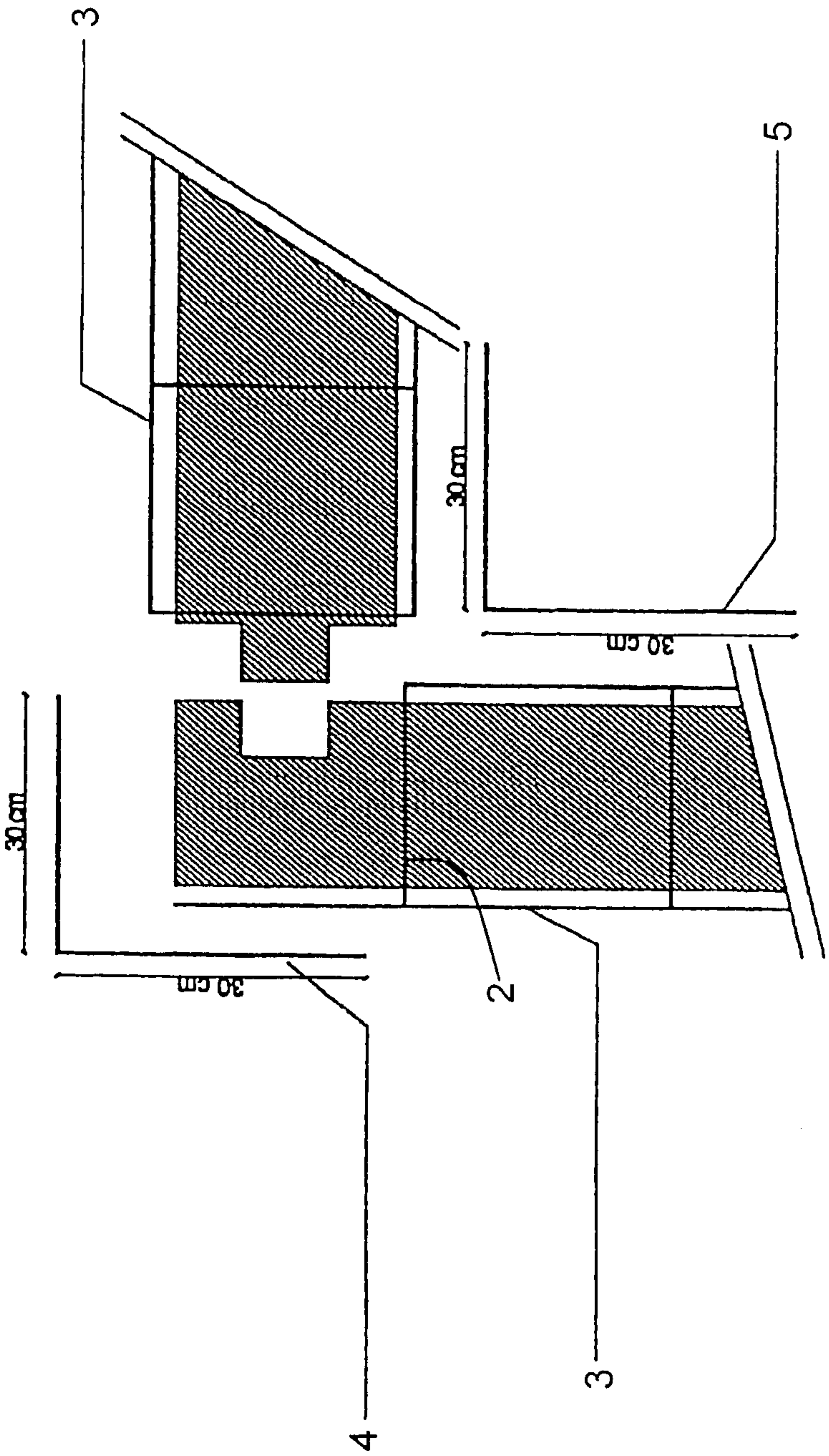


Fig. 3

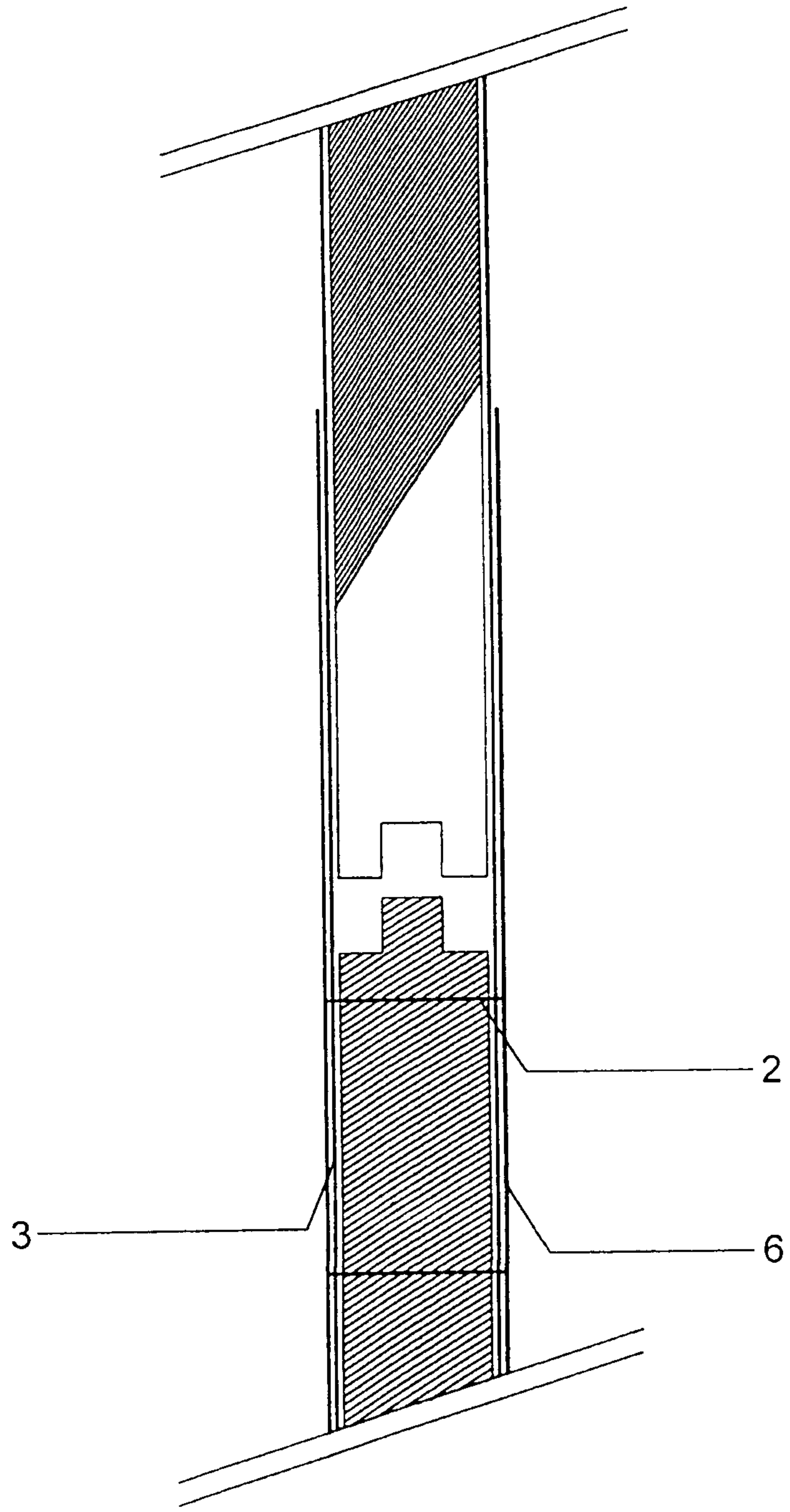


Fig. 4

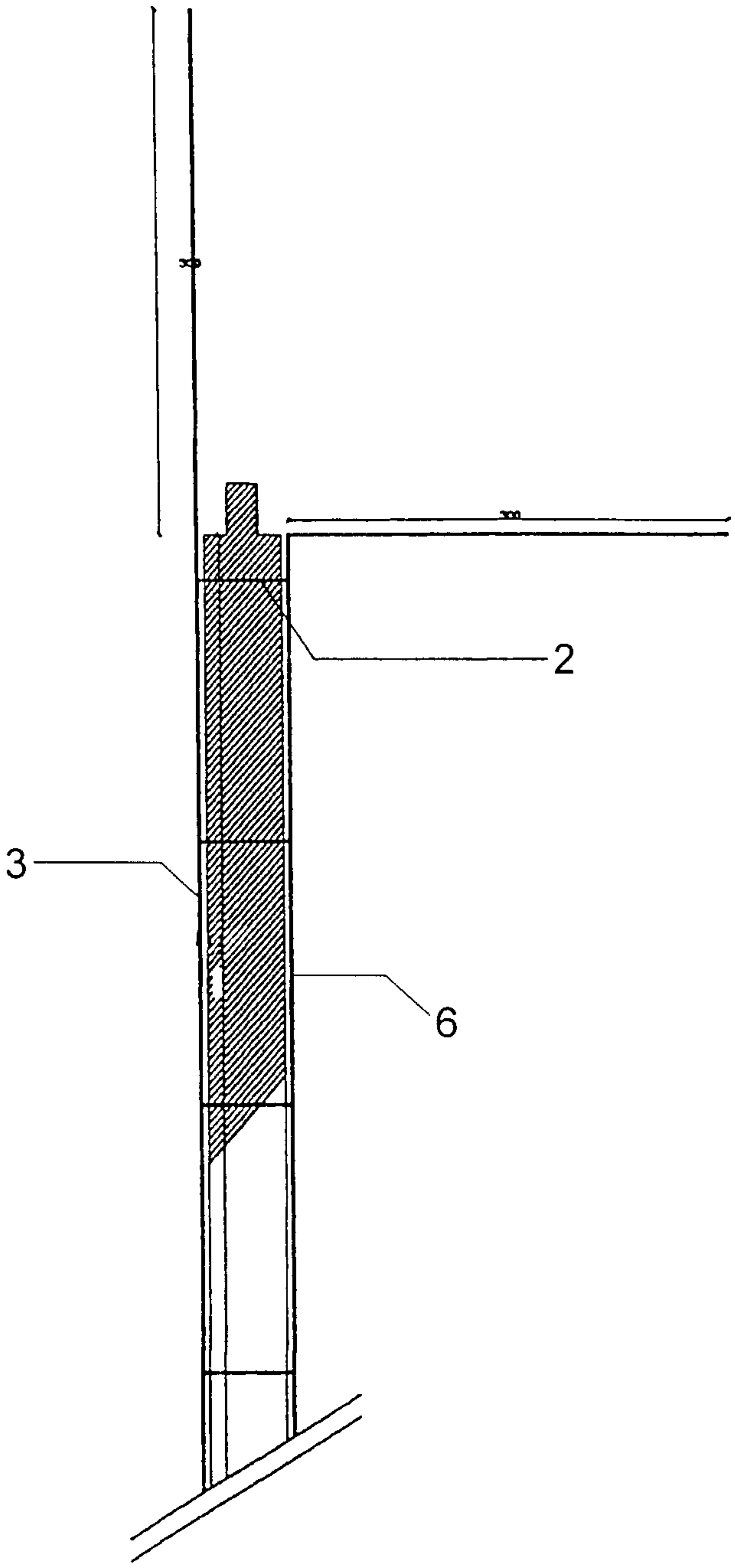
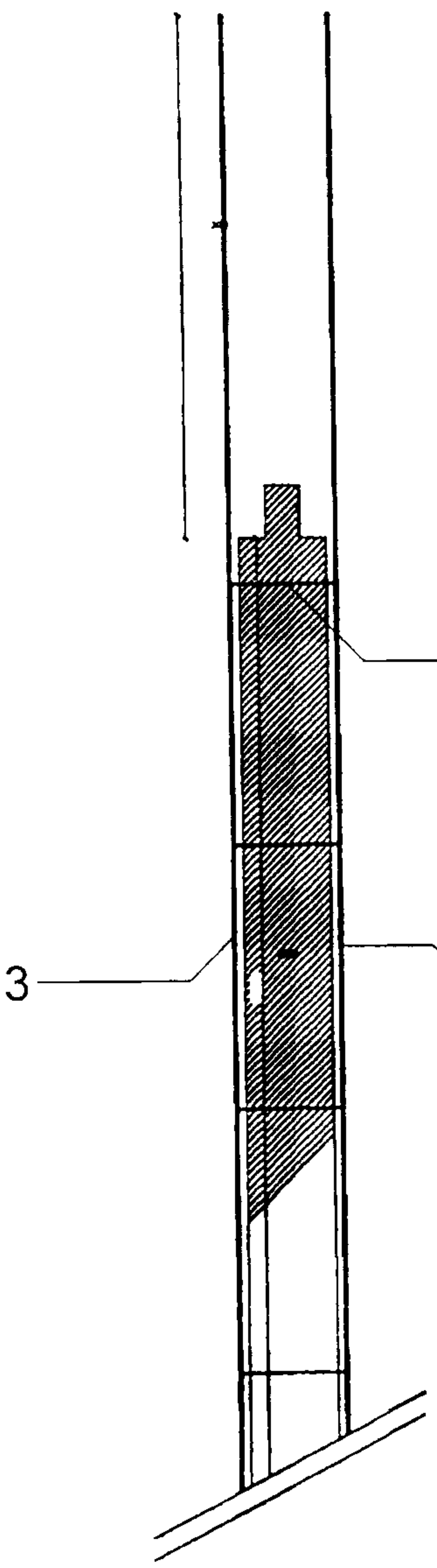
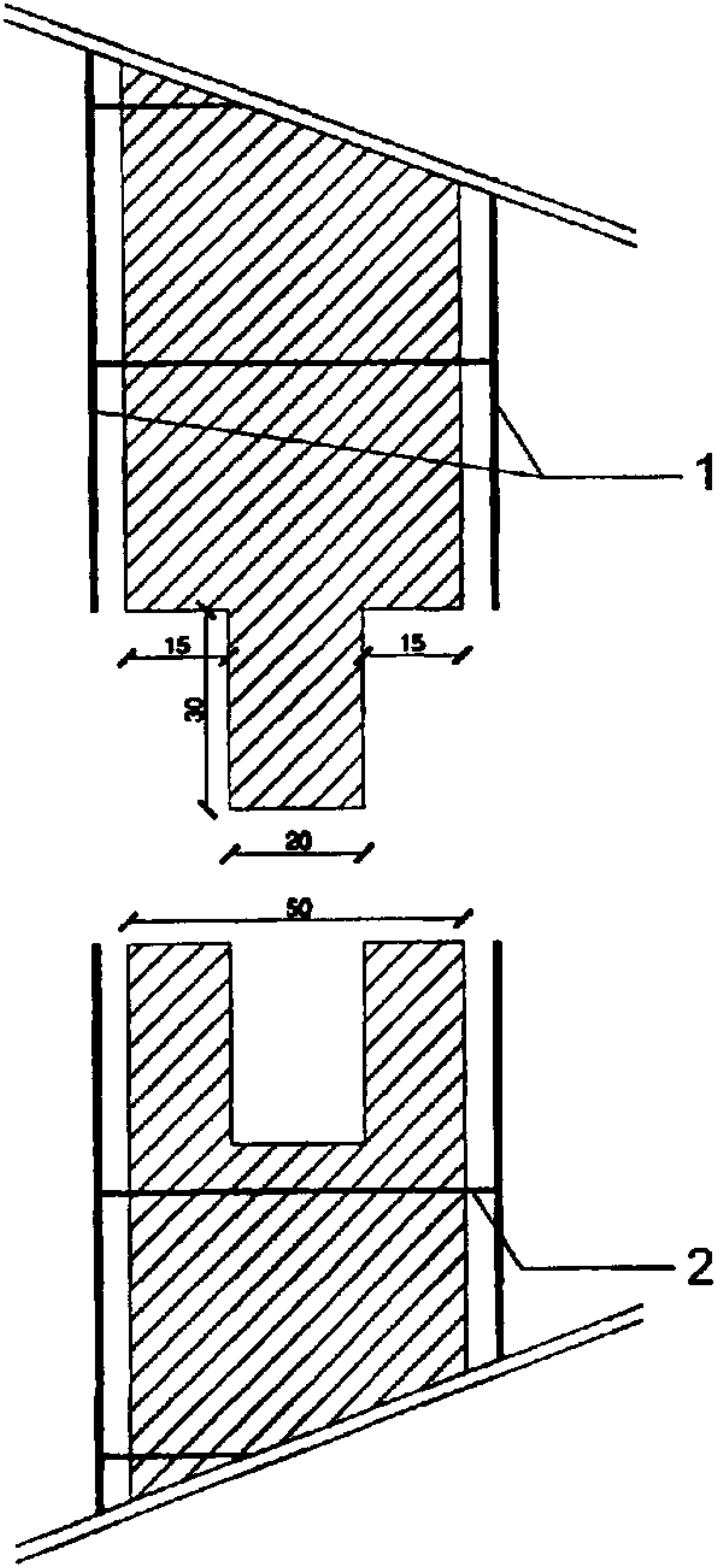


Fig. 5





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