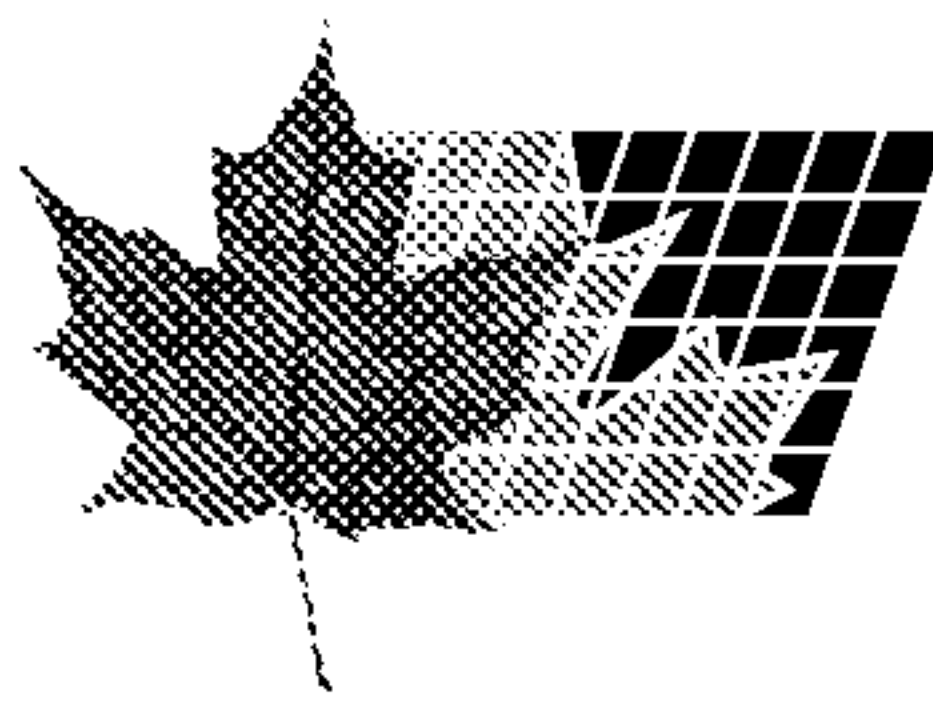




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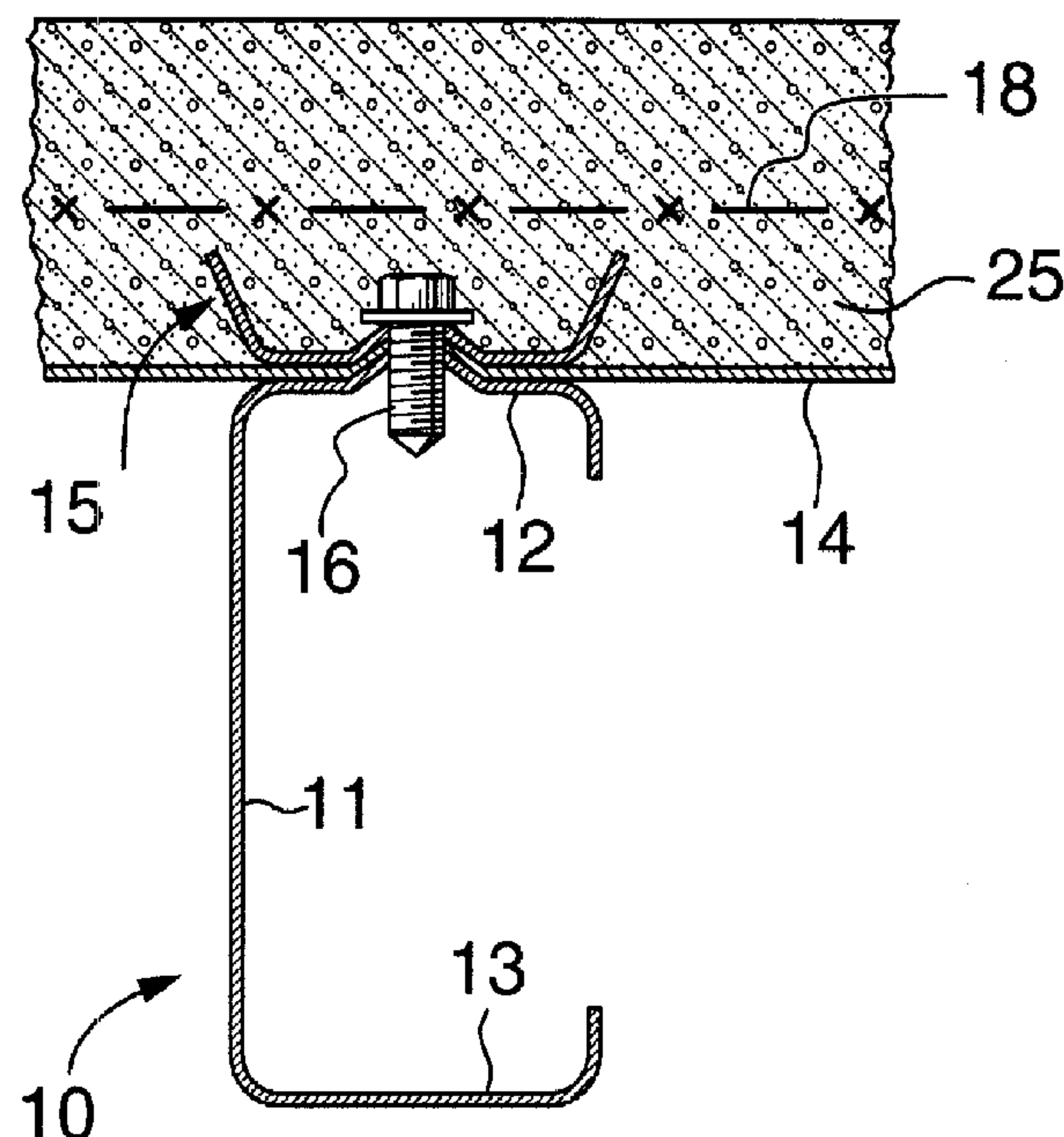
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(54) **ASSEMBLAGE DE PANNEAUX DE CONSTRUCTION
RESISTANT AU CISAILLEMENT**

(54) **SHEAR RESISTANT BUILDING PANEL ASSEMBLY**



(57) A novel connector is described for joining formwork panels to supporting studs or beams such that high shear resistance is provided in a concrete panel formed on the formwork panels. This connector is a dished shear washer having a flat, circular base and upturned skirt portion. A plurality of these shear washers are positioned on the formwork panels in alignment with the studs or beams, and with the skirt portion extending outwardly away from the formwork panels. In this position the shear washers, formwork panels and studs or beams are securely fastened together and a concrete panel is poured on the formwork. The concrete surrounds the upturned skirt portions resulting in an extremely strong structure having, in particular, high shear resistance.

Abstract

A novel connector is described for joining formwork panels to supporting studs or beams such that high shear resistance is provided in a concrete panel formed on the formwork panels. This connector is a dished shear washer having a flat, circular base and upturned skirt portion. A plurality of these shear washers are positioned on the formwork panels in alignment with the studs or beams, and with the skirt portion extending outwardly away from the formwork panels. In this position the shear washers, formwork panels and studs or beams are securely fastened together and a concrete panel is poured on the formwork. The concrete surrounds the upturned skirt portions resulting in an extremely strong structure have, in particular, high shear resistance.

Shear Resistant Building Panel AssemblyBackground of the Invention

This invention relates to building constructions and, more particularly, to a form of construction with concrete
5 panels supported by metal or wood studs or beams.

Many different types of cementitious building panels have been provided in the past to form walls, floors or roofs of building structures. Some of these panels have included insulation and others have included structures cast in the
10 panels for attaching both interior and exterior finishing panels thereto.

Many examples of previously known cementitious wall panels are included in U.S. Patents 2,071,349; 2,270,672; 2,704,935; 3,442,056; 3,956,864; 4,112,646; 4,185,437 and
15 4,602,467. Many of these include various projections for providing a bond between the metal studs or beams and formed concrete panels. These include projecting lugs of various designs, etc.

It is the object of the present invention to provide a
20 support system for pouring a concrete panel in which the connectors between the panels, metal or wood studs or beams and concrete panel have high shear resistance.

Summary of the Invention

The present invention in its broadest aspect relates to a
25 novel connector for joining formwork panels to supporting studs or beams such that high shear resistance is provided in a concrete panel formed on the formwork panels. This connector is a dished shear connector having a flat base and upturned skirt portion formed from heavy gauge sheet steel. A
30 plurality of these shear connectors are positioned on the formwork panels in alignment with the studs or beams, and with the skirt portion extending outwardly away from the formwork

panels. In this position the shear connectors, formwork panels and studs or beams are securely fastened together and a concrete panel is poured on the formwork. The concrete surrounds the upturned skirt portions resulting in an
5 extremely strong structure have, in particular, high shear resistance, i.e. it resists sliding or lateral movement between the components of the floor structure when subjected to shear forces.

One preferred embodiment of the present invention
10 comprises a formwork assembly including a plurality of C-shaped sheet steel channel beams, each having a central web and inner and outer flanges, these beams being laterally spaced from each other. Sheet steel formwork panels are placed in contact with the outer faces of the inner flanges
15 and extend across between the channel beams.

A plurality of said dished shear connectors are placed at spaced locations on the formwork panels and in alignment with the beam inner flanges. Then the dished connectors, formwork panels and studs or beams are connected together by means of
20 screws or welds. With the formwork assembled in this manner, a concrete panel is formed on the formwork panels with the shear washers embedded therein.

When connector screws are used, they may be tightened to a position in which they draw the metal surrounding the screw
25 consisting of the flange, formwork and shear connector into a coextensive generally conical configuration. This provides exceptionally high shear resistance between the concrete slab, the formwork and the stud or beam.

The dished shear connector is typically a washer made
30 from 12 to 16 gauge sheet steel and is preferably circular with a diameter of about 2 to 3 inches and a skirt

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height of about 0.5 to 1 inch. The free edge of the side wall is preferably fluted. It is also advantageous to use at least two screws to hold the shear washer securely to the beam.

According to an alternative embodiment of the invention,
5 the screws for holding the dished shear washer may be replaced by a welded connection, such as a spot weld or a plug weld. Such welds are easily carried out and are also highly effective in terms of shear resistance.

According to a still further embodiment of the invention,
10 it is possible to substitute the C-shaped steel channel beams with wooden beams. These are used together with the screws and dished washers to provide a very inexpensive structure having high shear resistance.

Brief Description of the Drawings

Figure 1 is a sectional view of an assembly according to the invention;

5 Figure 2 is a sectional view of an assembly according to the invention with a wooden stud;

Figure 3 is a sectional view of a dished shear washer;

Figure 4 is a top plan view of a dished shear washer;

Figure 5 is a sectional view of an assembly;

Figure 6 is a sectional view of the assembly of Figure 4;

10 Figure 7 is a sectional view of a full assembly;

Figure 8 is a top plan view of a full assembly;

Figure 9 is a sectional view of C-channels forming a column;

15 Figure 10 is a sectional view of C-channels forming a different shape of column;

Figure 11 is a further sectional view of channels forming another shape of column;

Figure 12 is a sectional view of C-channels forming a still further form of column;

20 Figure 13 is a side elevation of a wall assembly;

Figure 14 is a sectional view through the wall assembly of Figure 13;

Figure 15 is a sectional view showing a beam and stud assembly;

25 Figure 16 is a sectional view showing another beam and stud assembly; and

Figure 17 is a sectional view showing a cantilevered beam assembly.

30 As will be seen from Figure 1, a galvanized sheet steel C-channel member 10 has a web portion 11 with an inner flange 12 and an outer flange 13. A sheet steel formwork panel 14 rests on the inner flange 12 and a dished shear washer 15 is placed on top of panel 14 in alignment with flange 12. A self-tapping screw 16 is turned through a hole in dished shear
35 washer 15 and through the formwork panel 14 and flange 12. This screw 16 is turned under tension until all three panels are pulled up coextensively as shown in Figure 1. Reinforcing

mesh 18 is positioned above the dished washers 15 and a concrete panel 25 is poured on top of formwork panel 14. The coextensive conical areas surrounding the screw provide very high shear resistance between the formwork panel 14 and flange 12, as well as against the concrete 25.

The dished shear washer 15 has a substantially flat bottom face with an upturned skirt portion and an axial hole. According to an alternative embodiment as shown in Figures 3 and 4, the dished shear washer 20 has a flat bottom wall 21 with holes 22 and a skirt portion 23 with flutes 24. This fluted design gives greater strength and greater shear resistance between the dished shear washer and concrete.

Figure 2 shows an embodiment in which the steel channel member is replaced by a wooden beam 39. This is particularly useful in wooden frame construction where the wooden beams form part of the final structure. As with the steel channel, the screw 16 forms a very strong connection to the wood and firmly holds the dished washer with excellent shear resistance.

Details of how the dished shear washers function can be seen in Figures 5 and 6. Channel members 70 are used having a web portion 71, a short top flange 72 and a large bottom flange 73. Formwork panels 14 with service channels 26 are laid on top of flange 72 and these are then joined by the dished shear washer 20 and screws 16. Reinforcing mesh 18 is placed above the shear washers and a concrete panel 25 is poured. Hat channels 74 are connected to the bottom flanges 73 and these support ceiling panels 75.

A typical full assembly of a deck including a series of studs or beams 10, formwork panels 14 and dished shear washers 15 is shown in Figure 8. From Figures 7 and 8, it will be seen that the formwork panels can take various forms and in Figure 7, it includes a flat panel 27 and recessed sections 26 which provide runways for electrical and mechanical services. In this embodiment, the concrete panel 25 has a downwardly extending portion 29 adjacent beam 10 which rests upon a support column 28.

Figures 9, 10, 11 and 12 show four forms of columns that can be created from C-channels. The configurations of Figures 10 and 11 are typically welded together, while the designs of Figures 11 and 12 can be joined by self-tapping screws 30.

5 The columns of Figures 9 - 12 can be filled with concrete to form the columns 34 as shown in Figures 13 and 14. Also shown in Figures 13 and 14 is a shear section with horizontal reinforcing rods 36, vertical reinforcing rods 37 and concrete.

10 Particular designs for special construction situations are shown in Figures 15, 16 and 17. In Figure 14, a pair of channel members 40 are positioned back-to-back and they serve to outline a large beam. Additional metal panels 41 and 42 are placed laterally from the back-to-back channels 40 to
15 create a formwork which is filled with concrete 46. The numeral 43 designates a C-channel support beam, 44 represents additional reinforcing bars, if needed, and numeral 45 represents joist supports. This assembly is completed by a formwork positioned above the deep beam assembly on which a
20 concrete deck 47 is poured.

In the configuration of Figure 16, again a pair of back-to-back channels 50 are used as the main structure. These are supported on a support column or wall 55 and have insulation 51 on the outer side. The inner side comprises concrete 54.
25 A C-channel beam 52 extends horizontally and supports a concrete deck 53.

Another form of construction in a cantilevered configuration is shown in Figure 17. Here a pair of back-to-back channels 60 are placed upon a column or support wall 68
30 and formwork is created by means of insulating blocks 64 and 65 positioned between the lower end of channel member 60 and C-channel beam 63 as well as between the bottom flange of channel member 63 and the top flange thereof. The other side of the formwork is created by metal panels 61 and 62.
35 Concrete 66 is poured into the formwork to create the beam as shown and a concrete deck 67 is poured on top.

For constructions according to this invention, the steel

C-shaped members are typically made from 16 to 11 gauge pickled and oiled or galvanized steel with web heights ranging from 6 to 18 inches. The formwork panels are typically made from about 28 gauge steel with a concrete panel having a thickness of about 2 to 2.5 inches formed thereon.

The desired shear resistance is at its maximum against the concrete when the capacity of the screw in shear is matched with the metal of the beam and that of the dished washer. For instance, a dished washer made of 14 gauge steel having an area of 1.75 in² against concrete capacity of 2500 psi offers 4375 psi resistance at the concrete after 28 days and a resistance of 2187 psi after 24 hours. This resistance of 2187 psi is sufficient to allow early removal of temporary shoring. If a screw is used having allowable capacity of 2000 psi in shear, then all components are closely matched for maximum shear resistance.

A particularly preferred embodiment of this invention is the one shown in Figures 3-6, using a 28 gauge steel deck connected to 16 gauge steel C-channels by means of shear washers having a diameter of about 2.5 inches and a height of 0.75 inch made from 14 gauge steel and each held by two #14 screws. When a concrete panel 2 to 2.5 inches thick is poured on this formwork, the shear washer provides 5000 psi maximum shear resistance when connected to a concrete slab having a strength of 3500 psi. The shear resistance in the C-channel is 6,000 psi and the two screws provide a minimum shear resistance of 5,200 psi.

Claims:

1. A formwork assembly for constructing a concrete building panel having high shear resistance and comprising the combination of:

5 (a) a plurality of studs or beams laterally spaced from each other,

(b) formwork panels extending across between the studs or beams, and

10 (c) shear resistant connector means for connecting the formwork panels to the studs or beams comprising a plurality of shear connectors formed from heavy gauge sheet steel, each having a flat base and upturned edge portions, said shear connectors being positioned on the formwork panels in alignment with the studs or beams and with the edge portions
15 extending outwardly away from the formwork panels and fastener means for securely connecting together the shear connector base portions, formwork panels and studs or beams,

said combination when used to form a concrete slab on the formwork panels with the shear connectors embedded in the
20 concrete acting to provide a composite floor structure having improved shear resistance between the concrete slab, the formwork and the beams to thereby resist sliding or lateral movement between the components of the floor structure when subjected to shear forces.

25 2. An assembly according to claim 1 wherein the stud or beam is a C-shaped sheet steel channel member having a central web and inner and outer flanges.

3. An assembly according to claim 1 wherein the stud or beam is formed of wood.

30 4. An assembly according to claim 1, 2 or 3 wherein the shear connectors, formwork panels and beams are connected together by means of shear resisting screws extending through

the shear connector base portions, the formwork panels and into the beams.

5 5. An assembly according to claim 2 wherein the shear connectors, formwork panels and beams are connected together by means of weld connections.

6. An assembly according to claim 1 wherein each shear connector comprises a washer having a circular flat base and upturned edge portion.

10 7. An assembly according to any one of claims 1 to 6 wherein each shear washer is formed of 12 to 16 gauge sheet steel.

8. An assembly according to claim 7 wherein each shear washer has a circular base having a diameter of about 2 to 3 inches and a skirt height of about 0.5 to 1 inch.

15 9. An assembly according to any one of claims 1 to 8 having a concrete panel of a thickness of about 2 to 2.5 inches formed thereon and surrounding said shear washers.

20 10. A steel beam and concrete composite floor structure for use in building construction comprising the combination of:

(a) a plurality of laterally spaced steel beams, each said beam having a central web and at least an upper flange;

(b) sheet steel formwork panels extending across between and being supported by said beams,

25 (c) a plurality of shear washers formed from cold formable heavy gauge sheet steel, each washer having a flat base and upturned peripheral skirt portion, said shear washers being positioned on the formwork panels in alignment with and directly above the beam upper flanges and with the skirt
30 portion extending outwardly away from the formwork panels and the shear washer base portions, formwork panels and beam upper flanges being securely fastened together by means of a

plurality of shear resisting screws extending through the shear washer base portions, formwork panels and beam upper flanges, and,

(d) a concrete slab formed on the formwork panels with
5 the shear washers embedded in the concrete,

said combination providing a composition floor structure having improved shear resistance between the concrete slab, the formwork and the beams and thereby resisting sliding or lateral movement between the components of the floor structure
10 when subjected to shear forces.

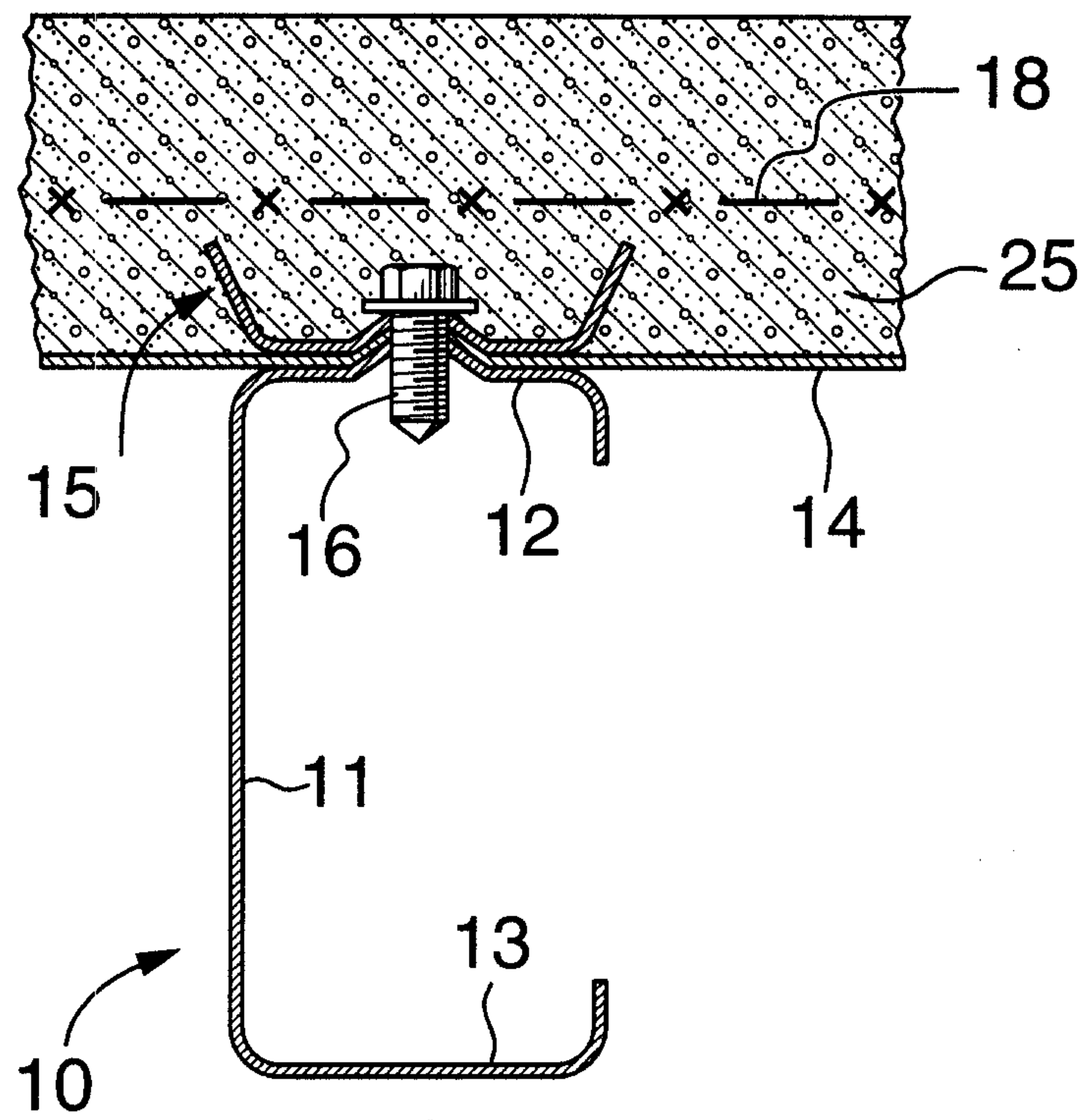


FIG. 1

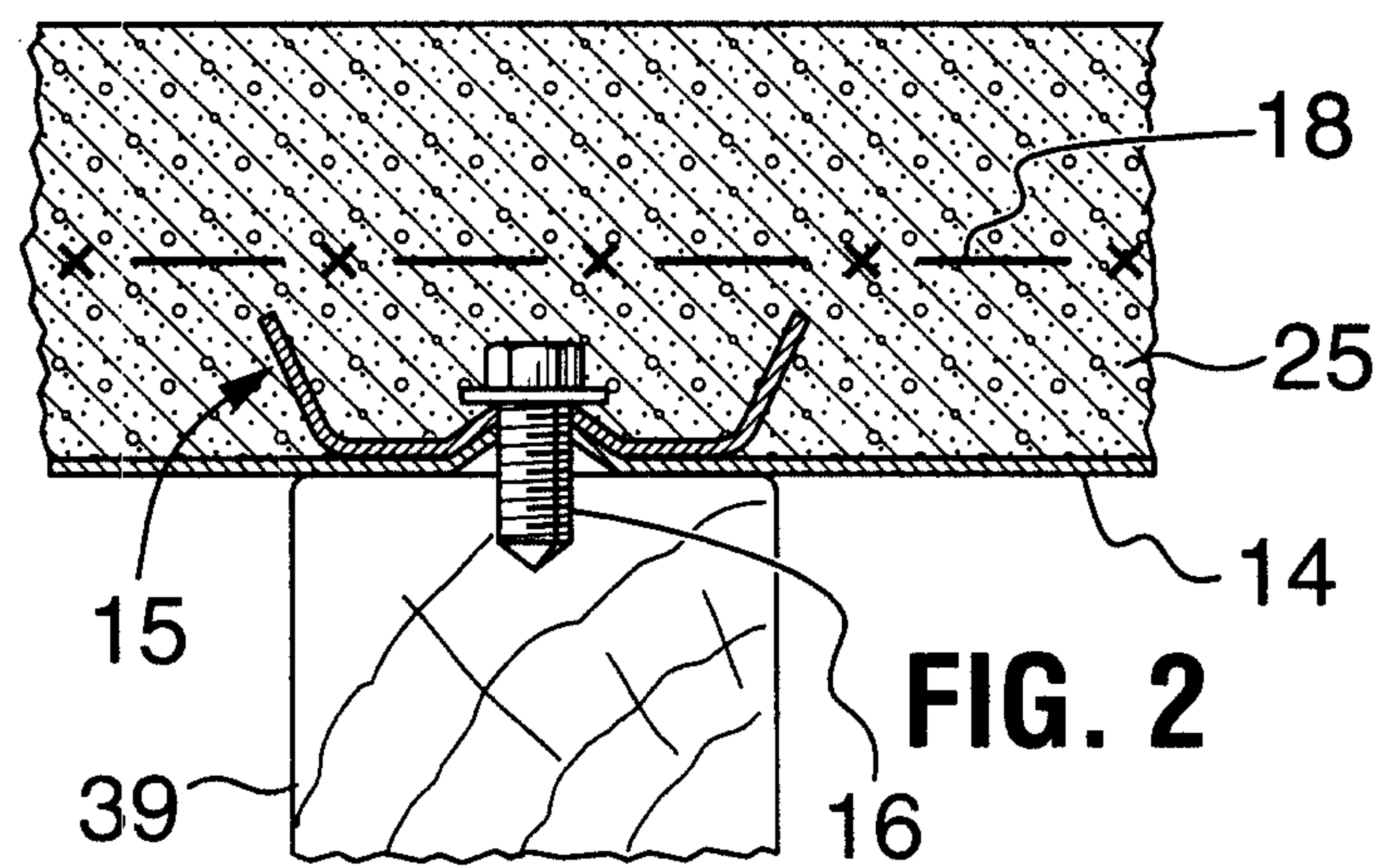


FIG. 2

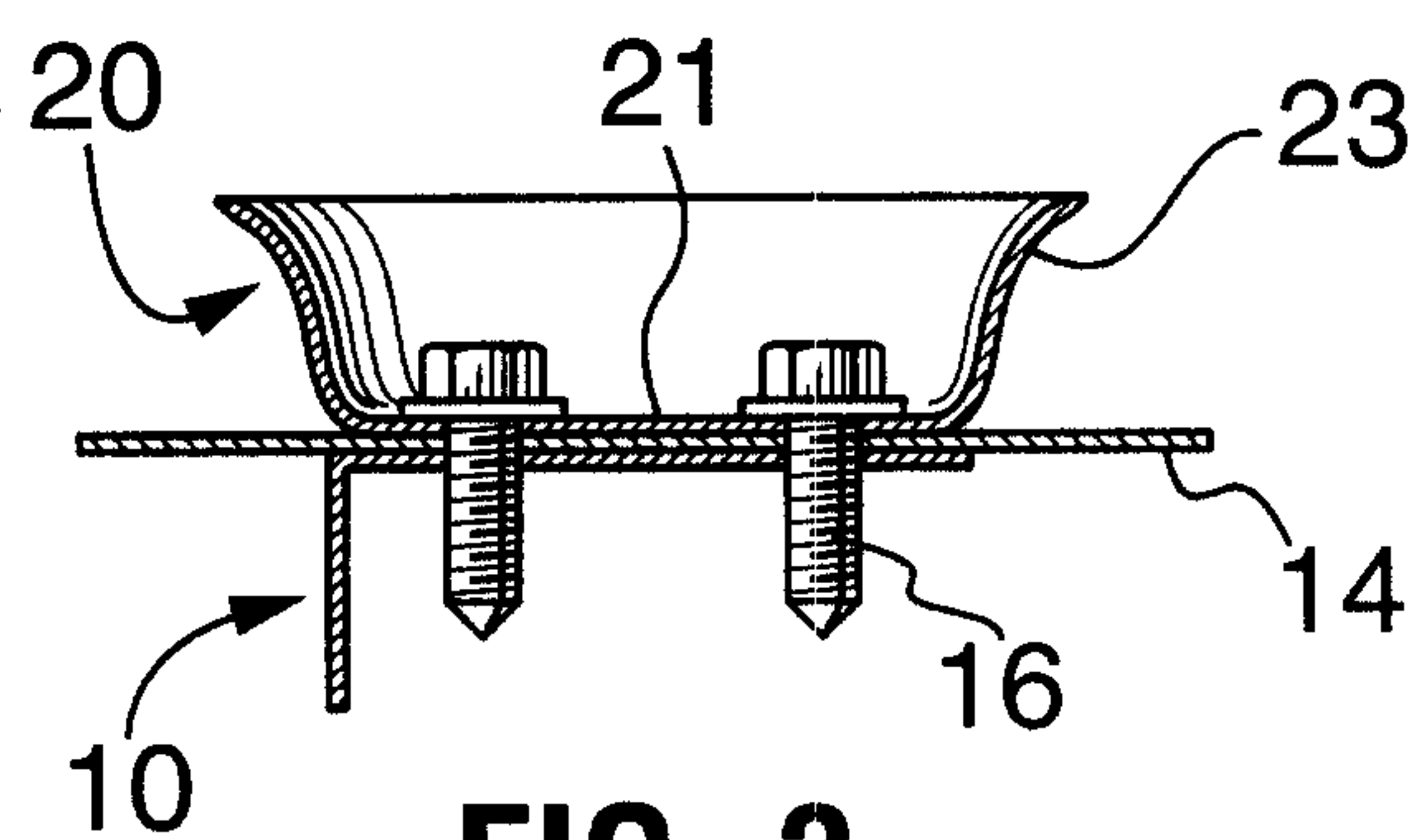


FIG. 3

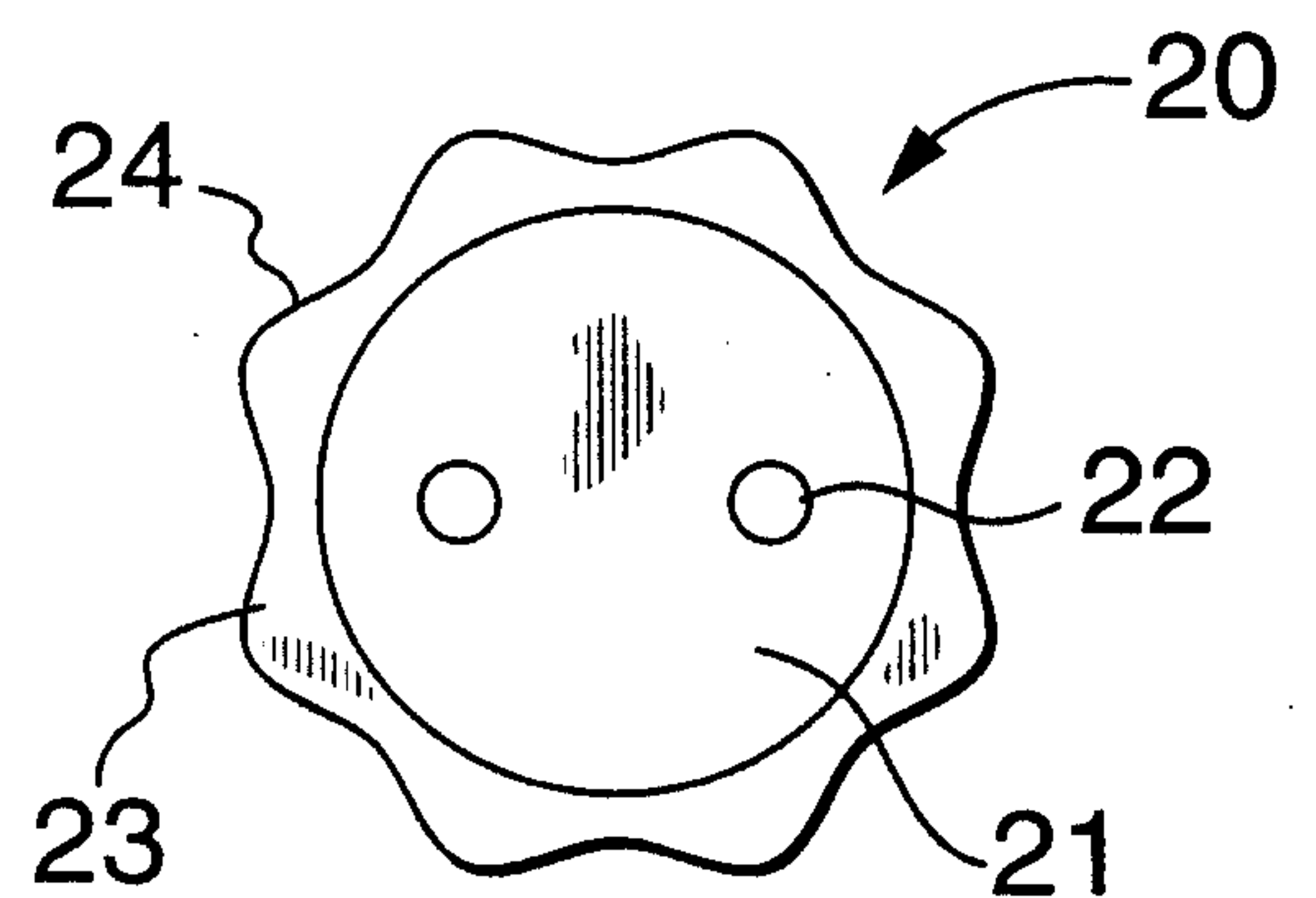


FIG. 4

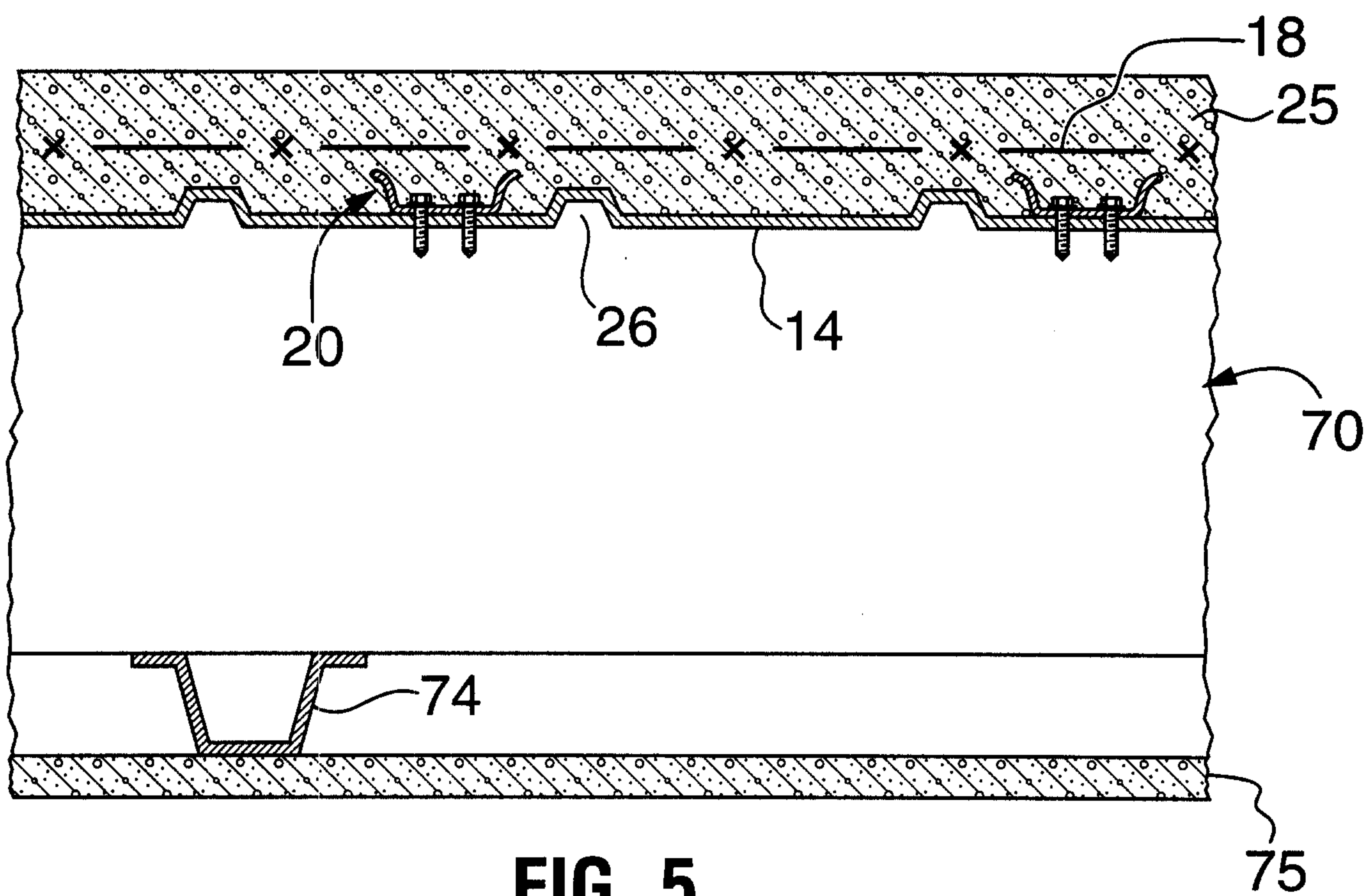


FIG. 5

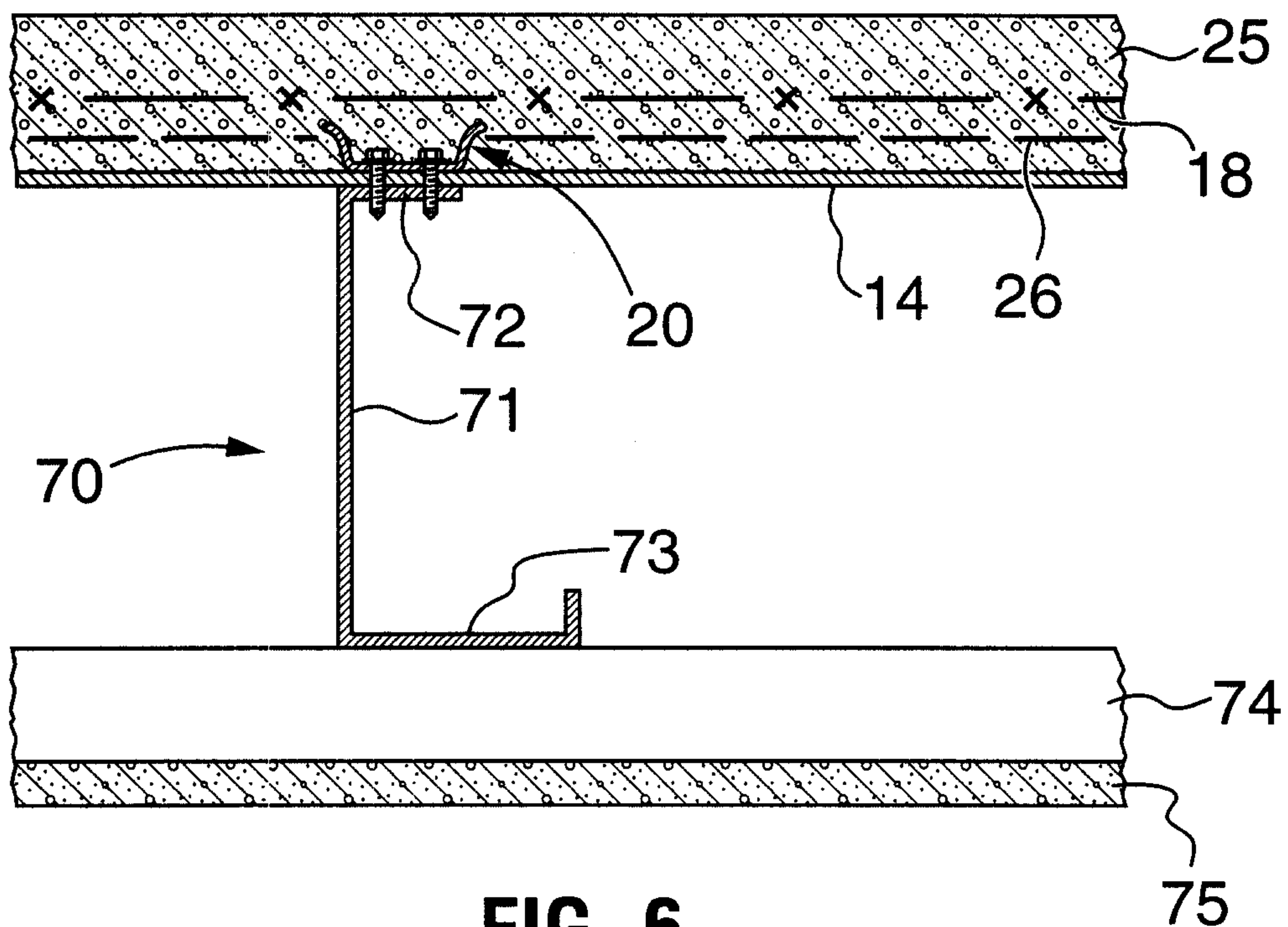
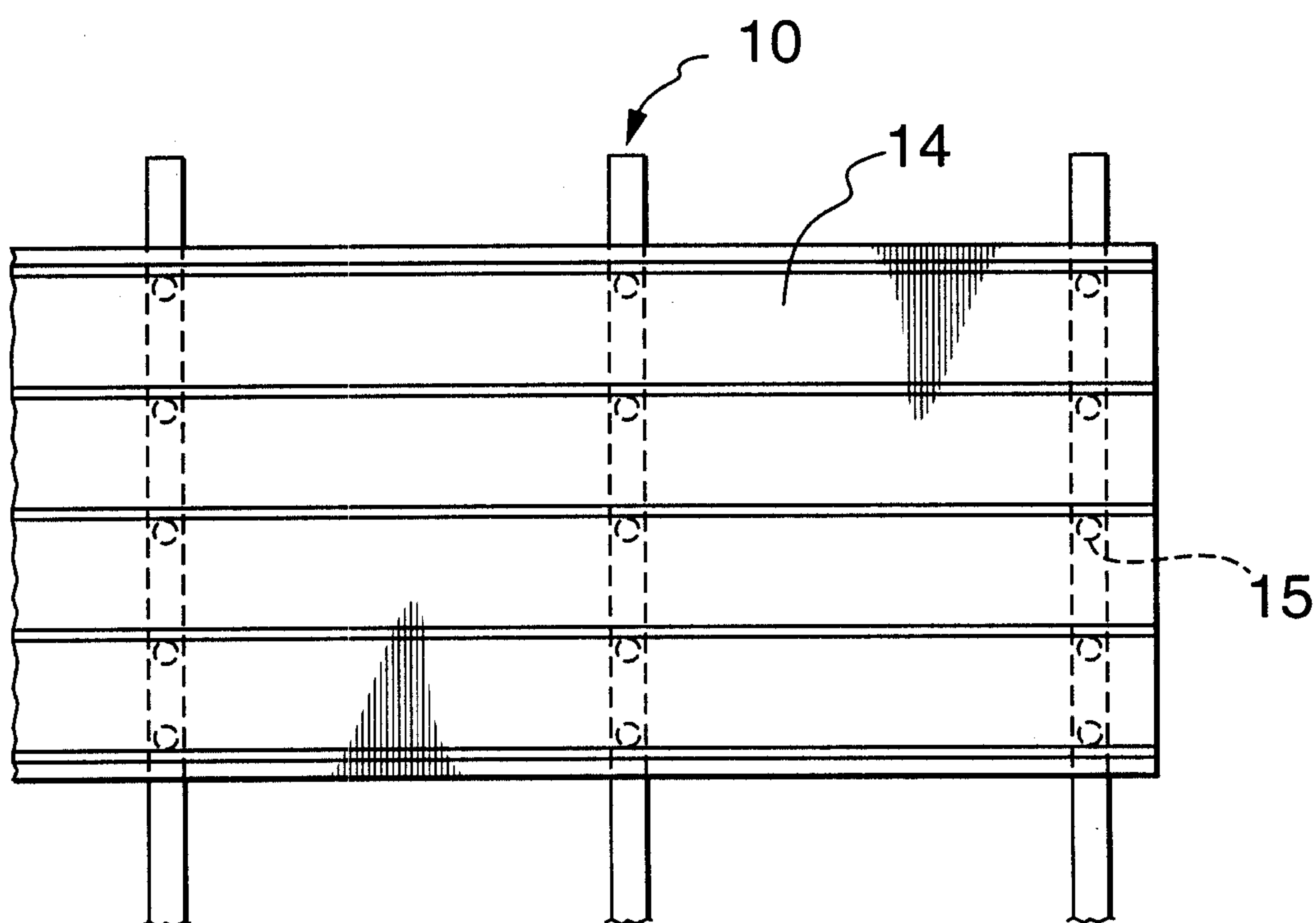
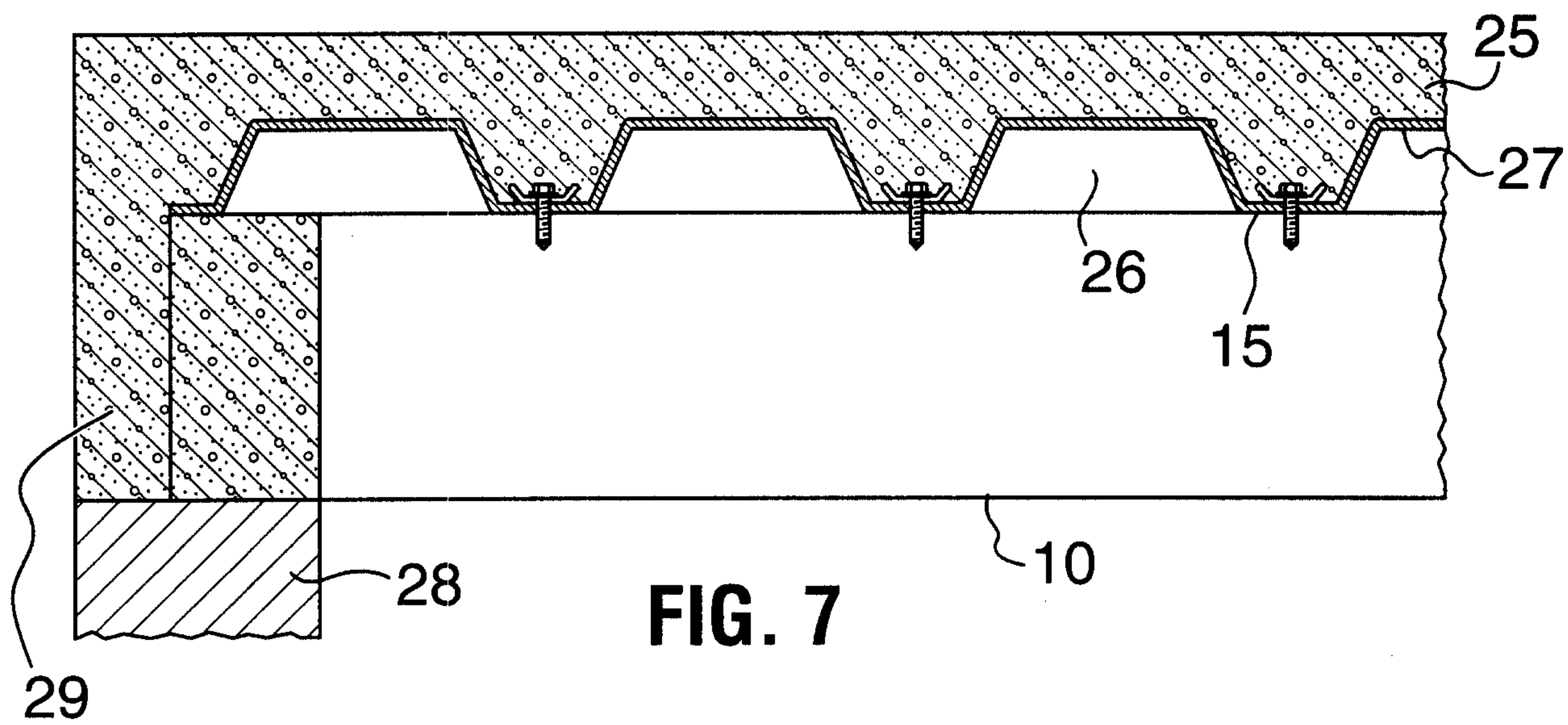


FIG. 6



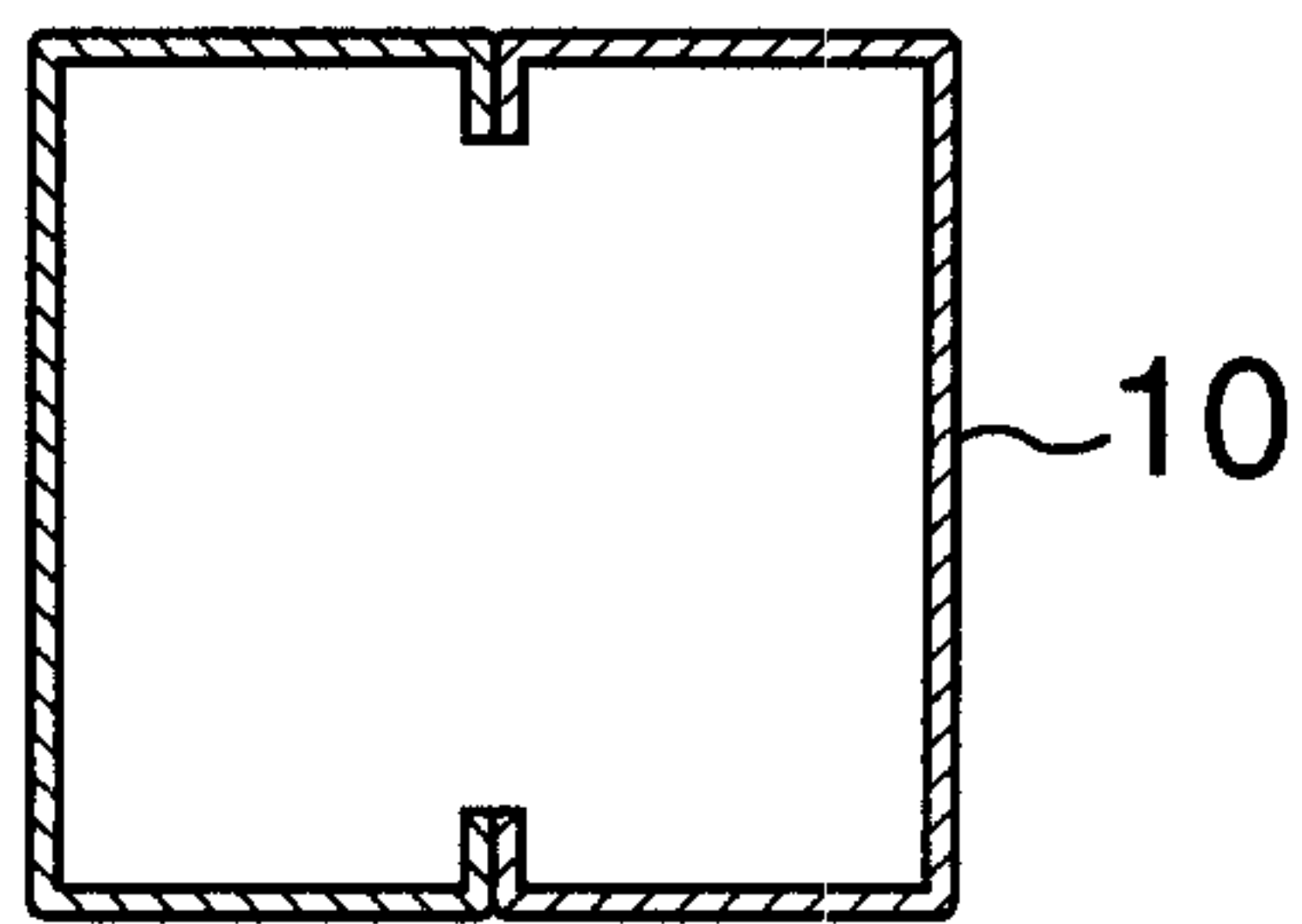


FIG. 9

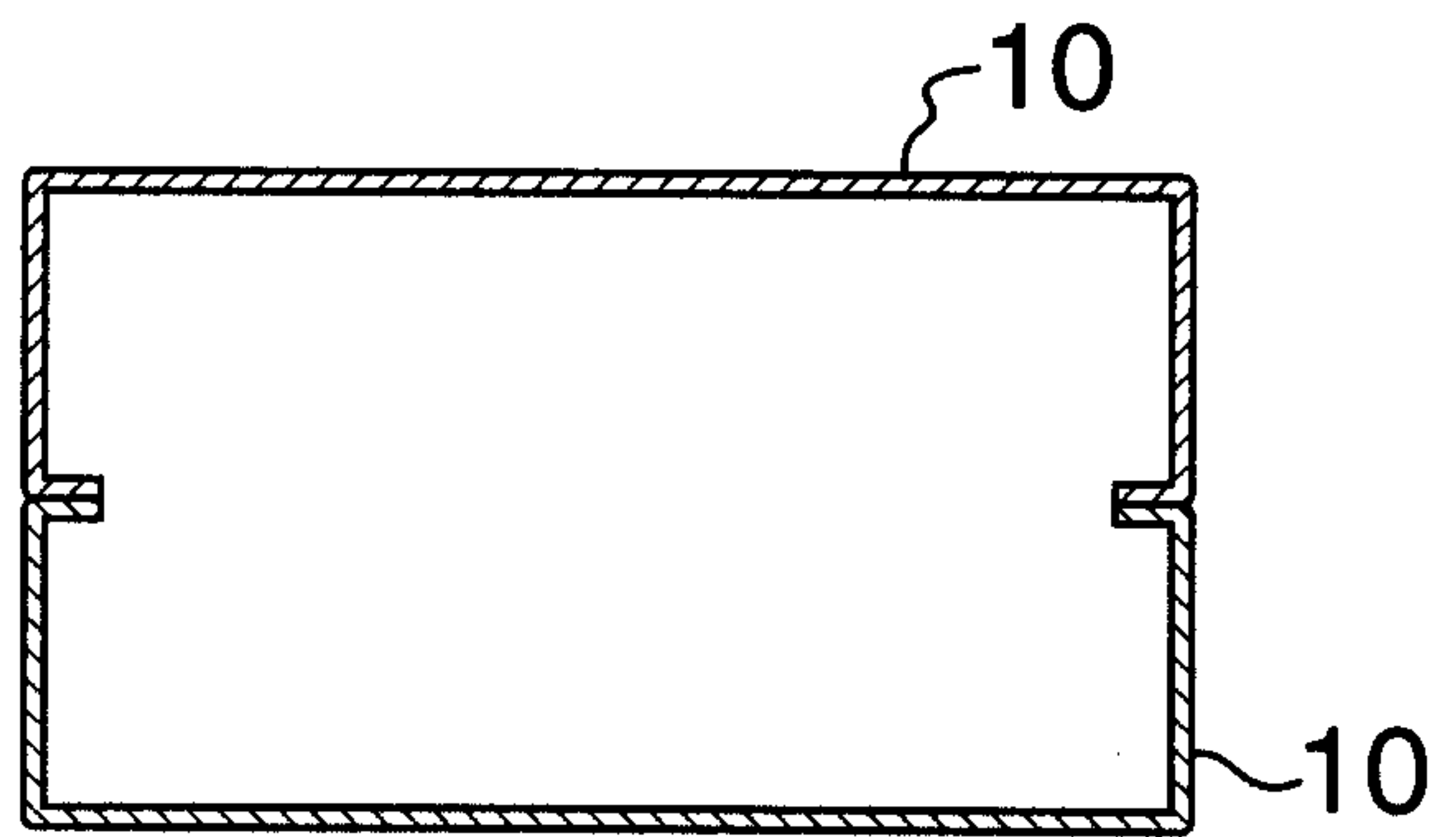


FIG. 10

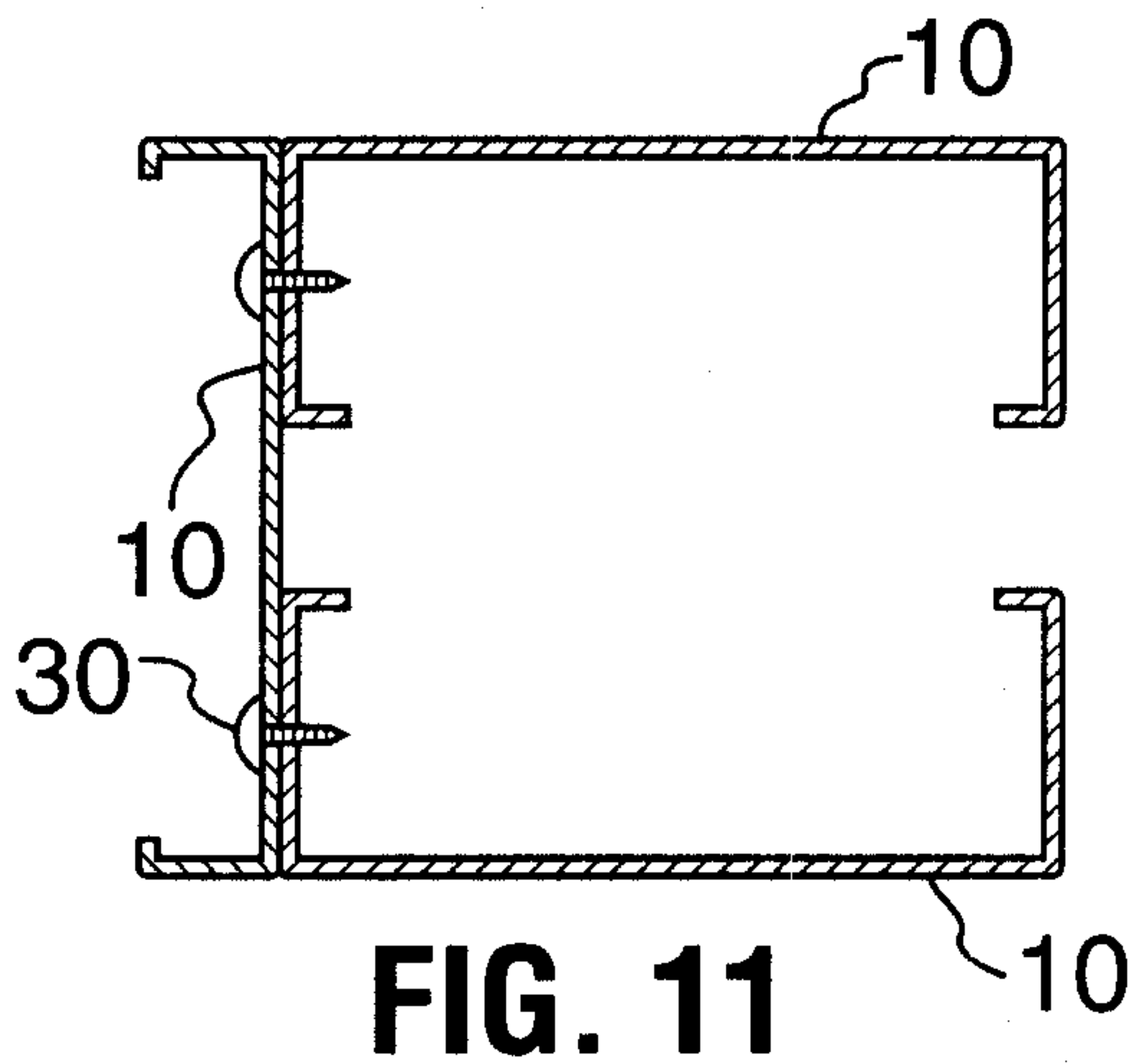


FIG. 11

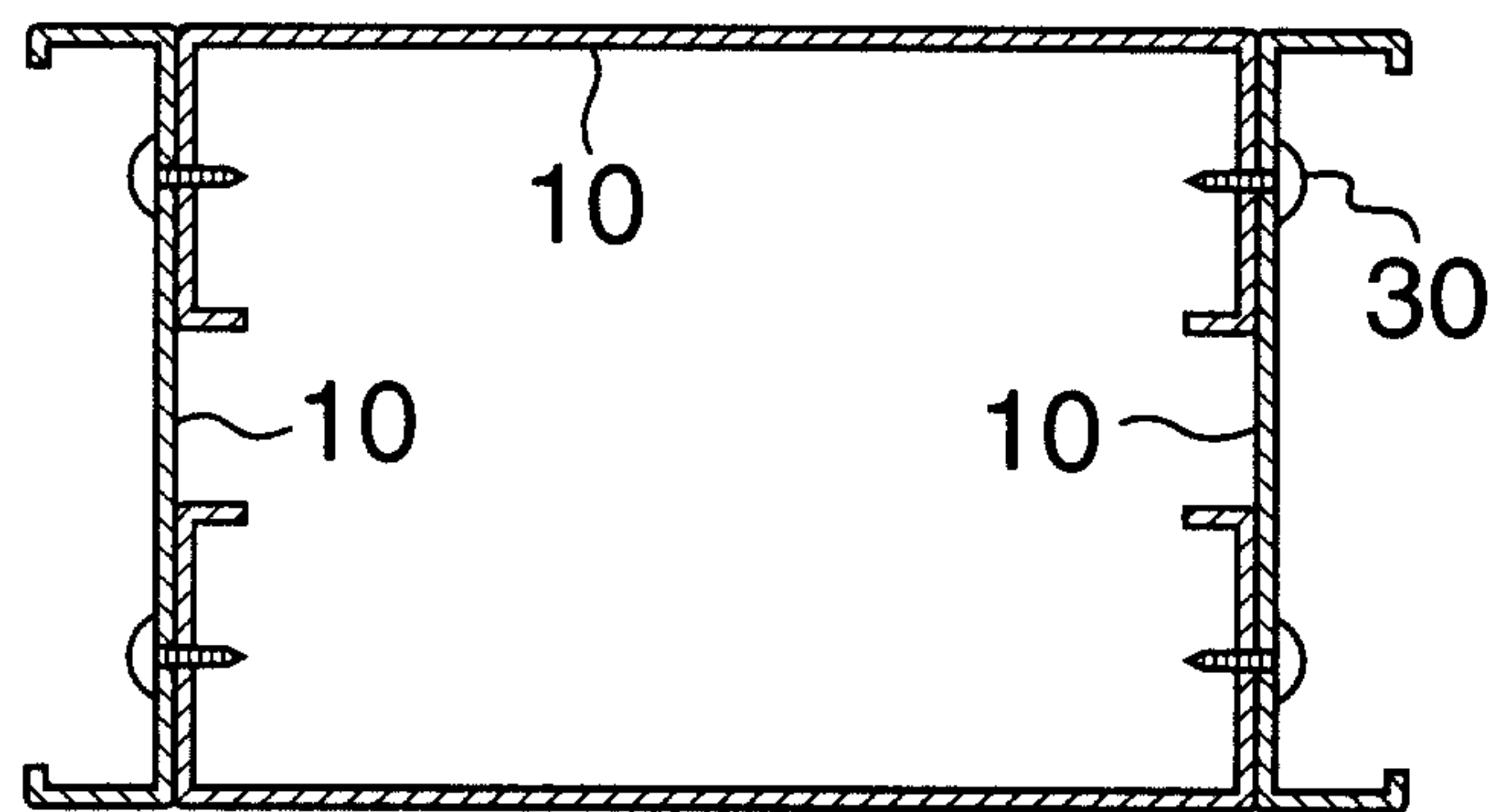


FIG. 12

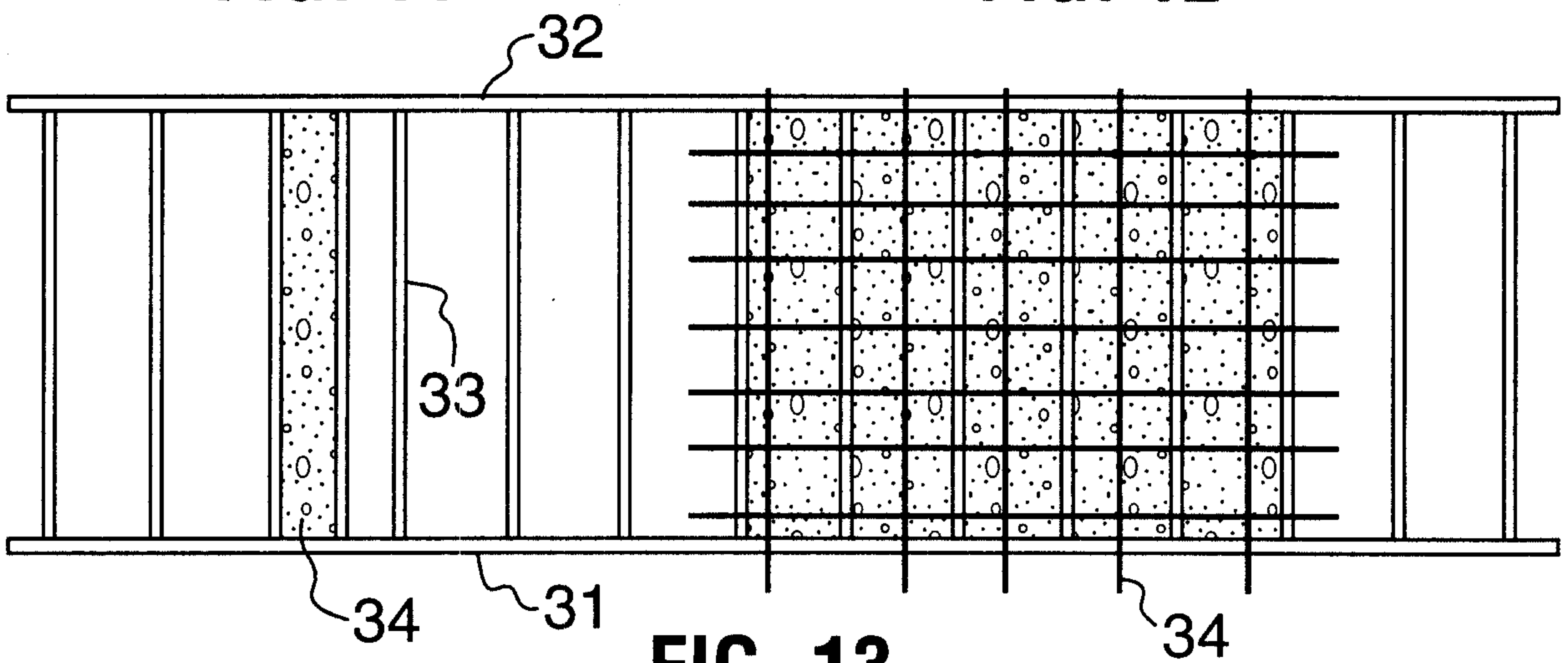


FIG. 13

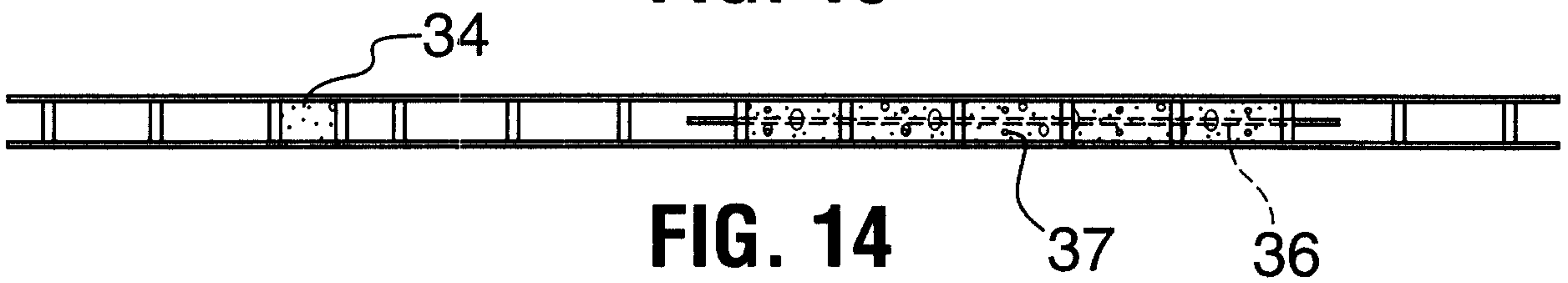


FIG. 14

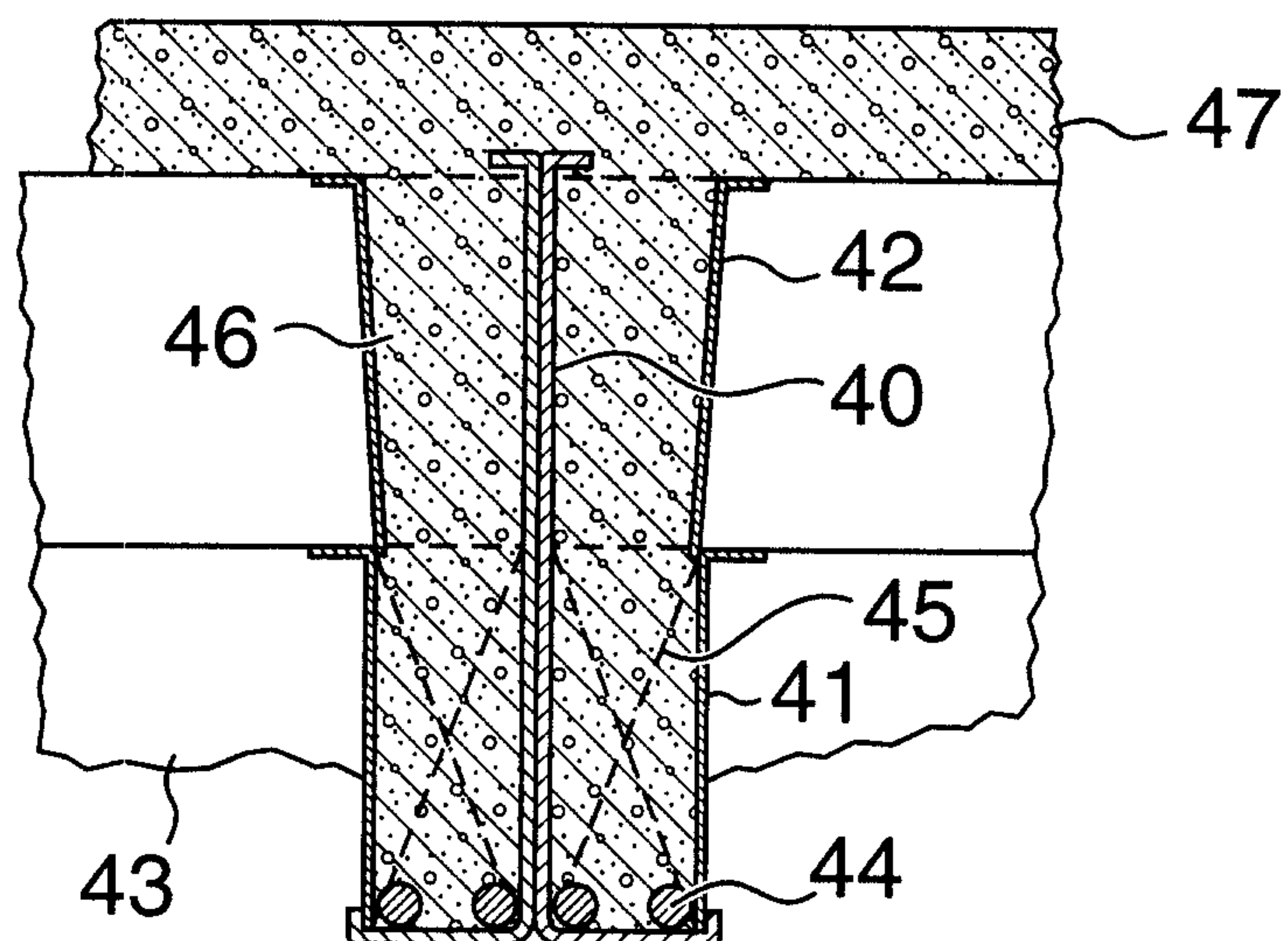


FIG. 15

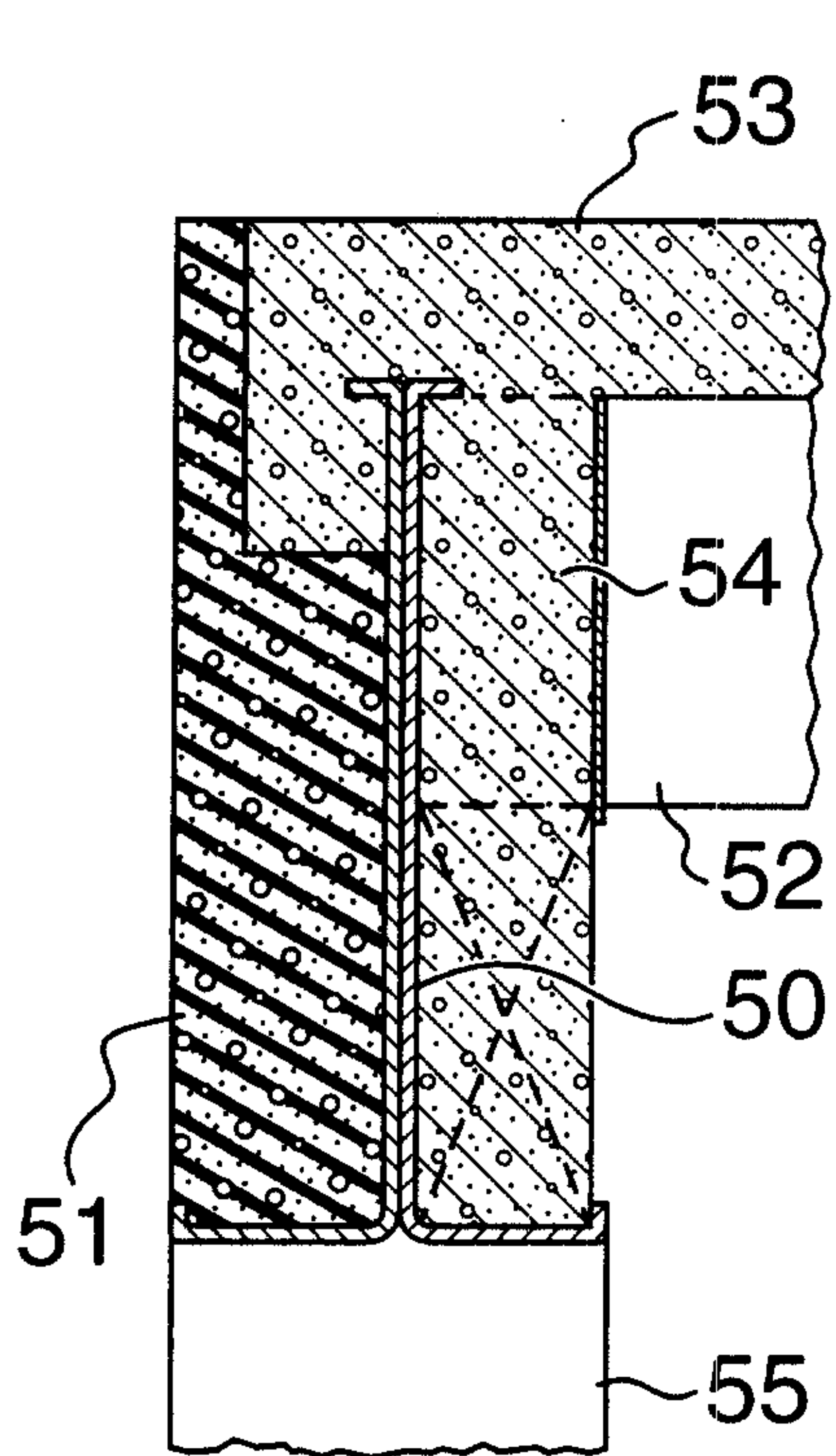


FIG. 16

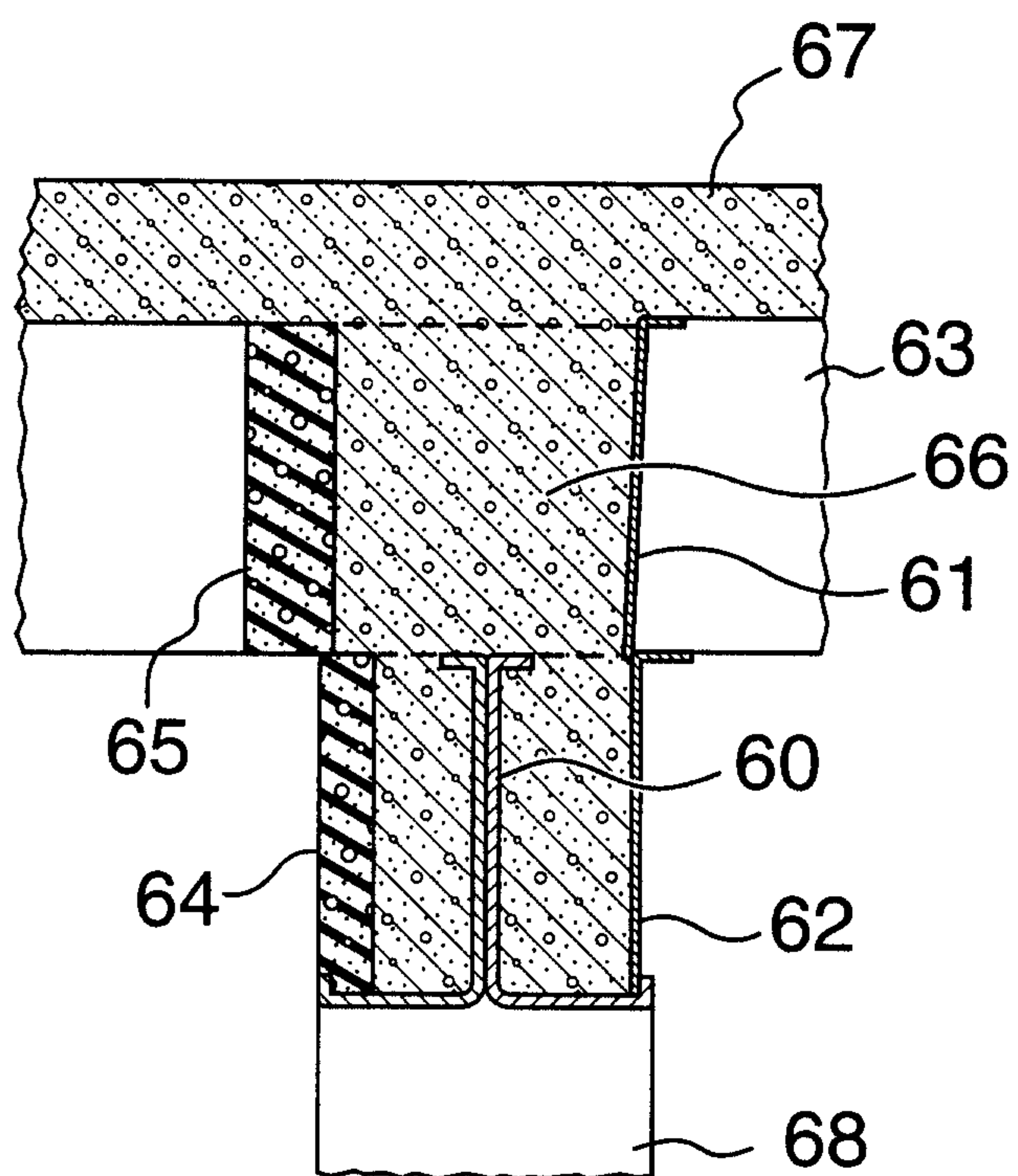


FIG. 17