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(54) **Concrete slab for a platform floor.**

(57) A concrete slab for false floors has a downwardly extending peripheral reinforcing rib, stiffening ribs extending across the slab in two orthogonal directions, a weight not exceeding 20 kgs for an area of 600 × 600 mm and fulfils the medium-grade requirements of Property Services Agency Specification 08.801. It may have further diagonal reinforcing ribs at the corners or a further reinforcing rib inwardly spaced from the peripheral reinforcing rib.

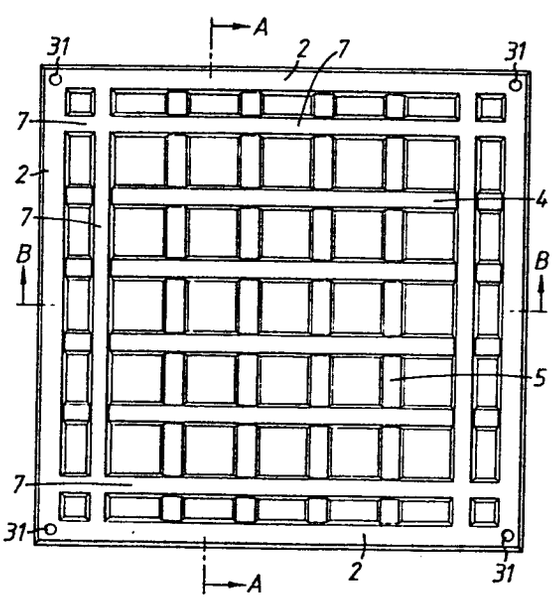

FIG.1

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CONCRETE SLAB FOR A PLATFORM FLOOR

This invention relates to concrete slabs suitable for use in raised floors or access floors known as "false floors" or "platform floors" in which the slabs may be supported at their corners and laid side-by-side to form a floor surface.

Such slabs or panels are used for providing false floors at a variety of locations, including buildings accommodating computers and other electrical equipment which are connected to cables. A false floor made up of slabs which may be lifted and removed for access as required allows cables and other items of equipment to be accommodated below the false floor surface, in a space formed between the lower surface of the slabs and the floor surface of the building on which they rest. The slabs are commonly square and supported at their corners on pedestals which stand on the floor surface of the building. The pedestals may be adjustable in height so that the slabs are supported to form a perfectly stable, level surface when laid side-by-side. The upper surfaces of the slabs are flat and are generally covered by carpeting or other surface finish.

Slabs for use in false floors have to meet a number of requirements. They must have a high strength to withstand both and point loads and distributed loads. The slabs must have a low deflection under load in order to provide a stable support surface and they should have a high degree of dimensional accuracy in order to be transferable and interchangeable. The slabs should be structurally stable, resistant to fire unaffected in performance by moisture and have sound

insulating properties; the latter is important as the space between the slabs and the floor of the building form a resonant cavity. It is also desirable that the slabs should have the lowest possible weight to facilitate handling, removal and replacement of the slabs and to minimise the load imposed on the supporting structure.

Performance Specification MOB 08.801 for platform floors, published in August 1985 by the Property Services Agency of the United Kingdom Government Department of the Environment, lays down test standards to be observed for false floor slabs.

False floor slabs have been made of a variety of materials including metals such as aluminium, wood, metal/wood composites and light-weight concrete/metal composites. European Patent Application 0135240 of CBR Beton discloses a floor slab of concrete containing constituents such as expanded glass, expanded clay or polystyrene balls to reduce the weight of the slab. However, hitherto there has not been produced a concrete false floor slab of acceptable weight which meets all the standards laid down in Specification MOB 08.801 mentioned above, notably regarding failure load and resistance to impact by soft and hard bodies falling on to the flat upper surface of the slab.

According to one aspect of the invention, there is provided a rectangular reinforced concrete slab for a platform floor having a flat upper surface and having on its underside a downwardly projecting peripheral reinforcing rib extending around the slab periphery and a plurality of downwardly projecting stiffening ribs extending across the underside of the slab in two orthogonal directions, the stiffening ribs extending in at least one direction extending to a lesser depth

below the upper surface of the slab than the peripheral rib, the slab having a weight not exceeding 20 Kg when having a square upper surface area of 600 x 600 mm and fulfilling the medium-grade structural requirements of Property Services Agency Performance Specification 08.801.

Rectangular slabs for platform floors, including square slabs, may be made in various dimensions but a square slab of surface dimensions 600 mm x 600 mm, which is intended to be supported by a pedestal at each of its four corners without intermediate pedestals between the corners, is generally regarded as a standard size of floor slab. The upper weight limit of the slabs according to the invention mentioned herein is quoted as referring to slabs of this standard size. It will be understood however that there may be made slabs of other dimensions which are within the scope of the invention and of which the weight does not exceed 20 Kg per 0.36 m^2 of area (i.e. the area of the standard square slab).

In one embodiment of the invention, the underside of the slab is provided with an inner reinforcing rib extending continuously around the slab adjacent and within the peripheral reinforcing rib, the inner reinforcing rib extending below the slab upper surface to substantially the same depth as the peripheral rib. The reinforcing ribs may be trapezoidal in cross-section and extend to a depth of about 40 mm below the upper slab surface. The peripheral rib may have a lower surface width of about 25 mm, the inner reinforcing rib a lower surface width of about 18 mm, and the inner reinforcing rib may be about 75 mm from the edge of the slab (measured up to the mid-point, that is the longitudinal axis of symmetry, of the rib).

The stiffening ribs running in one direction may extend to a depth of 34 mm, and the stiffening ribs in the other direction to a depth of 28 mm, from the slab surface. The ribs may be separated by flat-bottomed recesses, the bottoms of the recesses forming the underside of the main body of the slab itself forming the floor surface.

It has been found that such a slab, of area 600 mm x 600 mm and weighing not more than 20 Kg, when supported by suitable pedestals at the four corners, can fulfill the medium-grade structural requirements given in the above-mentioned Performance Specification 08.801, paragraphs P4.01 to P4.05. These requirements may be summarized as follows.

1. The slab shall support a load of 4.5 KN distributed over an area of 300 mm square, or of 3.0 KN over 25 mm square, or of 8.0 KN/m^2 uniformly distributed, at any point without deflection exceeding 0.4% of the shortest span and without residual deflection exceeding 0.50 mm.

2. The slab shall support three times these loads for 5 minutes without failure.

3. The slab shall withstand impact by a 40 Kg soft mass dropped from a height of 1 metre, and by a 4.5 Kg hard mass having a 50 mm hemispherical end and dropped from a height of 600 mm.

4. The slab shall not move more than 1.5 mm horizontally, or 1.00 mm vertically, when subjected to 250,000 cycles of the pedestrian dynamic load test quoted in Paragraphs T 14 and T 34 of the Performance Specification.

In another embodiment of the invention, the portions of the underside of the slab adjacent the angles of the slab are provided with reinforcing ribs extending diagonally across the slab. The diagonal reinforcing ribs may be of the same dimensions as the peripheral ribs, for example a depth of about 40 mm, a trapezoidal cross-section and a lower surface width of about 25 mm. In this embodiment the stiffening ribs running in one direction may have a depth of about 40 mm and those in the transverse direction a depth of about 34 mm.

In yet another embodiment, the underside of the slab is provided with diagonal reinforcing ribs extending across the whole of the slab between opposite corners. In this embodiment the peripheral reinforcing rib may again have a depth of 40 mm but the diagonal ribs may have a lesser depth, for example 34 mm.

In the two last-mentioned embodiments the recesses between the reinforcing ribs may be provided with auxiliary ribs of triangular cross-section extending parallel to the slab edges.

Slabs according to the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows the underside of a concrete slab,

Figures 1A and 1B are cross-sections of the slab of Figure 1 along A-A and B-B respectively,

Figure 2 shows another slab,

Figures 2A and 2B are cross-sections along A-A and B-B respectively of the slab of Figure 2,

Figure 3 shows yet another slab,

Figures 3A and 3B are cross-sections along A-A and B-B respectively of the slab of Figure 3,

Figure 4 is a partial cross-section of the slab of Figure 1 on an enlarged scale.

The slab of Figure 1 comprises a square body of concrete having a flat upper surface of dimensions 600 mm x 600 mm to serve as a floor surface. In use, the slab is supported by pedestals at its four corners to form a platform floor. The underside of the slab is provided with a peripheral trapezoidal strengthening rib 2 extending around the whole periphery of the slab having a lower edge 40 mm below the upper surface of the slab and reinforced by steel reinforcing bars 3. The underside is also provided with orthogonal trapezoidal stiffening ribs 4 and 5 extending across the slab between the opposite sides of the peripheral rib and parallel to respective slides of the slab. The lower surfaces of ribs 4 are 34 mm below the slab upper surface, those of the ribs 5 are 28 mm below the upper surface. Ribs 4 and 5 are reinforced by steel bars 6. Ribs 2 have a width at their lower end of 25 mm, and ribs 4 and 5 a width of 18 mm at their lower end. The ribs are separated by flat-bottomed recesses and the thickness of the slab in the recesses is 14 mm.

In order to further reinforce the edges of the slab an inner trapezoidal strengthening rib 7 is provided. Rib 7 also extends 40 mm below the upper surface and is reinforced by steel bar 8. The lower surface of rib 7

has a width of 18 mm and the mid-point of rib 7 is 75 mm horizontally from the edge of the slab. The horizontal separation between the parallel ribs 4 and 5, and between ribs 4 and 5 and the inner peripheral rib 7, is 90 mm.

The slab of Figure 2 comprises a square body of concrete having a flat upper surface 11 of dimensions 600 mm x 600 mm. The underside of the slab is provided with a strengthening rib 12 of trapezoidal cross-section projecting downwardly and extending around the whole periphery of the slab. The depth of rib 12 is 40 mm and its lower surface width 25 mm. The underside is also provided with stiffening ribs 13 extending across the underside parallel to one pair of sides of the slab. Ribs 13 are also of trapezoidal cross-section and extend to the same depth below the slab as ribs 12.

The slab is also provided with stiffening ribs 14 extending across the slab orthogonally to and between ribs 13. Ribs 14 are of trapezoidal cross-section and extend downwardly to a lesser depth, 34 mm, than ribs 12 and 13. Ribs 12, 13 and 14 are all provided with longitudinal steel reinforcing bars embedded in the concrete.

Ribs 12, 13 and 14 together form a pattern of squares on the underside of the slab and within these squares, except for the squares at the corners of the slab, there are provided auxiliary ribs 15 of triangular cross-section and extending downwards by a lesser depth than ribs 14. These auxiliary ribs are arranged parallel to both pairs of sides of the slab and extend between the opposite ribs 12, 13, 14 defining the squares.

The squares at the corners of the slab are not provided with auxiliary ribs 15 but instead comprise diagonal reinforcing ribs 16 of depth and cross-section similar to ribs 12 and provided with similar reinforcing bars. The lower surfaces of ribs 16 are flush with those of ribs 12. The purpose of diagonal ribs 16 is to give the slab increased strength adjacent the corners, where the maximum stress is concentrated when the slab is supported at its corners and a load is imposed on the upper surface of the slab.

The slab shown in Figure 3 is also square, having a flat upper surface 21 of dimensions 600 mm x 600 mm and a reinforcing rib 22 of trapezoidal cross-section extending downwardly around the whole periphery of the slab. The depth of rib 22 is 40 mm and its lower surface width 25 mm. The slab has one reinforcing rib 23 similar to ribs 22 extending across the slab parallel to one pair of sides of the slab and also has stiffening ribs 25 of triangular cross-section extending in both orthogonal directions between the reinforcing ribs.

The slab is also provided with a further reinforcing rib 24 extending across the slab orthogonal to rib 23 and with diagonal reinforcing ribs 26 extending between opposite corners of the squares defined by ribs 22, 23 and 24. Ribs 24 and 26 are of lesser depth (34 mm) than ribs 22 and are reinforced by embedded steel bars in the same manner as ribs 22. As in the slab of Figure 2, these diagonal ribs increase the strength of the slab at its corners which are subject to stress when the slab is supported at the corners and bears a load.

The slabs of all the Figures have a maximum depth of 40 mm and, as shown in the drawings, the outside surfaces of the peripheral ribs are inwardly inclined in the downward direction so that the maximum horizontal dimensions of the slab are those of its upper surface (600 mm x 600 mm). The slab upper surfaces may be accurately dimensioned to provide a close fit when the slabs are laid side-by-side to form a false floor. The edges of the slabs may be provided with a protective lipping of a plastics material such as PVC. Alternatively, as shown in Figure 4 the edges of the slabs may be provided with a metal edging 32 which is preferably cast into the edge of the slab when the slab is cast in a mould. Such metal edging may be provided on all the slabs of Figures 1-3.

As shown in the drawings, the lower surfaces of the peripheral reinforcing rib at the corners of the slab are provided with recesses 31, of depth of about 2 mm. These recesses assist correct location of the slab on the pedestals used to support the corners of the slab when the slab is installed in a building. The pedestals may be provided with bosses upstanding from the pedestal surface to engage the recesses. The recesses may also assist correct location of the metal reinforcing bars within the concrete during casting.

A hole may be provided in the panel to accommodate a service outlet box to allow passage of cables, pipes and the like through the slab and additional reinforcing ribs may be provided surrounding the hole. The slab may also be formed with one or more apertures to facilitate lifting and handling of the slab.

The preferred composition of the concrete used for casting the slab is as follows:

Cement	from 650 to 750 Kg
Inert filler of density from 800 to 1000 Kg/m^3 and particle size up to 3 mm	from 750 to 850 Kg
Pulverized fuel ash	from 120 to 160 Kg
Micro silica slurry	from 70 to 90 litres
Steel fibres	from 45 to 60 Kg.

The slabs of all the Figures are formed by casting a concrete having the following compositions per cubic metre:

Cement	700 Kgs
Inert filler (up to 3 mm diameter)	800 Kgs
Pulverised fuel ash	140 Kgs
Micro silica slurry (Emsac F 100, a slurry containing 50% silica in 50% water)	80 litres
Steel fibres (0.4 mm x 30 or 0.4 mm x 25 mm)	52 Kgs

The slabs are formed by conventional casting methods and the reinforcing bars are incorporated in the reinforcing ribs in known manner.

All the above-described slabs have a weight not exceeding 20 Kg and meet the requirements of Performance Specification MOB 08.801.

CLAIMS

1. A rectangular reinforced concrete slab for a platform floor having a flat upper surface and having on its underside a downwardly projecting peripheral reinforcing rib extending around the slab periphery and a plurality of downwardly projecting stiffening ribs extending across the underside of the slab in two orthogonal directions, the stiffening ribs extending in at least one direction extending to a lesser depth below the upper surface of the slab than the peripheral rib, the slab having a weight not exceeding 20 Kg when having a square upper surface area of 600 x 600 mm and fulfilling the medium-grade structural requirements of Property Services Agency Performance Specification 08.801.

2. A slab according to claim 1, in which the underside of the slab has an inner reinforcing rib extending continuously around the slab adjacent and within the peripheral reinforcing rib, the inner reinforcing rib extending below the slab upper surface to substantially the same depth as the peripheral rib.

3. A slab according to claim 2, in which the peripheral and inner reinforcing ribs are of substantially trapezoidal cross-section and extend to a depth of about 40 mm below the slab upper surface, the peripheral rib has a lower surface width of about 25 mm and the inner reinforcing rib has a lower surface width of about 18 mm and the centre of the inner reinforcing rib is separated from the slab edge by about 75 mm.

4. A slab according to claim 2 or 3, in which the stiffening ribs extending in one direction are of lesser depth below the slab surface than the peripheral rib and the stiffening ribs extending in the other direction are of lesser depth below said surface than the ribs extending in said one direction, the strengthening and stiffening ribs being separated by flat-bottomed recesses.

5. A slab according to claim 4, in which the stiffening ribs extending in one direction have a depth below the upper slab surface of about 34 mm and the stiffening ribs extending in the other direction have a depth of about 28 mm.

6. A slab according to claim 4 or 5, in which the stiffening ribs are of substantially trapezoidal cross-section, have a lower surface width of about 18 mm and are separated from each other by a centre-to-centre distance of about 90 mm.

7. A slab according to claim 1, in which the portions of the underside of the slab adjacent the angles of the slab are provided with reinforcing ribs extending diagonally across the slab.

8. A slab according to claim 7, in which the peripheral reinforcing rib and the diagonal reinforcing ribs are of substantially trapezoidal cross-section, extend below the slab upper surface by about 40 mm and have a lower surface width of about 25 mm.

9. A slab according to claim 8, in which the stiffening ribs extending in one direction have a depth below the slab upper surface of about 40 mm and the stiffening ribs extending in the other direction have a depth of about 34 mm.

10. A slab according to claim 1, in which the underside of the slab is provided with diagonal reinforcing ribs extending across the slab between opposite corners of the slab.

11. A slab according to claim 10, in which the peripheral reinforcing rib extends downwardly to a depth of about 40 mm below the slab upper surface and the diagonal reinforcing ribs extend to a depth of about 34 mm, the reinforcing ribs being of substantially trapezoidal cross-section and having a lower surface width of about 25 mm.

12. A slab according to any one of claims 7 to 11, in which the recesses formed between the reinforcing ribs are provided with auxiliary ribs of triangular cross-section extending parallel to the slab edges.

13. A slab according to any preceding claim, in which the outside surfaces of the peripheral ribs are inwardly inclined in the downward direction.

14. A slab according to any preceding claim, in which the slab edges are provided with a protective lipping of plastics material or with a metal edging.

15. A slab according to any preceding claim, in which the lower surfaces of the peripheral reinforcing rib at the corners of the slab are provided with recesses.

16. A slab according to any preceding claim, formed by casting a concrete containing the following constituents per cubic metre:

Cement	from 650 to 750 Kg
Inert filler of density from 800 to 1000 Kg/m^3 and particle size up to 3 mm	from 750 to 850 Kg
Pulverized fuel ash	from 120 to 160 Kg
Micro silica slurry	from 70 to 90 litres
Steel fibres	from 45 to 60 Kg.

17. A concrete slab for a platform floor, substantially as hereinbefore described with reference to Figures 1, 2 or 3 or 4 of the accompanying drawings.

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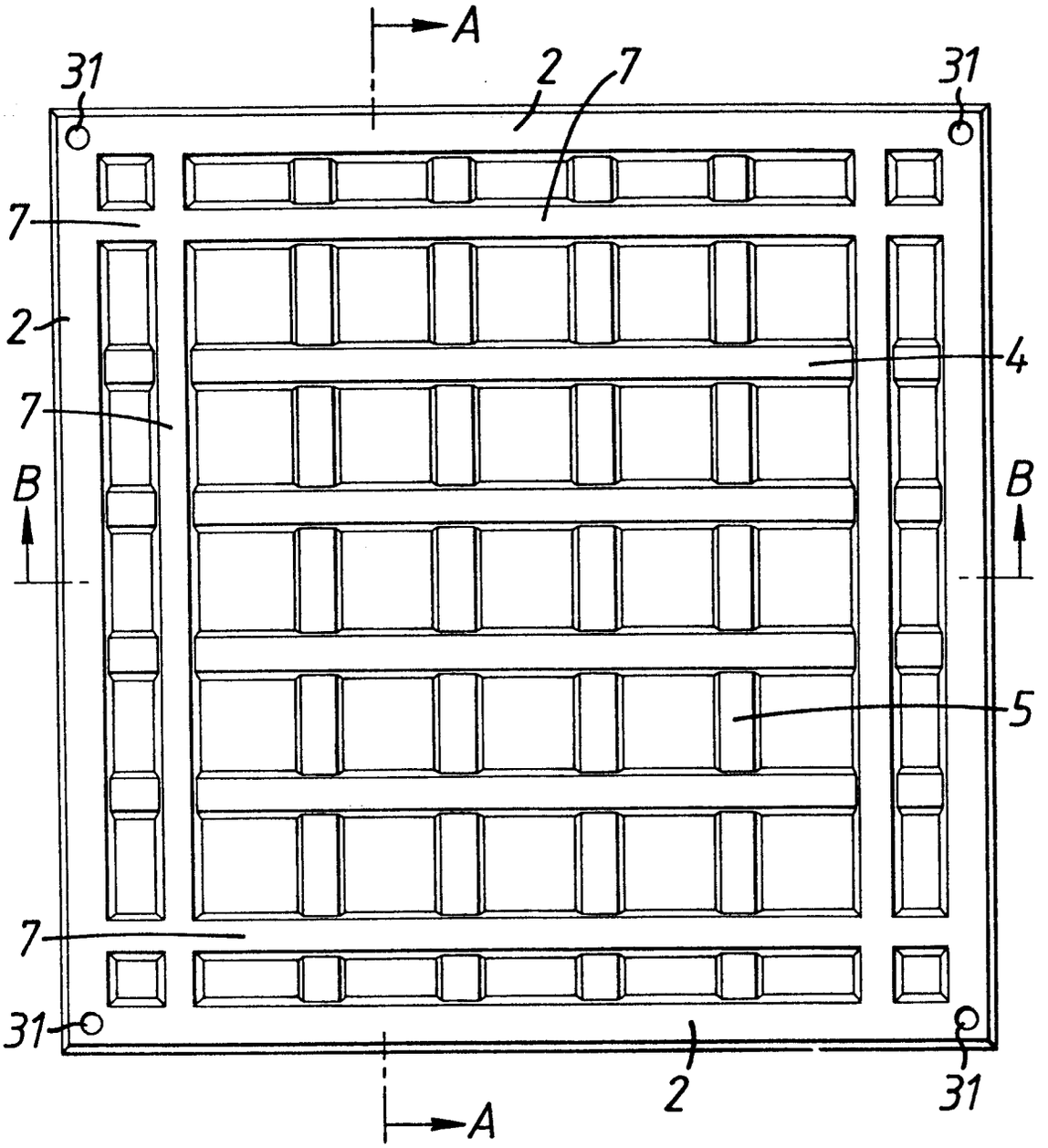

FIG.1

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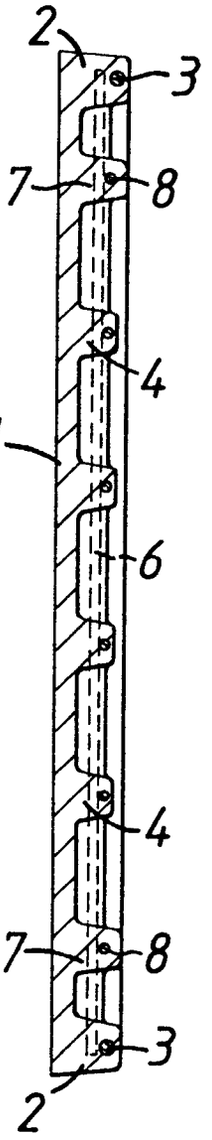

FIG.1A

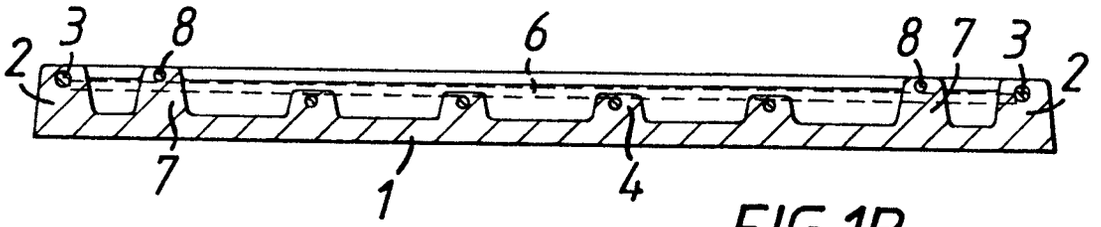

FIG.1B

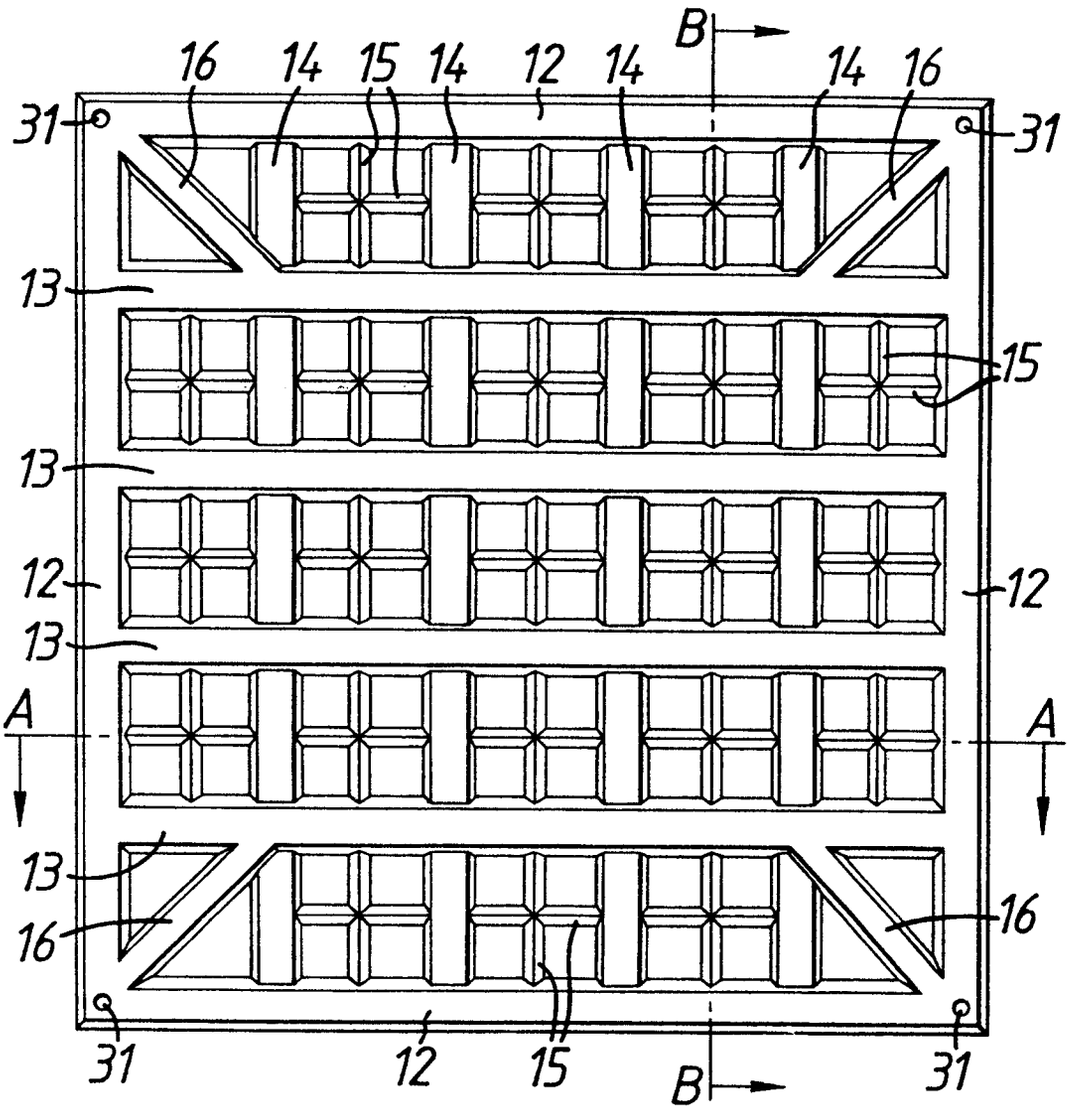
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FIG. 2

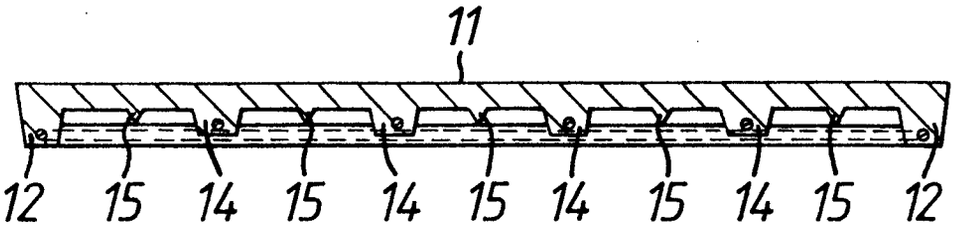

FIG. 2A

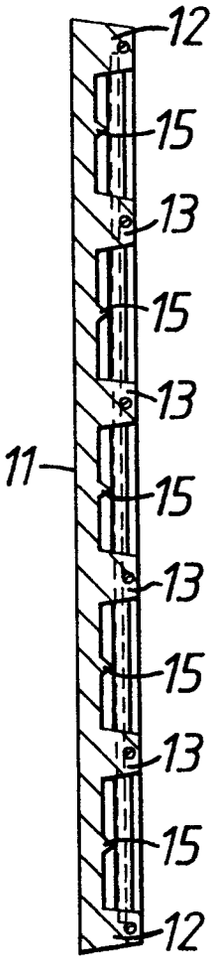

FIG. 2B

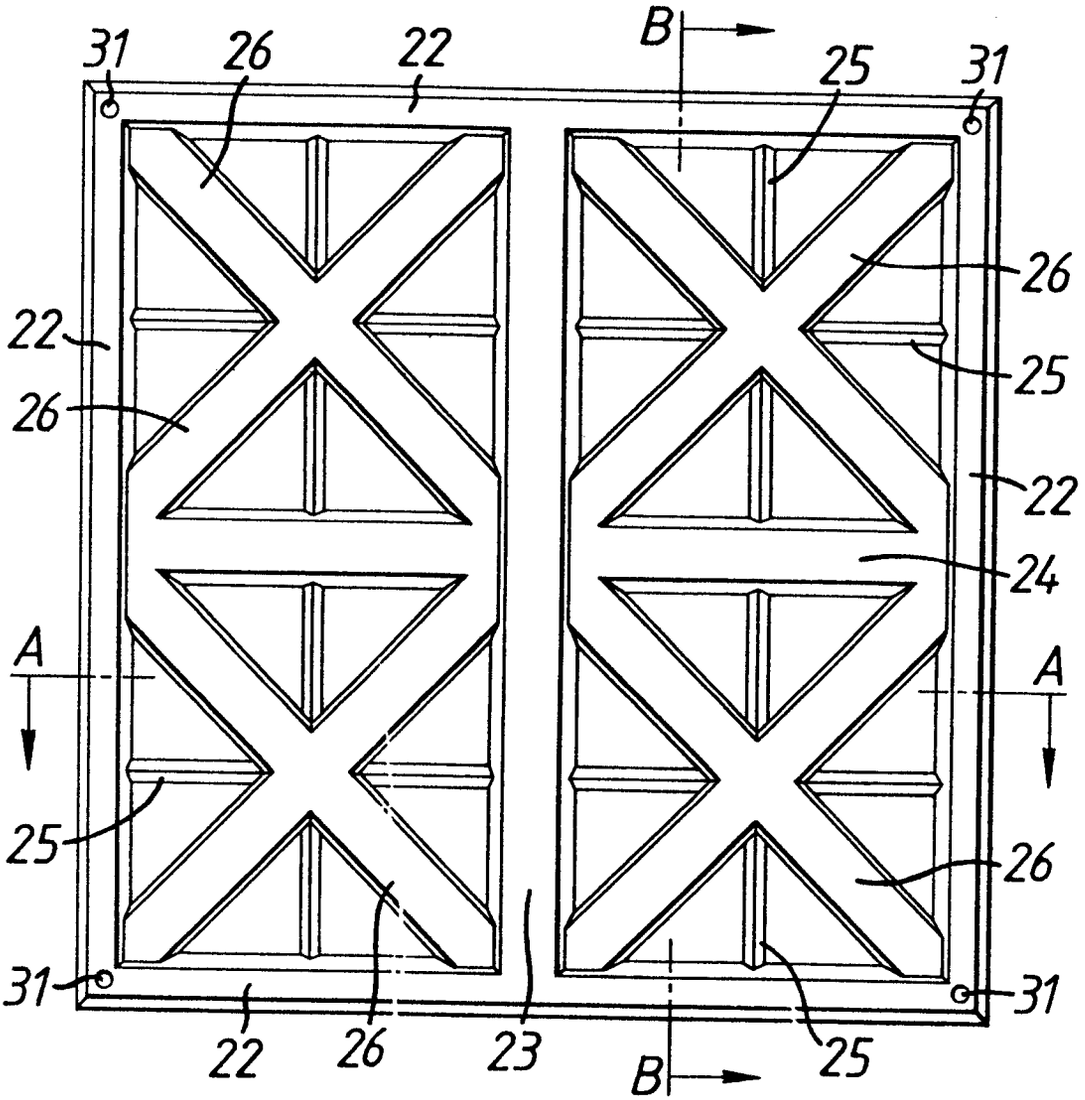

FIG. 3

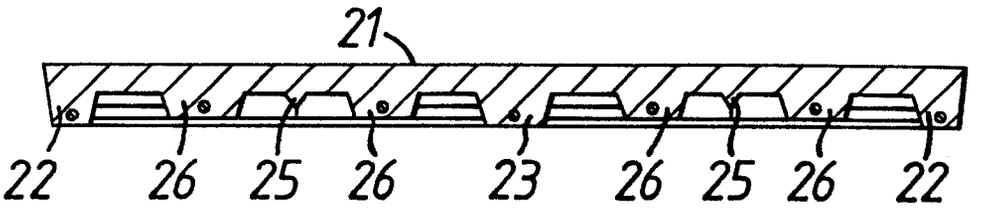

FIG.3A

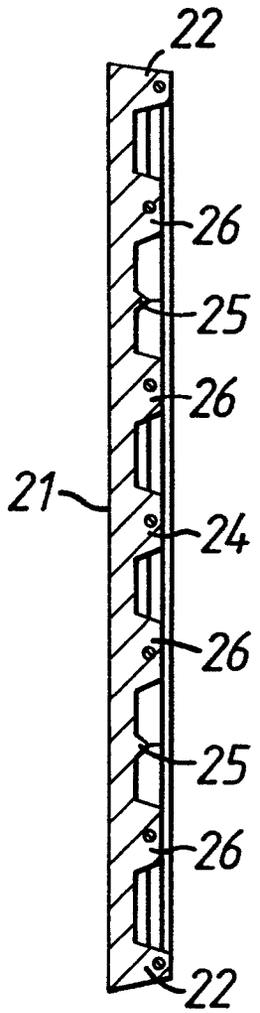

FIG.3B

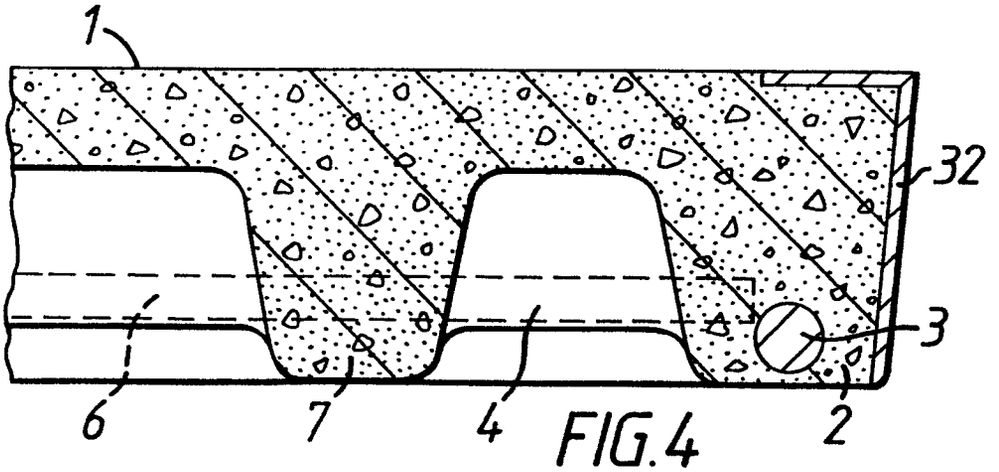

FIG.4