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(54) **Thermal insulating floor panel with reinforcement and supported floor structure**

(57) A floor structure 10 includes two panels 12, which abut. Each comprises a slab 14 of thermal insulation material. There is reinforcement 16, 18 at oppositely directed faces of the slab 14. The lower reinforcement 18 provides resistance in tension and may be a relatively

thin layer formed by strands of reinforcing material running generally parallel to the lower face 20 of the slab 14. The upper reinforcement 16 is preferably a body of material which is incompressible relative to the slab 14, such as a concrete, screed or other cementitious material.

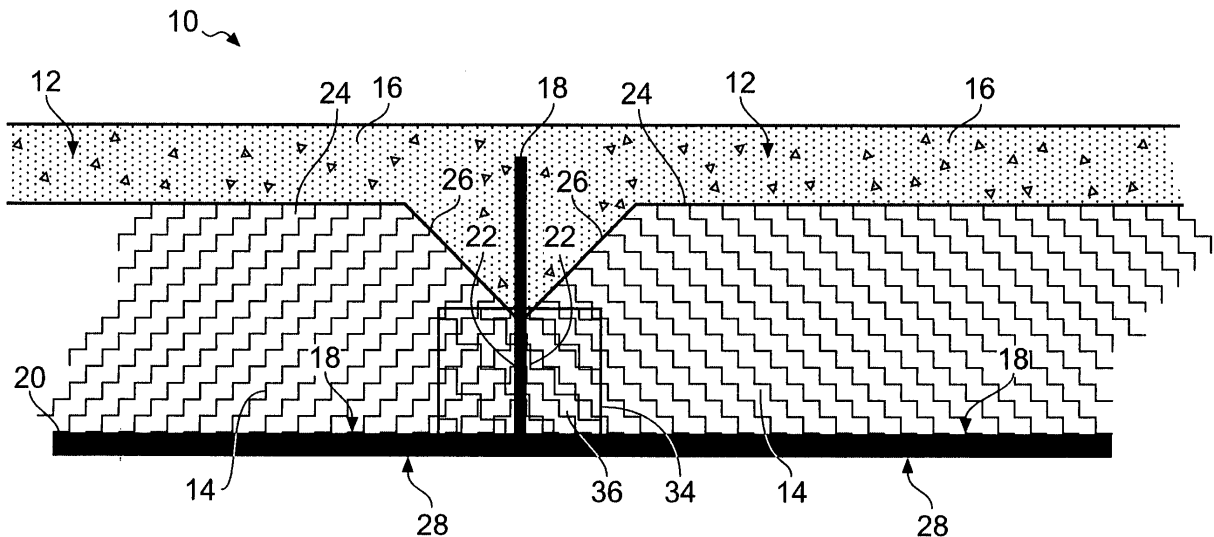


Fig. 1

## Description

**[0001]** The present invention relates to flooring and in particular, to insulated flooring for buildings, such as domestic dwellings.

**[0002]** The present invention provides a floor panel comprising:

a slab of thermal insulation material;  
 reinforcement of two faces of the slab, the faces being generally oppositely directed;  
 the reinforcement providing resistance in tension and in compression at respective faces, to strengthen the slab against buckling when in use as flooring.

**[0003]** The slab is preferably of foam material, preferably a rigid foam material, and may be a synthetic material such as polystyrene, polyurethane, urea formaldehyde or other polymeric foam with thermal insulation properties adequate for the intended application.

**[0004]** The reinforcement preferably provides resistance in tension by means of strands of reinforcing material. The strands may run generally parallel to the respective face. The strands may be located at the face and may be adhered to the face. The strands may form a mesh which may be woven. The strands may be of a synthetic material or metal.

**[0005]** The means providing resistance in tension preferably extends around an edge of the slab toward the reinforcement against compression.

**[0006]** The reinforcement preferably provides resistance in compression by means of a body of material which is attached to the slab and is incompressible relative to the slab. The attached body of material may be at the face of the slab and may be adhered to the face or cast on to the face. The attached body may be of settable material which may be cementitious such as concrete or screed and may contain insulating bodies such as bodies of polystyrene. Alternatively, the attached body may be of sheet material such as a cement or concrete particle board, wood fibre board or board strengthened with other types of fibre.

**[0007]** The slab preferably has principal faces separated by the thickness of the slab material, at least one edge of one face being chamfered to accommodate additional reinforcement.

**[0008]** In a second aspect, the invention provides a floor structure comprising:

at least one slab of thermal insulation material;  
 having an upper face reinforced in compression;  
 and a lower face reinforced in tension.

**[0009]** The floor structure preferably comprises a plurality of panels in accordance with the first aspect of the invention. The panels preferably abut neighbouring panels at their edges. The floor structure is preferably supported above ground level by foundation structures. The

foundation structures may carry at least one rigid tubular member received within rebates in the slab to provide support therefor. The or each tubular member may be received in a rebate at a corner of a slab. The or each tubular member may span the gap between neighbouring slabs to support a plurality of slabs. The tubular member or members may contain thermal insulation material.

**[0010]** An example 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 an enlarged vertical section through part of a floor structure according to the present invention;

Fig. 2 is a plan view of the floor structure showing the section line 1-1 for Fig. 1; and

Fig. 3 is a vertical section along the line 3-3 of Fig. 2.

**[0011]** Fig. 1 shows part of a floor structure 10 which includes two panels 12. Fig. 1 shows the edges of the panels 12, where they abut. Each panel comprises a slab 14 of thermal insulation material. There is reinforcement 16, 18 at oppositely directed faces of the slabs 14, namely the faces which, in use, are the upper and lower faces respectively.

**[0012]** The lower reinforcement 18 provides resistance in tension. The upper reinforcement 16 provides resistance in compression. The combination has the effect of strengthening the slab against buckling when used as flooring.

**[0013]** In more detail, the slab 14 is a slab of foam material, such as a synthetic foam of a polymeric material such as polystyrene. Other polymeric materials could be used, such as polyurethane or urea formaldehyde. The slab is preferably a rigid foam having thermal insulation properties adequate for the intended application. The slab may be square, rectangular or other shape and of a size convenient for handling and for speedy construction.

**[0014]** The lower reinforcement 18 is in the form of a relatively thin layer formed by strands of reinforcing material running generally parallel to the lower face 20 of the slab 14. The strands may run across the lower face 20 and be adhered to it, or may be embedded within the lower face 20. The strands may be of various different materials, such as nylon, carbon, glass fibre or metal. The strands may form a mesh to resist in tension in more than one direction, and the mesh may be woven.

**[0015]** The lower reinforcement 18 may extend around the edge 22 of the slab 14 and project upwardly, for reasons to be described.

**[0016]** The upper reinforcement 16 is a body of material which is incompressible relative to the slab 14. The reinforcement 16 extends across the upper face 24 of the slab 14 and is preferably adhered to the face 24 by its own action or by additional adhesive. In a particularly preferred arrangement, the upper reinforcement 16 is a

body of settable material such as concrete, screed or other cementitious material and which may incorporate bodies of insulation material such as polystyrene, or fibres of reinforcing material such as plastic, carbon fibre, glass fibre or metal, for increased thermal and strength characteristics. Alternatively, the reinforcement 16 may be in the form of a sheet of material such as composite board or cement or concrete particle board, wood fibre board or other fibre reinforced board, and may be attached to the slab 14 by adhesive.

**[0017]** Edges of the slabs 14 are rebated at 26. The rebates 26 accommodate additional reinforcement 16, thus further strengthening the panels 12 and the joints between them. In particular, the lower reinforcement 18 extends up to the rebates 26, allowing the upper and lower reinforcements 16, 18 to be secured together.

**[0018]** The lower face of the structure 10 is preferably finished by means of a damp-proof membrane 28 across the lower face of the reinforcement 18.

**[0019]** Several panels 12 are arrayed side by side, as can be seen in Fig. 2, to form the structure 10. Accordingly, it is convenient if the panels 12 are square or rectangular, or another shape which readily tessellates to form a continuous floor.

**[0020]** It is advantageous if the floor structure is formed by first abutting the slabs 14 and then casting the upper reinforcement 16 across the whole structure 10 simultaneously, so that the upper reinforcement 16 is seamless across the boundaries of the slabs 14, and the upwardly extending extensions of the lower reinforcements 18 are embedded in the body of upper reinforcements 16.

**[0021]** The structure 10 is preferably supported on foundation structures such as piles or pile heads 30 (Fig. 3) to leave a cavity 32 beneath the structure 10, providing additional insulation, protection from damp etc.

**[0022]** Support of the structure 10 on the piles 30 is optionally further improved by the use of short cylinders 34 of rigid material, such as plastic. The cylinders 34 may be square in horizontal section. They are seated on the piles 30 at corners of the panels 12, which corners in turn rest on the cylinders 34. The material of the upper reinforcement 16 extends down into the rebates 26 in the region of the cylinders 34, which are filled with a further body 36 of insulation, which may be of the same material as the slab 14, so that the material of the reinforcement 16 rests on the cylinders 34 and body 36.

**[0023]** In use, the panels 12 stand between piles 30, so that load on the floor structure 10 will tend to cause downward deflection of the panels 12, resulting in tension at the lower face and compression at the upper face. These forces are resisted by the appropriate reinforcement 16, 18. It is not necessary to reinforce the upper face in tension, or the lower face in compression, because the floor will only bear downward load. The slabs 14 provide the principal thermal insulation to the arrangement. Thus, the composite construction of the slabs 14 with upper and lower reinforcements 16, 18 provides strength for the floor, together with thermal properties.

Additional thermal insulation is provided by the cavity 32. Protection against damp penetration is provided by the damp-proof member 28. Accordingly, the structure 10 is expected to provide a cheap and effective floor structure which is light and easy to construct.

**[0024]** The skilled reader will appreciate that sizes, relative sizes and materials described above can be varied and changed according to the performance characteristics required for a particular application.

**[0025]** 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 floor panel comprising:

a slab of thermal insulation material;  
reinforcement of two faces of the slab, the faces being generally oppositely directed;  
the reinforcement providing resistance in tension and in compression at respective faces, to strengthen the slab against buckling when in use as flooring.

2. A panel according to claim 1, wherein the slab is of foam material.

3. A panel according to claim 2, wherein the slab is of a rigid foam material.

4. A panel according to claim 2 or 3, wherein the slab is of a synthetic material.

5. A panel according to claim 4, wherein the slab is of polystyrene, polyurethane, urea formaldehyde or other polymeric foam.

6. A panel according to any preceding claim, wherein the reinforcement provides resistance in tension by means of strands of reinforcing material.

7. A panel according to claim 6, wherein the strands run generally parallel to the respective face.

8. A panel according to claim 7, wherein the strands are located at the face.

9. A panel according to claim 8, wherein the strands are adhered to the face.

10. A panel according to any of claims 6 to 9, wherein the strands form a mesh.

11. A panel according to claim 10, wherein the mesh is woven.
12. A panel according to any of claims 6 to 11, wherein the strands are of a synthetic material or metal. 5
13. A panel according to any preceding claim, wherein the means providing resistance in tension extends around an edge of the slab toward the reinforcement against compression. 10
14. A panel according to any preceding claim, wherein the reinforcement provides resistance in compression by means of a body of material which is attached to the slab and is incompressible relative to the slab. 15
15. A panel according to claim 14, wherein the attached body of material is at the face of the slab.
16. A panel according to claim 15, wherein the attached body is adhered to the face or cast on to the face. 20
17. A panel according to any of claims 14 to 16, wherein the attached body is of settable material. 25
18. A panel according to claim 17, wherein the settable material is cementitious.
19. A panel according to claim 17 or 18, wherein the settable material is concrete or screed. 30
20. A panel according to any of claims 17 to 19, wherein the settable material contains insulating bodies.
21. A panel according to claim 20, wherein the insulating bodies are of polystyrene. 35
22. A panel according to any of claims 14 to 16, wherein the attached body is of sheet material. 40
23. A panel according to claim 22, wherein the sheet material is a cement or concrete particle board, wood fibre board or board strengthened with other types of fibre. 45
24. A panel according to any preceding claim, wherein the slab has principal faces separated by the thickness of the slab material, at least one edge of one face being chamfered to accommodate additional reinforcement. 50
25. A panel substantially as described above, with reference to the accompanying drawings.
26. A floor structure comprising: 55  
 at least one slab of thermal insulation material;  
 having an upper face reinforced in compression;  
 and a lower face reinforced in tension.
27. A structure according to claim 26, wherein the floor structure comprises a plurality of panels in accordance with any of claims 1 to 25.
28. A structure according to claim 26 or 27, wherein the panels abut neighbouring panels at their edges.
29. A structure according to any of claims 26 to 28, supported above ground level by foundation structures.
30. A structure according to claim 29, wherein the foundation structures carry at least one rigid tubular member received within rebates in the slab to provide support therefor.
31. A structure according to claim 30, wherein the or each tubular member is received in a rebate at a corner of a slab.
32. A structure according to claim 30 or 31, wherein the or each tubular member spans the gap between neighbouring slabs to support a plurality of slabs.
33. A structure according to any of claims 30 to 32, wherein the tubular member or members contain thermal insulation material.
34. A floor structure substantially as described above, with reference to the accompanying drawings.
35. 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.

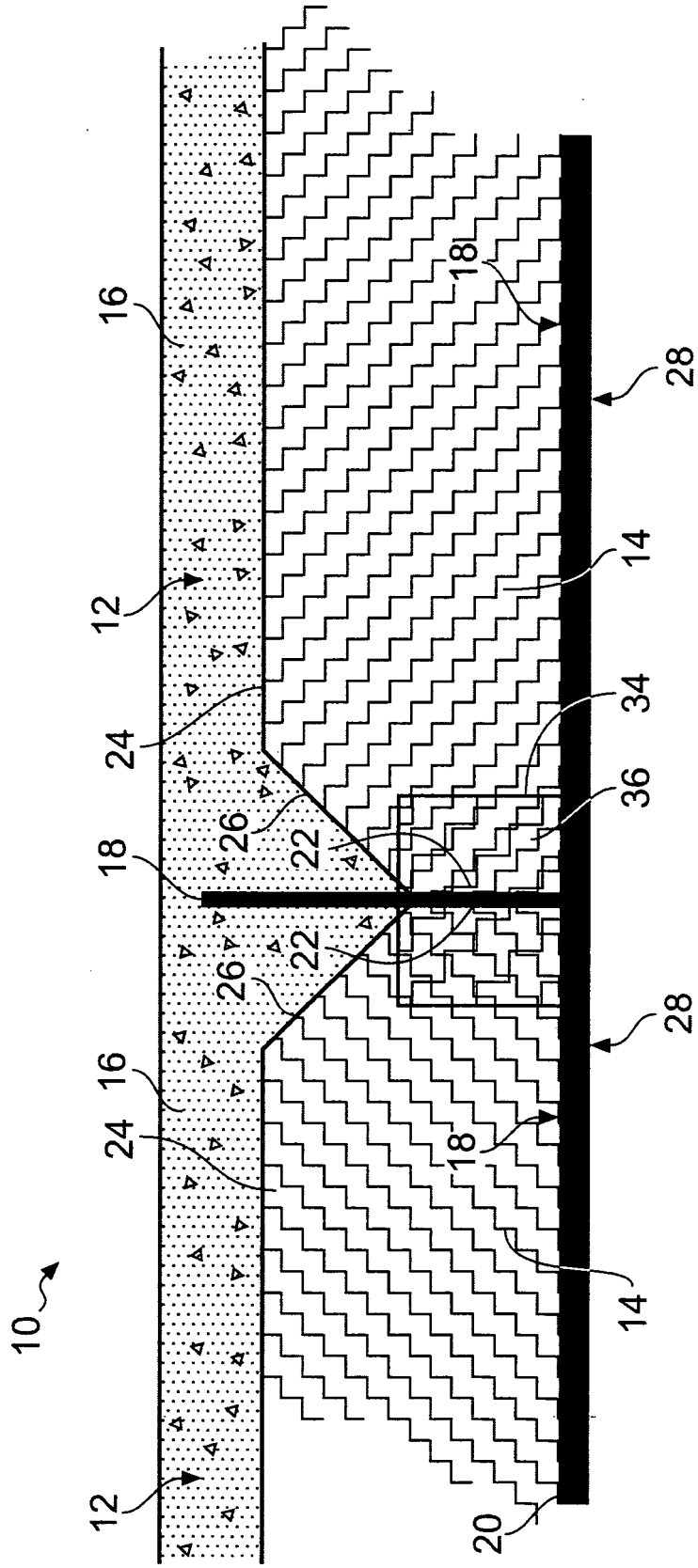


Fig. 1

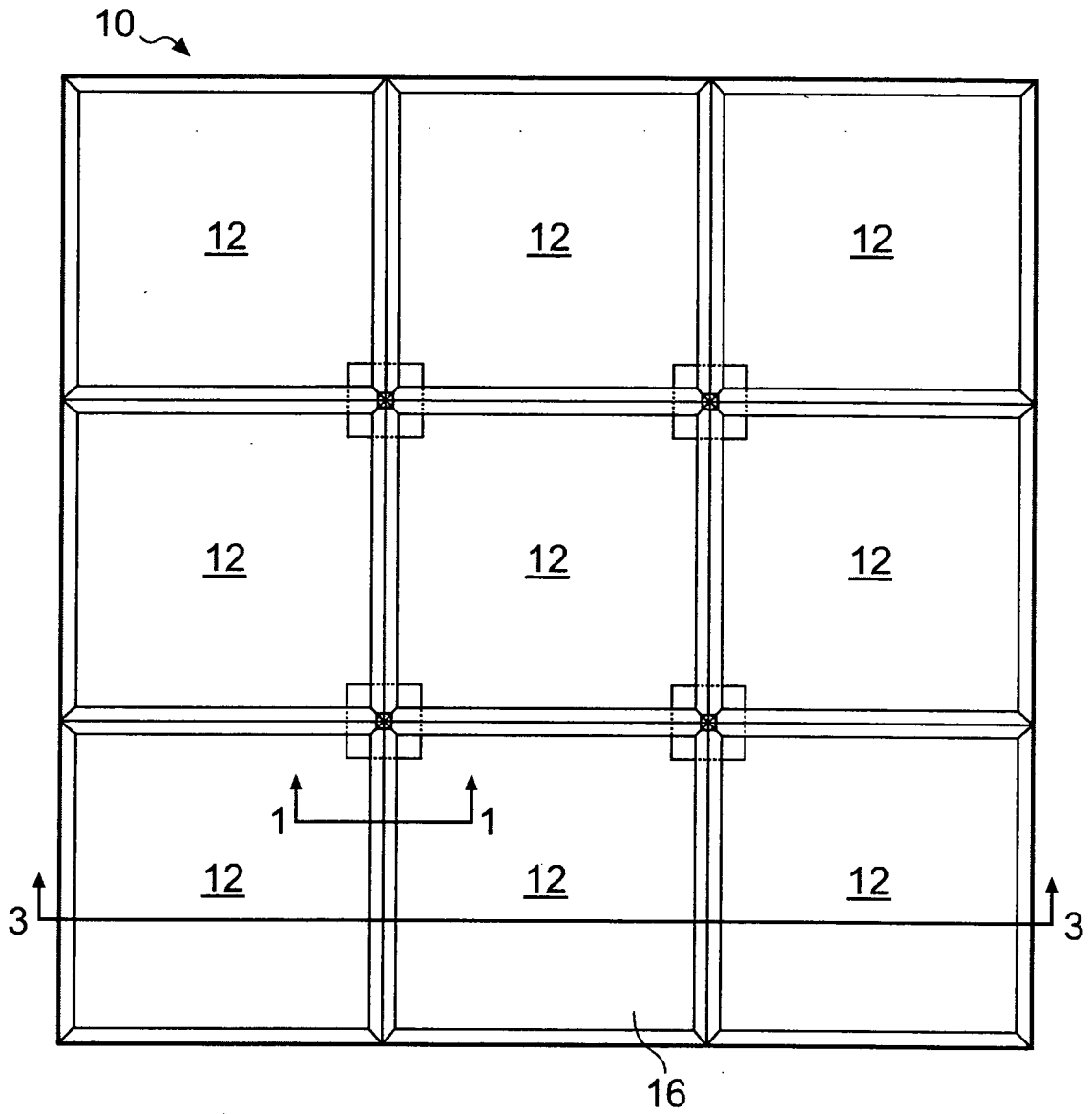


Fig. 2

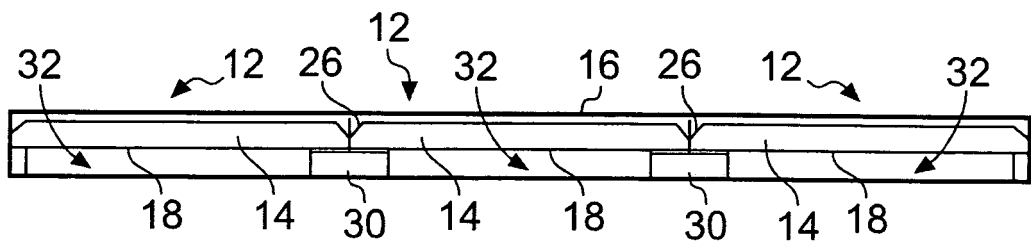


Fig. 3