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(54) External wall insulation

(57) A plurality of units (1) each of which is lighter in weight than a conventional brick or stone block, is of a square, rectangular or other form and is of substantially uniform thickness are arranged in rows with the extreme edges of each unit abutting the adjacent edges of the units on every side thereof, and a fixing plate (15) is interposed between each unit and a sub-structure or existing wall (4) and serves to secure that unit to the sub-structure or existing wall. Sheets 5 of waterproofing material and a layer 6 of impact-absorbing insulation may be provided. The external face (9) of each unit (1) may simulate brick or stone. Plastic strips (10) serve to band adjacent units together and permit relative movement therebetween. Layer 6 may be shaped to prevent capillary action and also provide drain passages for condensation. Recess (3) provide air pockets to enhance insulation and accommodate fixing means for the units (1).

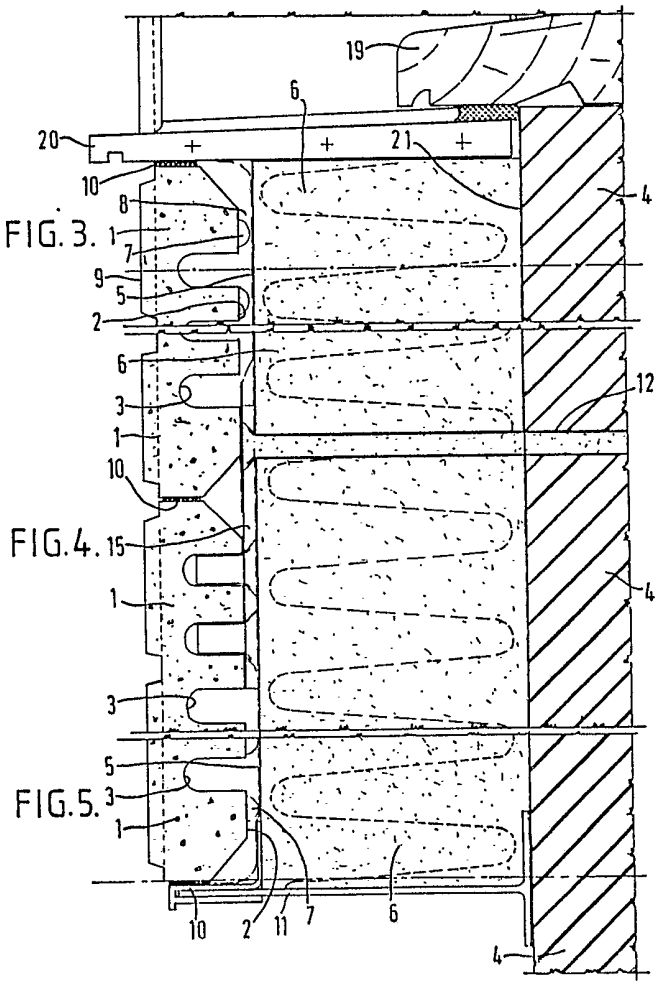

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FIG.2.

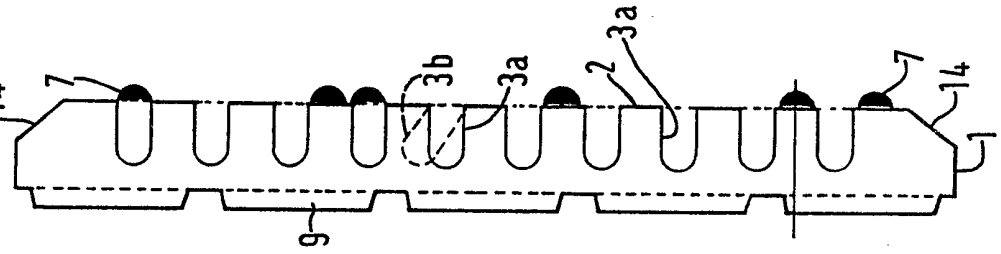
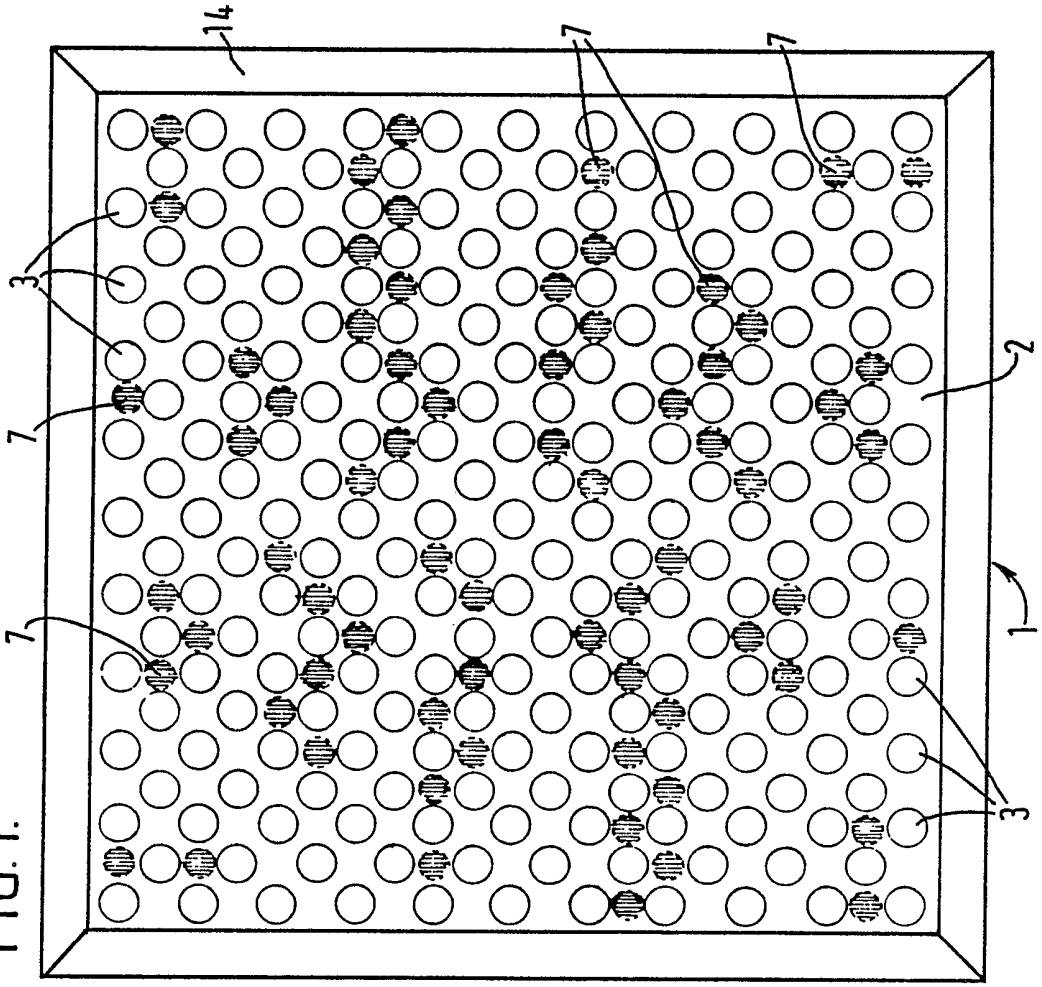


FIG.1.



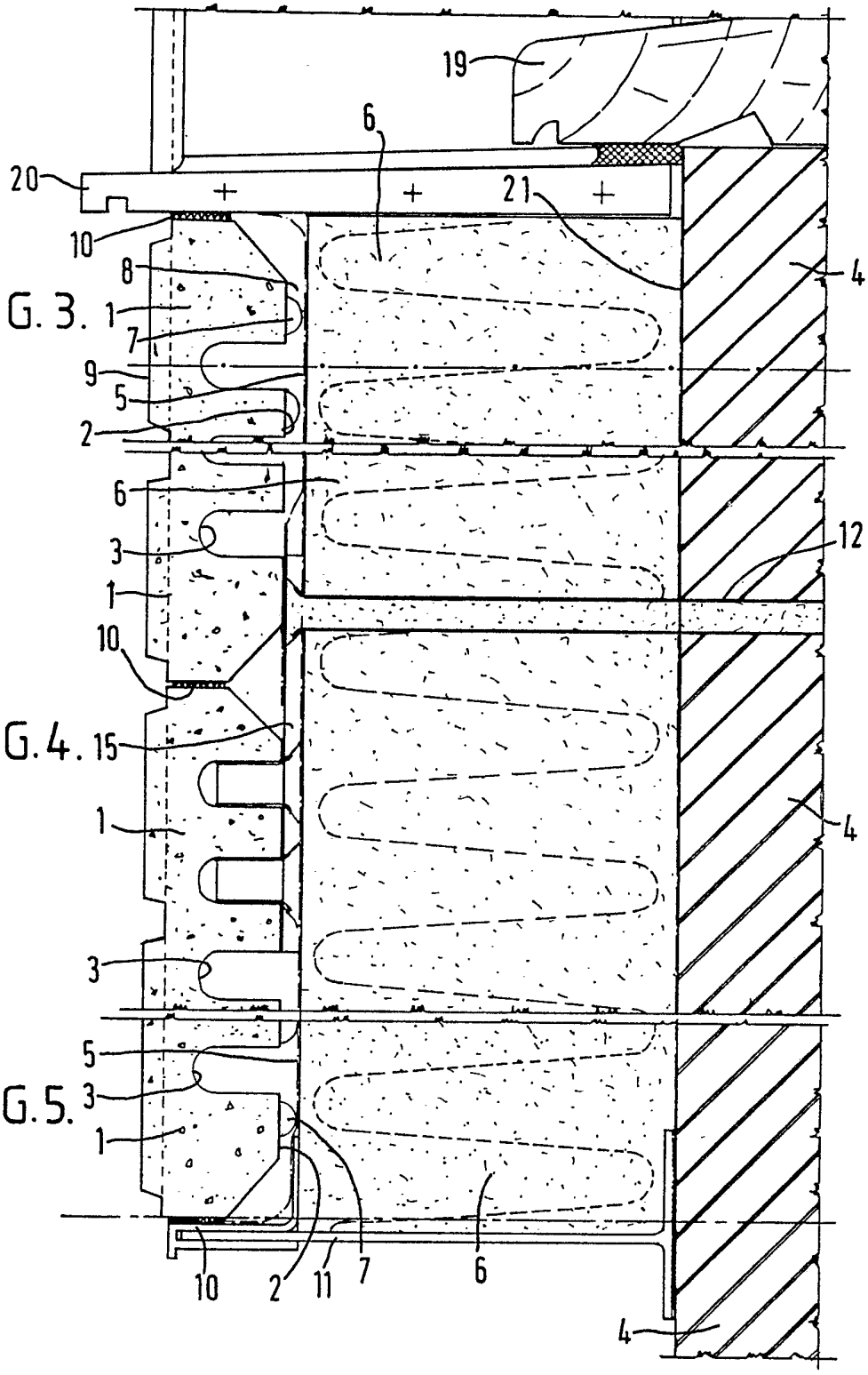


FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

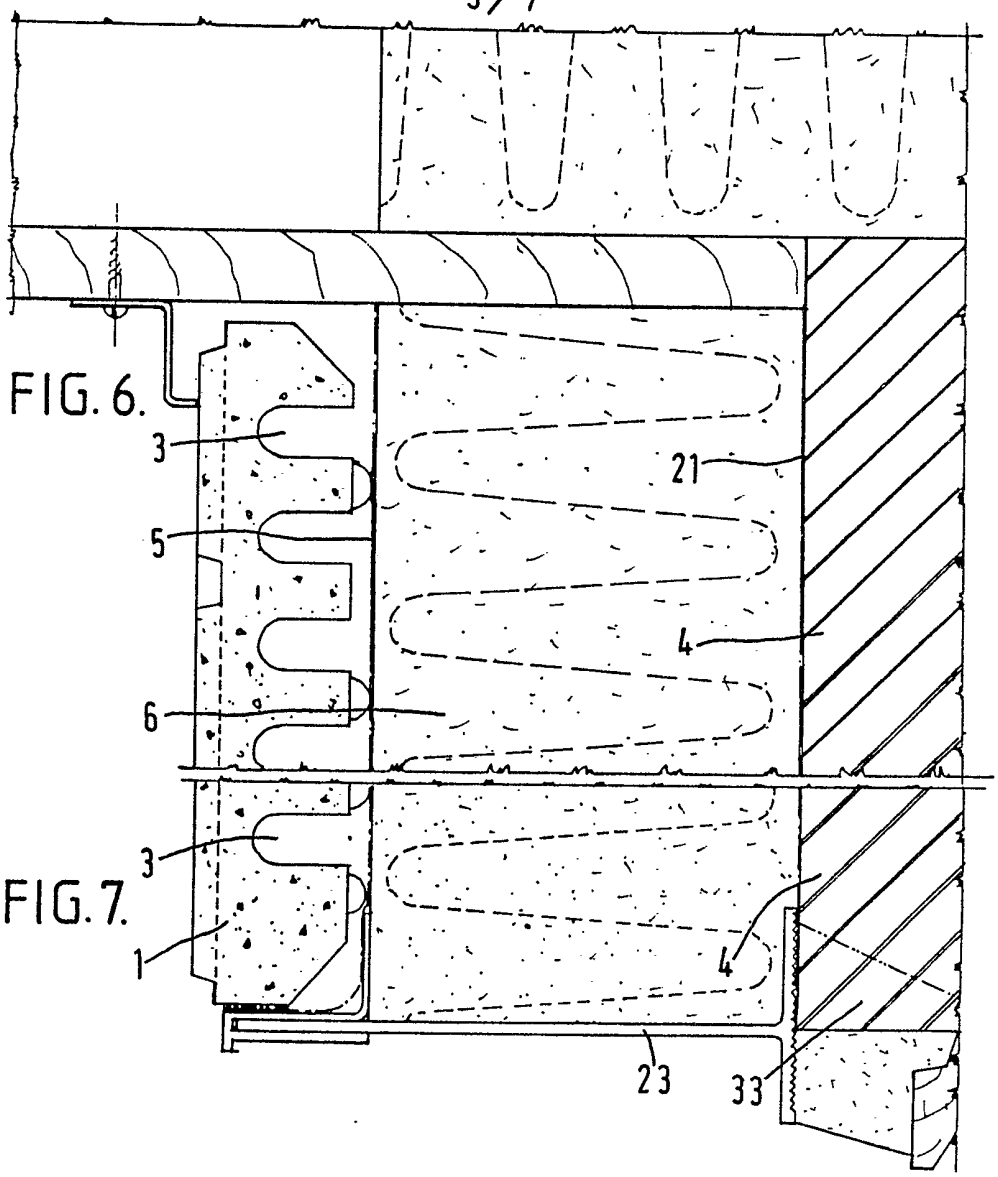
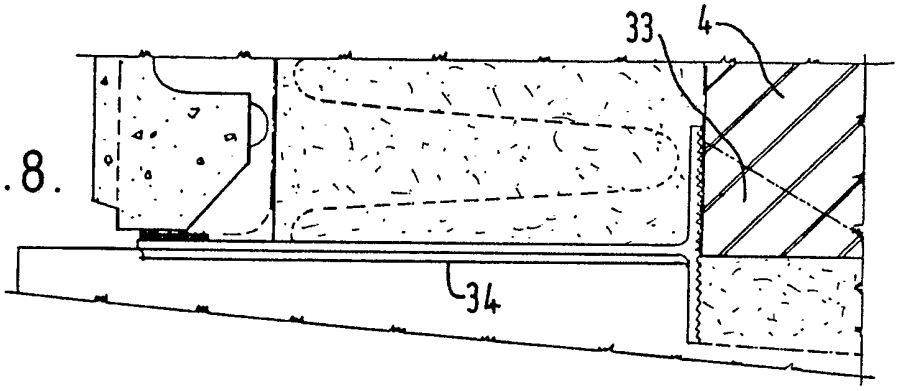


FIG. 7.

FIG. 8.



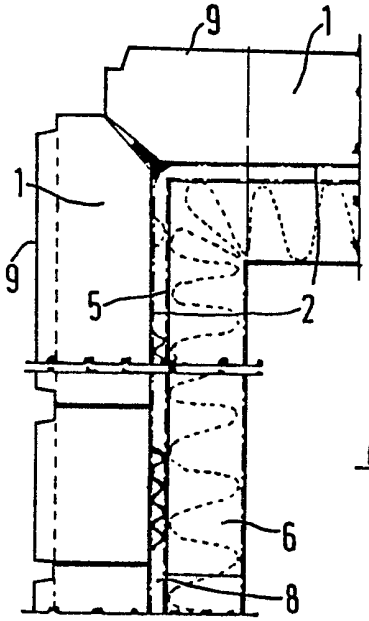


FIG. 9.

FIG. 10.

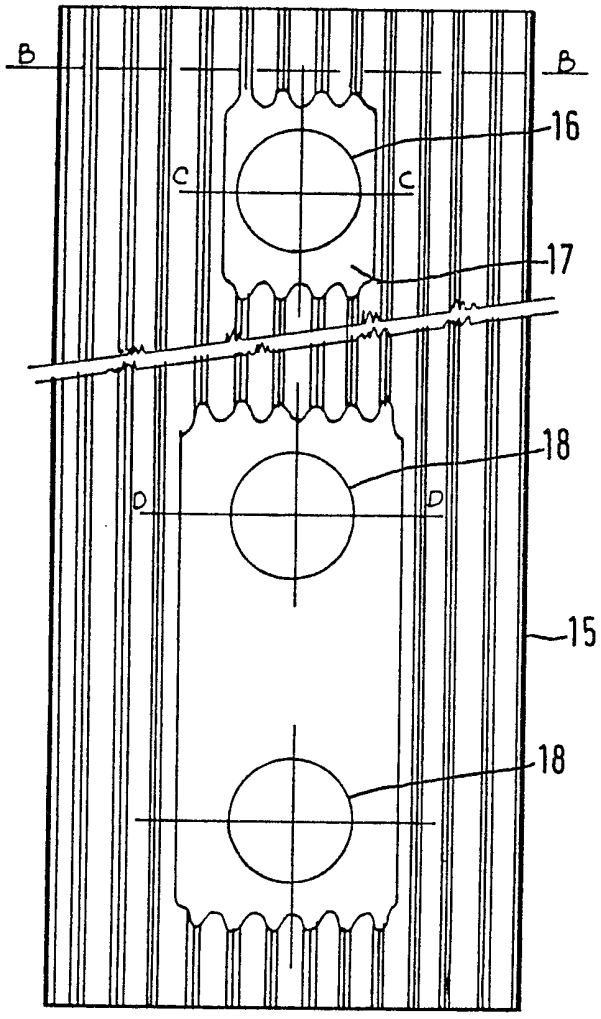


FIG. 11.

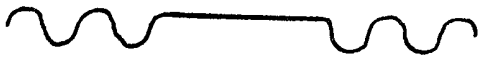
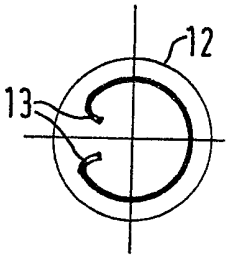


FIG. 12.

FIG. 13.

FIG. 15.



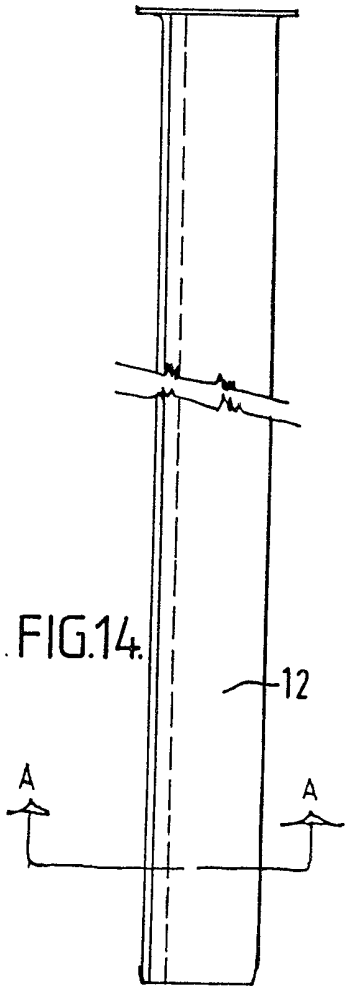


FIG. 14.

FIG.16.

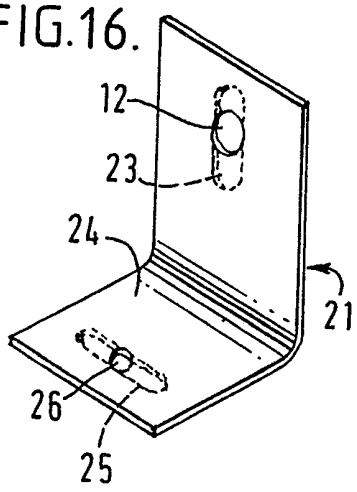


FIG.17.

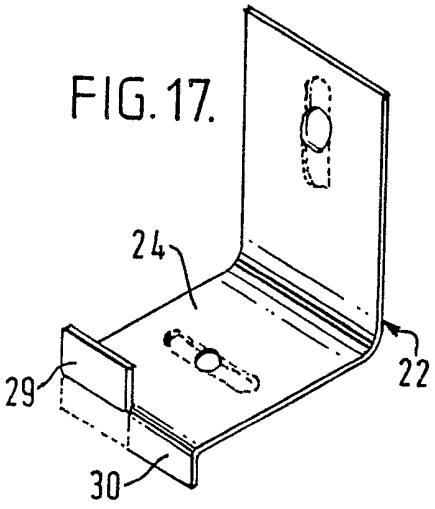


FIG. 18.

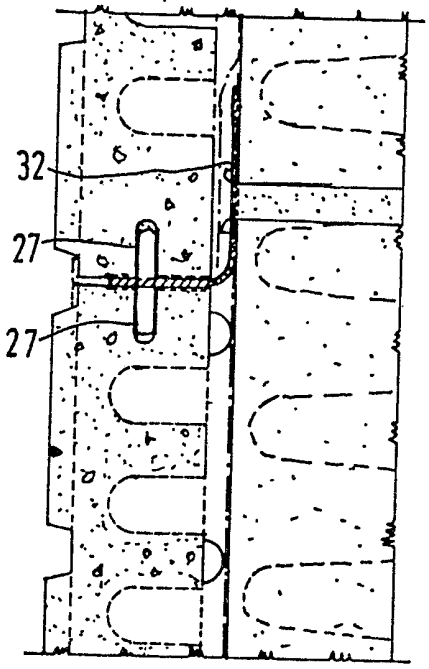
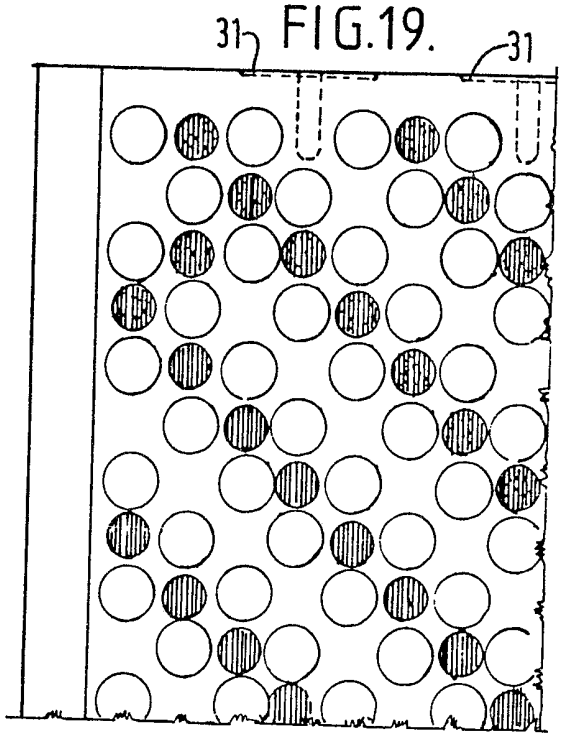


FIG.19.



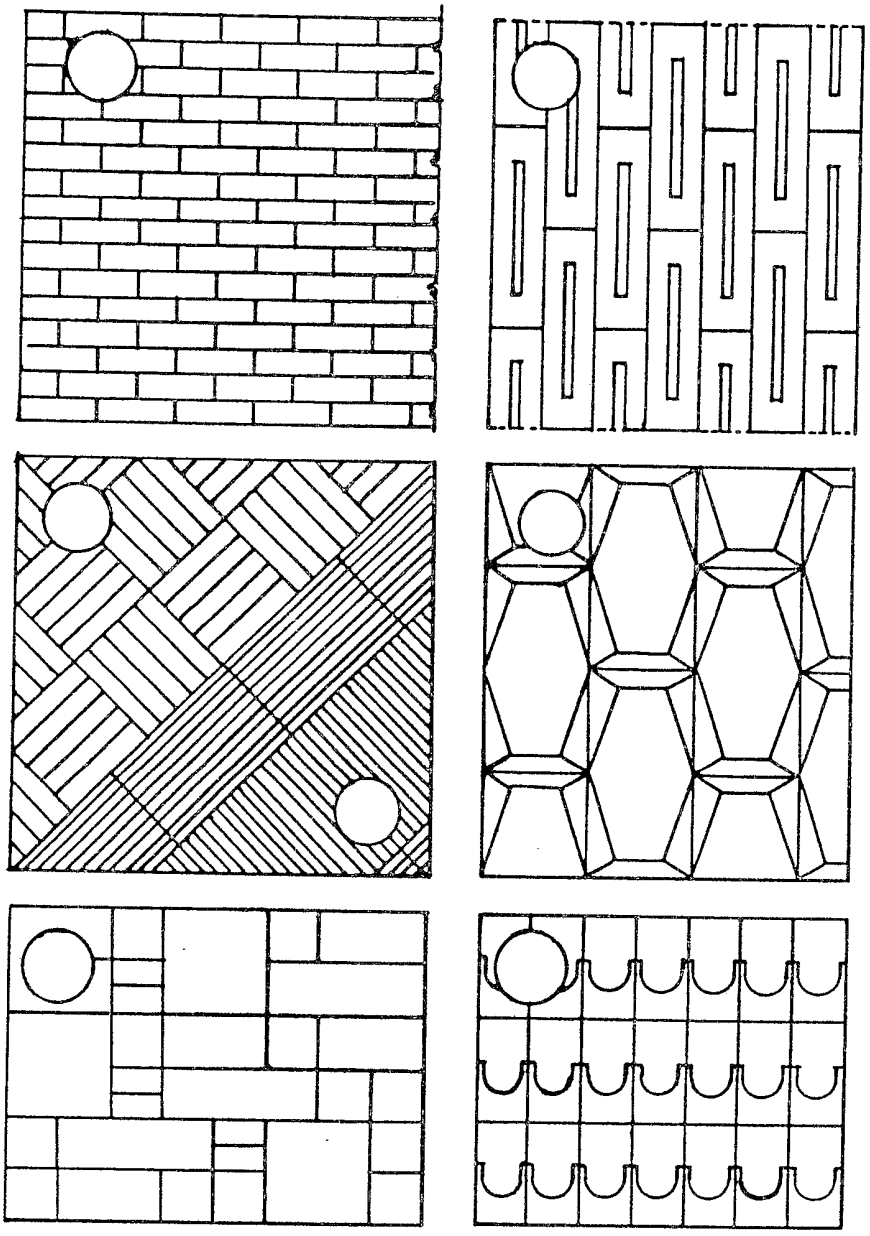


FIG. 20.

SPECIFICATION

External wall insulation system for building structures

This invention relates to wall structures for buildings and is particularly concerned to provide a permanent, durable, waterproof external wall insulation system which adequately conforms to recently enacted requirements and is flexible enough to meet future requirements regarding structural performance and technical standards of thermal efficiency. The invention is of particular value in the upgrading of existing properties of brick or other forms of construction and in the provision of insulating, water-proofing and breathing elements in their most effective relationship to a substructure or existing wall.

To this end, according to the invention, such an insulation system comprises a plurality of units each of which is lighter in weight than a conventional brick or stone block is of a square, rectangular or other form and is of substantially uniform thickness, said units being arranged in rows with the extreme edges of each unit abutting the adjacent edges of the units on every side thereof, and an independent mechanical fixing device interposed between each unit and a sub-structure or existing wall and serving to secure that unit to said sub-structure or existing wall.

Sheets of waterproofing material forming a damp-proof course or a combined damp-proof course and breather layer may be disposed at the rear of the units with the lower end of one sheet overlapping the upper end of the sheet next below at the location of said fixing devices and a layer of impact-absorbing insulating material may be arranged behind the units and between the damp-proof course and the outer surface of the sub-structure or existing wall to provide greater thermal efficiency while avoiding cold spots and cold bridging.

One form of the invention will be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a rear view on a reduced scale of one suitable form of unit capable of being employed in the system according to the invention;

Figure 2 is a typical cross-section on the line II—II of Fig. 1;

Figures 3 to 8 are sectional views to a reduced scale of various parts of a system, in accordance with the invention, applied to a typical existing structure, Fig. 3 being taken at the lower end of an existing window opening. Fig. 4 at the location of a fixing device, Fig. 5 at the base of the structure, Fig. 6 directly below the eaves, Fig. 7 at the head of a conventional window opening and Fig. 8 at the reveal of a conventional window;

Figure 9 is a plan view showing the arrangement at an external corner of the structure;

Figure 10 is an elevation on an enlarged scale with a part broken away, of one suitable form of plate forming a part of a fixing device;

Figures 11 to 13 are sections on the line B—B, C—C and D—D respectivley in Fig. 10;

Figure 14 is a side view, on an enlarged scale with a part broken away, of a fixing element constituting another part of the fixing device;

Figure 15 is a section on the line A—A of Fig. 14;

Figures 16 and 17 are perspective views of modified forms of plate forming part of a fixing device;

Figure 18 is a cross-section through the junction between two superposed units showing the plate of Fig. 16 or 17 in position;

Figure 19 is a rear view of the corner of a unit showing its edge recessed to receive a plate of the kind shown in Fig. 16 or 17; and

Figure 20 shows elevations of a number of assemblies of units illustrating the flexibility of the units in achieving a variety of different designs.

The insulation system shown in the drawings comprises a plurality of units 1 which are lighter in weight than conventional bricks or stone blocks and may be square, as shown in Fig. 1, or of rectangular or other form which bears a relationship to a basic module. Each unit 1 preferably measures 450 x 300 mm., is of substantially uniform thickness and is provided in its rear face 2 with a plurality of recesses 3 which may be circular, as shown in Fig. 1, or of elongated form, and extend either at right angles or at an inclination to the plane of the rear surface as shown in full lines at 3a and in broken lines at 3b respectively in Fig. 2. The units 1, which may be manufactured from sand, or any lightweight base aggregate, firmed or bonded with cement or synthetic resin, can be arranged in rows extending parallel with or at an angle to the horizontal with the edges of the units in each row abutting the adjacent edges of the units immediately above, below and on each side and are secured to a sub-structure or, as shown in Figs. 3 to 8, an existing wall 4, by independent mechanical fixing devices, examples of which are shown in Figs. 10 to 19. Sheets 5 of waterproofing material forming a damp-proof course or a combined damp-proof course and breather layer are disposed at the rear of the units 1 with the lower end of one sheet overlapping the upper end of the sheet next below at the location of each fixing device, and a layer 6 of impact-absorbing insulating material is arranged behind the units and between the water-proofing material and the outer surface of the sub-structure or existing wall 4 to provide greater thermal efficiency while avoiding cold spots or cold bridging.

The rear face 2 of each unit 1 is provided with a plurality of projections 7 which may be part-spherical in form and serve to create a space 8 behind the unit to accommodate a fixing device without the need for further recesses and to establish a plurality of points of contact between the unit and the impact-absorbing layer 6, thus enhancing the value of said layer in absorbing those forces resulting from initial impact with an external body. The external face 9 of each unit 1 is formed to simulate brickwork or stonework or

provided with a required ornamental design.

Although the units 1 are shown in the drawings as having straight edges their aesthetic appearance may be enhanced, either by departing from a straight-edged design, provided that the edges make contact with the edges of adjacent units when fixed in position, or by not producing the designs on the faces 9 of the units until two or more units have been fixed in position.

Indentations or holes may be provided in the edges of the units 1 of purposes to be described. Plastic material 10, preferably in the form of a prefabricated strip may be interposed at intervals between the horizontal abutting edges of adjacent units 1 and act, under pressure, to penetrate the pores in the adjoining edges and secure the units to one another, while at the same time permitting individual units to yield to a limited extent relative to each other on impact. The spacing of the strips from each other in the horizontal direction permits the egress of any moisture or condensation passing through the units. Similar strips 10 may be interposed between the lower edges of a row of units 1 at the bottom of the structure or immediately above a door or window opening and the upper surface of a base member 11, made of rigid or expanded p.v.c., aluminium or other suitable material which is secured to the sub-structure or existing wall 4 by corrosion-resistant screws or other suitable fastening devices (not shown). The base member 11 may be designed to be able, where necessary, to bridge a conventional horizontal damp-proof course associated with the existing wall or sub-structure without generating capillary action, thus giving a degree of tolerance to the level of its location and counteracting any inaccuracies in the level of the damp-proof course within the existing wall or sub-structure.

The impact-absorbing, thermal insulating layer 6 may be of uniform thickness or so shaped as to prevent any capillary action and also to provide drain passages in the event of any condensate forming. The layer is preferably made up of panels of polystyrene or other suitable material interposed between the vertically overlapping sheets 5 of the damp-proof course and the sub-structure or existing wall 4 and serves not only to maintain a constant thermal value throughout the structure, but also to provide a very efficient cushion which enhances the ability of the lightweight units as a whole to absorb conventional impact forces.

The recesses 3 in the rear face 2 of each unit are designed either to provide static air pockets which enhance the degree of thermal insulation and act in conjunction with the resilient panels 6 to lessen the likelihood of damage on impact, or to accommodate fixing elements. These may include plugs preferably made of heat-resistant material which remain in position for a predetermined minimum period of time in the event of fire, and are designed to accommodate screws, nails or the like with sufficient strength to cantilever from the substrate 4 through the insulation 6 and take the weight of the unit 1. A single fixing element which combines the functions of plug and cantilever support is shown at 12 in Figs. 14 and 15. This element 12 in the form of a split sleeve made of a resilient material such as spring and/or stainless steel acts in reverse manner to the plug and screw in that it is driven horizontally or at an angle to the horizontal, directly into the substrate 4 or into a hole of slightly smaller diameter in the substrate or the unit 1, where it is permanently under compression. The cantilever effect of the element 12 is enhanced by turning the adjacent free ends of the split sleeve inwards as shown at 13 in Fig. 15 or outwards along their whole length. After installation the elements 12 can easily be filled with foam to substantially eliminate any cold bridging.

The recesses 3 are so arranged as to reduce the risk of the units 1 fracturing along a straight line in the event of an exceptionally violent impact and to provide an adequate number of fixing points even when it is necessary to cut a unit horizontally, vertically or at any angle necessary to conform to the design of the sub-structure or existing wall or to conform to the size of a door or window opening, particularly on existing buildings having no dimensional coordination. Furthermore, the arrangement of the recesses 3 for the fixing means enables a unit to be turned through any desired angle to take full advantage of the aesthetic effect of the front surface design and by chamfering the edges of the units, as shown at 14, it is possible to obtain a mitred joint between two units at the corner of a building structure, as shown in Fig. 9, regardless of the orientation of the front faces 9 of the units.

Each unit 1 may be secured to the sub-structure or existing wall 4 at its upper end through the medium of a connecting device which, as shown in Fig. 10, may take the form of a thin plate 15 of stainless steel which is corrugated in places to combine stiffness with economy in the use of metal, and has an aperture 16 in a flattened area 17 adjacent one end for the passage of the fixing element 12 or of a screw or other element having a head of a size to suit the hole and surrounding area and preferably made of corrosion-resistant alloy or stainless steel for securing the plate to the sub-structure or existing wall with or without the use of a plug. The plate 15 may have one or more further apertures 18 at its other end for the passage of additional means for securing it to the units 1. One or more fixing devices may be employed according to technical requirements. When it is not possible to fix the units from their top edges, such as immediately below an existing cill 19 or a supplementary cill 20 inserted beneath an existing cill, the plate 15 may be turned through 90°, in which condition it can be secured to both sides of the unit, with one side fixed to the structure whilst the other is sandwiched between the adjacent unit and the structure.

Each unit may also be supported, at its lower edge junction with the unit next below it, by another stainless steel plate 15 which is likewise

fixed to the sub-structure or existing wall. Thus the unit can be mechanically held at its upper edge in one or more locations, and at the corner intersection of four units, these can be held by a single fixing device without impairing their impact absorption qualities for high exposure or suction areas. Alternatively, the lower edge fixing can be effected in the manner described in the preceding paragraph by turning the fixing plate 15 through an angle limited by the upper edge of the unit next below.

The plates 15 may be replaced by L-shaped plates of the kind shown at 21 and 22 in Figs. 16 and 17 respectively which are designed to both support and connect adjacent units in the manner shown in Fig. 18. The plate 21 has one arm 32 formed with an aperture or slot 23 for the passage of the fixing element 12 or any other suitable means for securing the plate to the sub-structure and its other arm 24 formed with a slot 25 for the passage of a dowel 26 or other suitable means adapted to enter indentations or holes 27 provided in the horizontal edges of superimposed units to connect the units together. The slots 23 and 25 afford suitable tolerances for adjustment of individual plates in relation to the fixing elements. Similar indentations or holes may be formed in the vertical edges of the units to receive dowels connecting adjacent units together. The plate 22 is similar to the plate 21 except for the fact that the free end of its arm 24 is bifurcated and the bifurcations bent in opposite directions out of the plane of the arm to form flanges 29, 30 which engage the external edge portions of adjacent units to assist in holding the units in position. As shown in Fig. 19, the upper and lower edges of the units may be formed with shallow recesses 21 to allow the arms 24 of the plates 21 and 22 to pass between adjacent units.

The waterproof sheets 5 forming the damp-proof course overlap at the fixing points and may also act as a breather membrane for the escape of internally generated vapour, and a second waterproof breather layer 28 may be interposed between the impact-absorbing insulating panels 6 and the sub-structure or existing wall 4 to meet the technical requirements of certain types of structures. This ensures that when the dew-point is located inwardly of the outer membrane 5 or within the insulation layer 6 the structure will be protected against water damage.

At each window or door opening the ends of the water-proof and breather sheets may be retained in terminal members of p.v.c. or other suitable material which are detachably secured to the frame and/or cill. Alternatively, the waterproof/breather sheets may be secured to door or window frame members or the like by an adhesive ribbon or strip of, for example, polysulphide. Where the door or window frame does not allow for the provision of sufficient insulation to prevent cold bridging, a part 33 of the substructure or existing wall 4 can be cut away, as indicated in Fig. 7 and 8, and the units cut to suit. In such cases, a terminal member 34 may be designed to accommodate insulation applied in situ.

The layers 5, 28 and the insulating panels 6 are so arranged that the air which is trapped within the pockets formed by the rearwardly opening recesses 3 in the uniformly thick units 1 ensures that any dew-point generated is always situated on the outside of the sub-structure or existing wall and the water-proof layer adjacent the existing wall, thereby ensuring a dry sub-structure.

The units may be mounted on a sub-structure made of timber, concrete, brick, metal or any other material capable of providing structural stability.

The invention is of particular value in the upgrading of existing properties, especially those with solid walls, since it provides the required degree of insulation, breathing and waterproofing in the most effective location and still gives the appearance of a conventional brick, stone or other traditional structure. Water penetration from the outside is thus prevented and conditions provided within the building which combat condensation and mould growth.

The invention is not, however, restricted to the upgrading of existing buildings but can be used in the construction of new buildings, replacing the usual form of cavity wall with its many technical complications by a solid wall having enhanced insulating qualities and other technical improvements.

CLAIMS

1. An external wall insulation system for a building structure, comprising a plurality of units each of which is lighter in weight than a conventional brick or stone block, is of a square, rectangular or other form and is of substantially uniform thickness, said units being arranged in rows with the extreme edges of each unit abutting the adjacent edges of the units on every side thereof, and an independent mechanical fixing device interposed between each unit and a sub-structure or existing wall and serving to secure that unit to said sub-structure or existing wall.

2. An external insulation system according to Claim 1, including a layer of impact-absorbing insulating material arranged between the units and the outer surface of the sub-structure or existing wall to provide greater thermal efficiency while avoiding cold spots and cold bridging.

3. A system according to Claim 2, including sheets of waterproofing material forming a damp-proof course or a combined damp-proof course and breather layer disposed between the units and said impact absorbing layer with the lower end of one sheet overlapping the upper end of the sheet next below at the location of a fixing device.

4. A system according to any one of Claims 2 or 3, which includes a waterproof/breather layer between the insulating layer and the building structure.

5. A system according to any one of Claims 2 to 4, wherein each units is provided on its rear face with a plurality of projections which serve to create a space immediately behind the units to

accommodate said fixing devices and provide a plurality of points of contact between the units and said layer of impact-absorbing material.

6. A system according to any preceding claim, wherein each unit is provided, in its rear face, with a plurality of recesses, any one or more of which may constitute a fixing point or points for the units.

7. A system according to any preceding claim, wherein the side edges at least of each unit each comprises a first portion extending rearwardly from the front face and substantially at right angles thereto and a second portion extending from said first portion to the rear face and inwardly inclined at an angle of the order of 45°.

8. A system according to any preceding claim, wherein strips of plastic material are interposed at intervals between the abutting horizontal edges of adjacent units.

9. A system according to Claim 8, wherein said strips are also interposed between the lower edges of a row of units at the bottom of the structure or immediately above a door or window opening, and the upper surface of a base member secured to the sub-structure or existing wall.

10. A system according to Claim 9, wherein said base member serves to bridge a horizontal damp-proof course associated with the existing wall or sub-structure, without generating capillary action.

11. A system according to any preceding claim, wherein each fixing device includes a connecting plate of thin metal or other suitable material which is apertured for the passage of fixing elements for securing the plate to at least one unit and to the building structure.

12. A system according to Claim 11, wherein each fixing element is inserted under compression in a hole in the building structure and forms a cantilever support for the unit.

13. A system according to Claim 12, wherein said cantilever element is inclined upwardly at an angle to the face of the unit.

14. A system according to Claim 12 or 13, wherein said cantilever element is in the form of a hollow tubular member.

15. A system according to any one of Claims 11 to 14, wherein said connecting plate is substantially L-shaped with one arm apertured for the passage of a first fixing element for securing it to the building structure and its other arm apertured for the passage of a second fixing element for securing two superimposed units together and to the plate.

16. A system according to Claim 15, wherein at least the aperture for said second fixing element is a slot.

17. A system according to Claim 15 or 16, wherein the free end of said other arm is divided and bent out of the plane of the arm to form oppositely extending flanges for engagement with the outer surfaces of two superimposed units.

18. An external wall insulation system for a building structure, substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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