March 2, 1965 S. B. S. LOMAR ETAL 3,171,772

REINFORCED PLASTIC COVERING PLATE

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Fig. 1

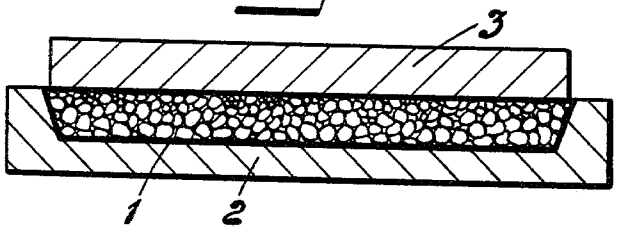

Fig. 2

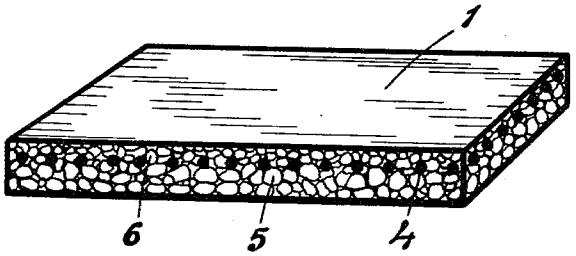

Fig. 3

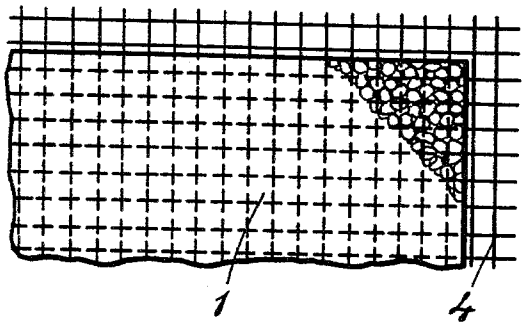

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Fig. 4

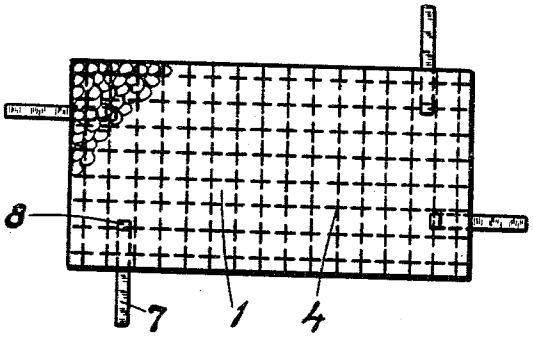


Fig. 5

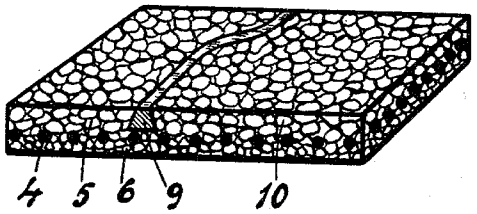
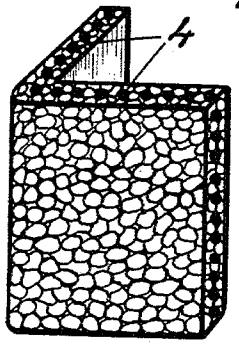


Fig. 6



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REINFORCED PLASTIC COVERING PLATE

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This invention relates to a covering plate for the building industry. The plate is intended for use as a facade covering, covering for interior walls, floor covering and roof or ceiling covering. The main purpose of the plate is to give walls and floors a decorative appearance and, above all, to provide a covering for facades, walls and floors which covering is of a high quality and entirely maintenance-free and fulfills all considerable requirements for highly varying fields of application of a surface covering. In the following, some of the properties of the plate are named, namely: full weather resistance, practically no absorption of moisture, high mechanical strength, high impact strength, high wear resistance, insensitiveness to rapid changes of temperature, flame resistance and low weight. The plate can be mounted on all conceivable bases. It can be cast, cemented or nailed to the base. It can be used with great advantage as a surface covering on a sandwich structure. The plate can be formed to finished corner pieces or to other shapes desirable for buildings. It can be used for artistically decorative purposes.

The invention relates to a covering plate for the building industry and is characterised by the fact that it consists of a mixture of granular mineral materials being composed such that the major volume part of the grains comprises grain sizes that make the colour and structure of the mineral material clearly visible, that is, consist of coarse grained material, whereas the other part of the mineral material consists of a practically uncoloured powdery or substantially powdery mineral material, that is, a fine grained material, and that the mineral grain mixture is mixed with a binder consisting of a completely polymerisable substance. Preferably, the coarse grained material amounts to 70–10, especially 60–50%, the fine grained material amounts to 10–70, especially 20–40%, and the binder amounts to 5–40, especially 10–25% by weight of the weight of the plate. The powdery material should comprise 30–70, especially 40–60% by weight of grains smaller than 0.04 mm. and a maximum grain size of 0.5 mm., especially 0.1 mm. An important feature of the building plate according to the invention is that the grain size gradually decreases from one side of the plate through the thickness thereof to the opposite side. Suitably, the size of the coarse grains varies in direct proportion to the thickness of the plate. Usually, the thickness of the plate is greater by 1–2 mm. than the average thickness of the coarse grains. The coarse grains have a maximum average extension of 6 mm.; especially 3–5 mm., and a minimum average thickness of 0.1–0.05 mm. In general, the plate is dimensioned such that the thickness is proportional to the area of the plate.

The granular mineral material is preferably located on one side of the plate, whereas the powdery material is located substantially on the opposite side of the plate. The granular material may comprise different kinds with different ranges of size in which case the coarse grains are located substantially on one side of the plate, whereas the smaller grains are located substantially above the coarse grains, while the powdery material is located substantially on the other side of the plate.

In order to increase the strength of the plate, a metallic net is embedded therein, preferably close to the side where the fine grained material is a maximum.

The size of the mineral grains is substantially larger than the mesh-width of the metallic net. The size of the smaller mineral grains is smaller than the mesh-width of the metallic net and the size of the larger grains exceeds the mesh-width of the metallic net.

The binder should be a polymerisable substance which during the polymerisation process does not elaborate gases or liquids. The polymerisable substance is suitably of the low-pressure type and is especially a polyester or an unsaturated polyester. Alternatively, it may consist of a vinylacetate, acrylate, methacrylate or styrene.

The method according to the invention comprises the steps of providing a mouldable mass made from mineral grains and a practically colourless, transparent and completely polymerisable plastic of the low-pressure type, spreading the mass on the bottom of a mould, placing a top mould thereon, and compressing the mass. The setting takes place in the mould at room temperature or at an increased temperature.

The mineral grain mixture has to be composed such that the final product, the finished plate, will have the desired colour and surface structure. Two different purposes of the plates have to be taken into consideration. (*a*) The colour and the surface structure of the plate correspond directly to a mineral type in the natural state, and the surface of the plate corresponds practically entirely to the surface of a ground stone of the same mineral. (*b*) The plate is built up such as to have a desired colour and structure which have no equivalents in natural stone of a certain kind of mineral.

To make a material according to (*a*) the natural product of the material has to be carefully studied before the mineral grains are composed to a mixture. As a general rule the mineral grains should not be too large, which would result in that the surface would have the character of a collection of pebbles embedded in a mass. The grain size should vary from a powdery state to sizes up to about 3–6 mm. The mineral grains may be a crushed product or a natural sand of the desired type of mineral. The mineral grain mass should be made as tight as possible so as to leave a space as small as possible for the binder. More than half of the mixture should comprise grain sizes which clearly bring out the colour of the mineral, and the surfaces of fracture of the coarse grains should be such as to give the plate the structure of the natural mineral. The powdery material is added to fill up the cavities between the coarse grains. This powdery material is advantageously a quartz powder with a high degree of purity which when mixed with the binder results in a semi-transparent material that does not take away the lustre of the colour and structure of the coarse grains. Also other minerals are conceivable which give the same effect. To obtain the best possible result it is suitable to mix the mineral grain mass thoroughly in a dry state prior to the addition of the binder.

A suitable binder has proved to be a completely polymerisable plastic of the low-pressure type. It should be colourless or practically colourless in order to obviate discolouration of the mineral grain mass. It should be of the type that sets at ordinary room temperature or at increased temperature. It should be added to the mineral grain mass in an amount such as to make the mass plastic or viscous. If it is deemed suitable to add thinners in order to make the binder more fluid, such thinners should not comprise volatile components. Experiments with satisfactory results have been made with certain polyesters to which a thinner, such as styrene, may be added. How-

ever, the amount of styrene added should not exceed 15% of the total volume of the plastic.

The mineral grain mass should be carefully dried prior to the addition of the binder.

The mineral grain mass and the binder are then mixed very carefully so that each grain in the mass will be coated by a film of binder. The mixing operation can be carried out in the open air or in an evacuated vessel to prevent air bubbles from being left in the mass and forming pores on the surface of the finished plate.

The finally prepared plastic-mineral mass is then spread over a mould bottom the surface of which corresponds to the shape of the surface of the finished plate. The bottom of the mould should be treated such that the finally set plate will readily come loose. Thus, it will be apparent that the facade surface of the plate faces the bottom of the mould, this being desirable in order to secure a quality as high as possible of the facade surface of the plate. Since the specific weight of the mineral grains is greater than that of the plastic and since the coarse grains of the mineral mass have a greater density than the powder, the coarse grains will move toward the bottom of the mould and force away the thinner part of the mass resulting in that only the cavities between the coarse grains will be filled with the mineral powder mixed with the plastic. Then a top mould is placed upon the mass and the whole of it is pressurized. The coarse grains of the mass will be urged more forcibly toward the bottom of the mould and will still further force away the part of the mass that consists of the mixture of plastic and mineral powder. After the plate has set in the mould under pressure it is taken out of the mould which can be used again for the next plate.

Now we have obtained a plate with a facade surface the appearance of which is practically entirely the same as the appearance of the natural product. From various sand materials or crushed mineral products we have reproduced the mineral to its natural form. It is only the binder that makes the difference between the products. If a plate according to (*b*) is to be produced in accordance with the invention, one has more liberty of choice of kinds of minerals because it is intended to produce a plate of a certain colour or composition of colours. The mineral mass is mixed in the same way as described above, but in contrast mineral grains of highly varying kinds can be used to obtain the desired colour and surface structure.

To produce plates of a thickness as small as possible, we have found it suitable to reinforce the plate. In order to permit an all-round use of the reinforcing member, it is suitable to devise this member in a certain manner. Advantageously, the reinforcing member consists of an iron ore metallic net which is pressed into the mass. This iron ore metallic net should be constructed such that the mesh width is smalfler than the largest grains in the mineral grain mass, the result being that the net cannot sink through the mass and spoil the effect of the facade surface of the plate. Still more advantages can be obtained. By devising the net as indicated above and due to the fact that it is pressed into the mass from above, it sort of divides the mass into two parts. One part of the mass which lies on the bottom of the mould and constitutes the facade surface of the plate will contain the largest grain sizes of the mineral grain mass. As a result thereof, the facade surface of the plate will contain an amount as great as possible of the coarse mineral grains which is favourable insofar as the natural mineral colour and natural structure are more clearly brought out. The fine grained part of the mass together with the excess of the synthetic mineral powder mass find their way through the net meshes and embed the net in the mass. In this way the reinforcing net is effectively bonded to the mass. The use of a reinforcing member in the form of an iron ore metallic net also results in the advantage that the plate, while it may crack when subject to great mechanical stresses, cannot fall to pieces since every mesh of the net is well bonded to the mass.

The plate reinforced by an iron ore metallic net can advantageously serve as a radio shield in buildings or parts of buildings where the plate is used. Nowadays it is customary to an ever increasing extent to have buildings shielded from electrical disturbance of normal or high frequency. This holds true especially of buildings which contain an electric equipment that cannot be shielded individually, such as electric laboratories, wireless stations and the like. This demand on shielding will probably soon be a general desideratum in every modern community having an ever increasing number of interference sources of different kinds. The net in our plate can be used as such a shield and can be connected to conductors which in turn are connected to conductors in adjacent plates so as electrically to connect all of the plates on a facade or in a room. The whole wall can then be connected to ground potential or another suitable potential.

According to a suitable embodiment the net extends somewhat outside the edges of the plate where it can be used to nail the plate, for instance on to a wooden base. The spaces between the plates can then be filled with a suitable joining material.

Another advantage of the plate according to the invention is the possibility of using it for artistically decorative works. If different sorts of minerals and combinations thereof are used, it is possible to produce plates of greatly varying colours. A strip of metal or other material may be placed into the mould, said strip having a cross-sectional shape such as to be retained by the mass and by the bonding to the net. The strip may be curved or straight and combined with similar strips in adjacent plates on a facade or wall so as to form a designed pattern or configuration. If masses of different minerals and colours are then filled into the separate fields, very beautiful works can be made by artistic treatment. Instead of remaining the partition strip between the different mineral masses can be removed before the net is placed upon the mass, in which case the different mineral masses partly flow into each other in the joints and result in a more diffuse change.

The plates need not have plain surfaces. By providing moulds of different shapes angular corner pieces or other types of plates required in the construction of buildings may be produced.

The invention is described below with reference to the annexed diagrammatic drawing. FIG. 1 illustrates a plate **1** with the facade surface turned down against the bottom mould **2** and with the top mould **3** placed above the plate. The grain sizes of the plate are shown diagrammatically, the coarse grains being located at the bottom. FIG. 2 illustrates a plate with a reinforcing net **4**. The grain sizes of the mass are diagrammatically illustrated, and it will be seen that the coarse grains **5** are located below the net **4** and that the fine particles **6** of the mass have passed through the net **4** with the result that the net is embedded in the plate. The side containing the coarse grains **5** forms the facade face of the plate and is turned down in the mould during the moulding operation. FIG. 3 illustrates a plate in which the ends of the net **4** extend outside the plate and can be used such as for nailing the plate. FIG. 4 illustrates conductors **7** which are electrically connected to the net at points **8** and may be used as electrical connections between the individual plates of a construction for the purpose of shielding from electrical disturbances. FIG. 5 illustrates a plate in which there is inserted a wedge-shaped sectional strip **9** which may be used as a partition between the mineral masses **5** and **10** which are of different kinds and colours. This form of construction is suitable if the plates are to be used for artistically decorative purposes. The pattern or figure is built up from a great number of plates which are joined to form a complete work of art. As mentioned above, this strip

need not remain in the finished plate, but may be removed before the net is placed upon the mass, in which case the change between the mineral masses will be more diffuse. FIG. 6 illustrates an angularly bent plate which may serve as a corner piece. Even other shapes desirable in the construction of buildings may be produced.

In order to elucidate the character and meaning of the invention two examples are given below which explain how the mass can be composed to achieve the desired result. These examples are based on experimental plates which have been manufactured in accordance with the invention and with the use of the materials indicated in the examples.

EXAMPLE 1

Plate according to (*a*) having a facade surface similar to ground granite.

The mass is composed of the following parts:

1 part Baskarp sand No. 2
1 part Baskarp sand No. 4
2 parts Simrishamn sand
3 parts quartz powder from Forshammars Bruk
3 parts polyester Grystic 198 Aktiebolaget Syntes, No. 1
This example relates to: "Experimental plate according to Example 1".

EXAMPLE 2

Plate according to (*b*) where it is desired to produce a plate of a certain colour and structure.

The mass is composed of the following parts:

2 parts white marble
2 parts Simrishamn sand
1 part quartz sand from Fyleverkens
2 parts quartz powder from Forshammars Bruk
3 parts polyester Grystic 198 Aktiebolaget Syntes, No. 1

This example relates to: "Experimental plate according to Example 2".

The grain sizes of the various kinds of mineral named in the Examples 1 and 2 are indicated herein below.

Baskarpsand No. 2

Mesh interval in mm.:	Percent of material
4–5.6	0.2
2–4	30.4
1–2	60.2
0.5–1	8.2
0.25–0.5	1.0

Baskarpsand No. 4

Mesh interval in mm.:	Percent of material
1.5–2.0	0.14
1.0–1.5	1.80
0.6–1.0	18.02
0.4–0.6	39.6
0.3–0.4	23.2
0.2–0.3	12.07
0.15–0.2	3.05
0.10–0.15	1.03
0.075–0.10	0.44
0.06–0.075	0.16
0.02–0.06	0.08
Slurry	0.41

Simrishamns sand

Mesh interval in mm.:	Percent of material
2.0–3.0	1.6
1.5–2.0	7.9
1.0–1.5	46.0
0.6–1.0	4.0
0.4–0.6	32.1
0.3–0.4	4.2
0.2–0.3	2.3
0.15–0.2	0.9
0.1–0.15	0.5
0.025–0.1	0.5

White marble

Mesh interval in mm.:	Percent of material
3.0–4.0	1.0
2.0–3.0	30.0
1.5–2.0	31.8
1.0–1.5	9.7
0.6–1.0	26.8
Less than 0.6	0.7

Quartz sand from Fyleverkens, major part 0.3–0.5 mm.
Quartz powder from Farshammars Bruk, 50% under 0.04 mm., remainder betwen 0.04–0.1 mm.

The examples in the above description illustrate compositions of plates in accordance with the invention. Similar compositions are conceivable within the scope of the invention.

What is claimed is:

1. A covering plate for the building industry, comprising a mixture of mineral material being composed such that the major volume part of the mixture comprises coarse grained material that makes the color and structure of the mineral material clearly visible whereas the other part of the mineral material consists of a practically uncolored substantially powdery fine grained mineral material, and that the mineral grain mixture is mixed with a binder consisting of a completely polymerizable substance which, during its polymerization, evolves no gas, vapor or liquid, the grain size gradually decreasing from one side of the plate through the thickness thereof to the opposite side, the coarse grained material substantially being located on one side of the plate, whereas the powdery material being substantially located on the opposite side of the plate, a metallic net being embedded in the mixture of plastic and grains, said net being adjacent the side where the finest grained particles are present in highest concentration, the size of the fine mineral grains being smaller than the mesh-width of said metallic net and the size of the larger grains exceeding the mesh-width of said metallic net, the plate thus being substantially composed of two layers the first layer containing the coarse grained material and the second layer containing the fine grained material, the two layers substantially being separated by the metallic net.

2. A plate as defined in claim 1 in which the coarse grained material amounts to 70–10%, in that the fine grained material amounts to 10–70%, and in that the binder amounts to 5–40%, by weight of the weight of the plate, in that the grains of the powdery material are smaller than 0.04 mm. in that the coarse grains have a maximum average thickness of 6 mm. and a minimum average thickness 0.1 mm. and in that the thickness of the plate is greater by 1–2 mm. than the average thickness of the coarsest grains.

3. A plate as defined in claim 1, in which the polymerizable substance is of the low-pressure type and is selected from the group consisting of a polyester, a vinyl acetate, an acrylate, a methacrylate and a styrene.

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