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MANUFACTURE OF FIBER-CEMENT SHEETS

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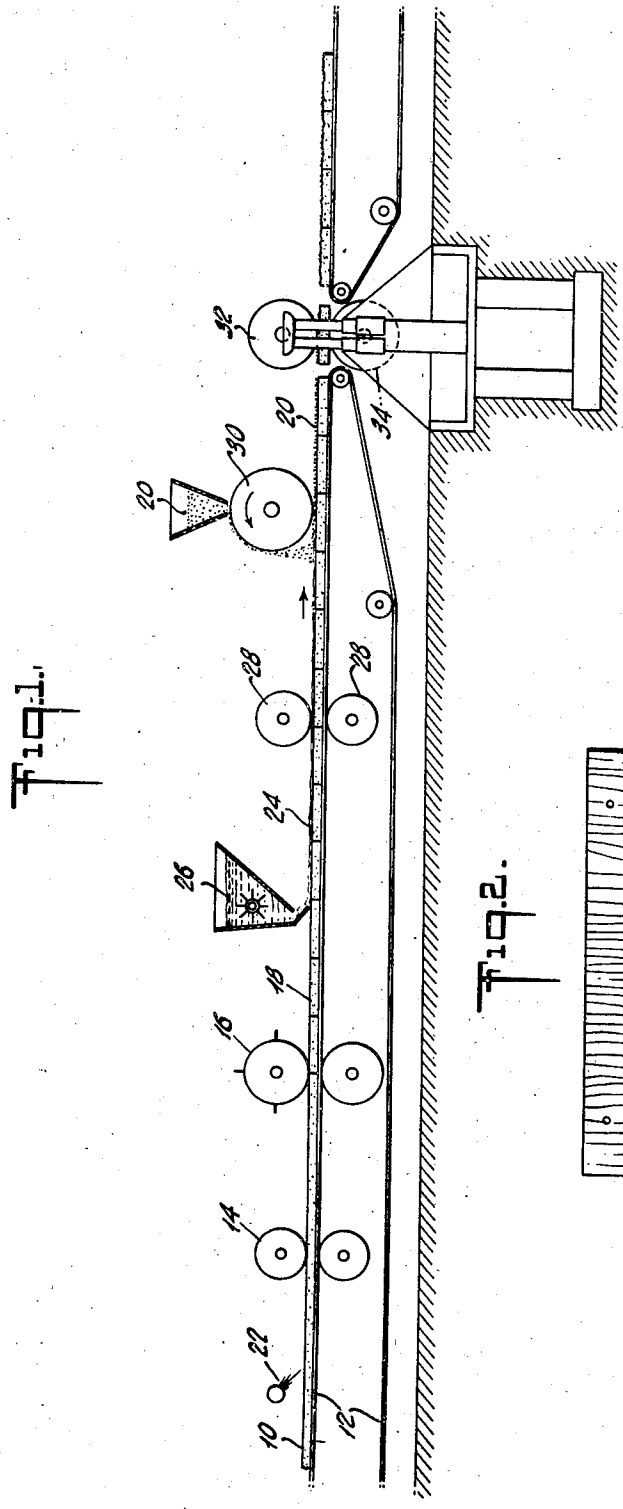


Fig. 1.

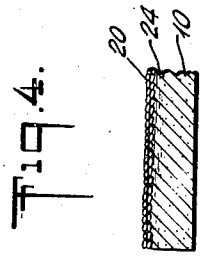


Fig. 4.

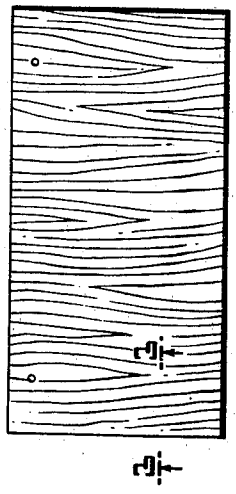


Fig. 2.



Fig. 3.

INVENTOR
ERNEST WAYNE REMBERT.
BY Virgil C. Kline
ATTORNEY

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MANUFACTURE OF FIBER-CEMENT SHEETS

Ernest Wayne Rembert, Hinsdale, Ill., assignor to Johns-Manville Corporation, New York, N. Y., a corporation of New York

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This invention relates to the manufacture of hard and dense fibro-cementitious sheets, and is particularly concerned with an improved method of developing a uniformly and permanently colored and smoothly textured veneer surface for asbestos-cement shingles and siding units.

One method heretofore employed for applying a decorative color finish to the weather exposed surface of an asbestos-cement shingle or siding unit has involved the steps of spreading a veneer mixture including clean asbestos fibers, mineral pigment and hydraulic cement binder over the moist surface of a compressible uncured asbestos-cement base sheet, sprinkling sand as a parting agent over the surface of the thus-applied veneer coating, strongly compressing the composite unconsolidated sheet so formed and simultaneously embossing a pattern on the veneer surface, and finally trimming the composite sheet and curing it to develop a hardening set of the cement binder.

Use of sand as a parting agent at the veneer surface performs the desirable functions of inhibiting blistering of the veneer surface caused by sticking of the moist veneer to the press rolls and embossing plates or grain rolls. The sand also prevents development of cracks in the veneer under the high pressures applied by the embossing plates and grain rolls during the densifying and embossing operations. However, the presence of sand at the veneer surface of the finished shingle or siding sheet imparts to said surface a relatively rough and coarse texture and undesirable nonuniformity of color, since the color of the sand is non-uniform and does not match that of the veneer. The rough texture of the sand surface increases the susceptibility of such surface to collection of dust and soil and to undesirable staining and rapid deterioration of color on exposure to moisture or weathering.

A principal object of the present invention is to provide a method of developing a uniform and permanently colored veneer coating of smooth texture for a structural fibro-cementitious sheet, while avoiding difficulties with formation of surface blisters or cracks in the veneer during high pressure densifying and embossing operations on the composite sheet product.

A still further object is to provide an efficient and economical method of manufacturing hard and dense veneer coated asbestos-cement sheets of improved color and surface texture.

With the above objects in view, the invention consists in the improved method of manufacturing hard and dense composite fibro-cementitious

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sheets which is hereinafter described and more particularly defined by the accompanying claims.

The invention will be hereinafter described with particular reference to the attached drawing, in which:

Fig. 1 is a diagrammatic assembly view of apparatus adapted for manufacturing composite fibro-cementitious sheets in accordance with the present invention;

Fig. 2 is a face view of an embossed composite sheet of the type produced by the process;

Fig. 3 is an enlarged sectional view, taken on the line 3—3 of Fig. 2; and

Fig. 4 is a magnified sectional view illustrating the manner in which the friable surfacing pellets are distributed over a moist compressible asbestos-cement base sheet prior to a high pressure densifying and embossing operation thereon.

The principal feature of the present invention is concerned with the use of prefabricated, friable pellets as a substitute for sand as a parting and surfacing agent in the manufacture of composite veneer surfaced and embossed asbestos-cement sheets. Such pellets consist essentially of air cured agglomerates of finely divided mineral pigment in a matrix formed by hydration of finely divided hydraulic cement. In addition to mineral pigment and hydraulic cement, the pellets may incorporate in their composition a substantial proportion of finely divided silica. The cement binder may comprise Portland cement or a low heat hydraulic cement. The pellets may be applied directly to a surface of the moist compressible base sheet in a layer of sufficient thickness to provide the sole veneer surfacing material for the base sheet. On the other hand, the pellets may be applied in smaller amount as a parting agent and as a final surfacing material, over an underlying veneer coating of approximately the same color. This underlying veneer coating may be applied to the surface of the base sheet as a wet slurry mixture of mineral pigment and hydraulic cement. Instead of interposing a coating of wet veneer between the base sheet and the surfacing pellets, a substantially dry veneer coating of mixed pigment, asbestos fibers and hydraulic cement may be deposited on the moist compressible asbestos-cement base sheet, prior to application of the parting and surfacing pellets.

The method of the present invention is not limited to any specific method of forming the base sheet layer, nor is it limited to any specific method of applying a primary veneer coating to the moist compressible base sheet. An illustrative example of one satisfactory method of prac-

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ticing the invention is hereinafter presented, as adapted to the apparatus which is illustrated in Fig. 1 of the accompanying drawing.

A preformed base layer 10 is deposited on the top surface of a conveyor belt 12. Such base layer may consist essentially of a uniformly distributed mixture of shingle grade asbestos fibers and finely divided hydraulic cement, moistened with sufficient water to effect hydration of the cement. Finely divided silica may also be incorporated in the base layer. Light consolidation of the moistened base layer and distribution of the base layer material into a sheet of uniform thickness, may be effected by means of a press roll 14. After passing press roll 14, the base layer material is conducted by belt 12 under a cutter roller 16. Cutter 16 divides the sheet into segments or panels 18 of slightly larger area than the finished shingles or siding units into which the segments are finally trimmed.

After the base layer material has been cut into segments 18, veneer coating material may be added thereto in one or two stages. The veneer coating material is designed to impart a thin, suitably colored veneer surface to the finished shingle and to function also as a dry parting agent preventing development of blisters by the sticking of wet material to the texture plates or grain rolls employed during the densifying and embossing operations on segments 18. For this reason, the top layer of the applied veneer coating consists of dry friable pellets 20 which are so constituted as to break down to form a finely textured surface of fine particles during the final densifying and embossing operation. At the same time such pellets provide a dry, non-sticky interface between the underlying wet base sheet and the texture plate or grain roll surface.

A preferred practice under the present invention contemplates use of pellets 20 as surfacing and parting agents and also as the sole source of material for the veneer coating of the composite shingle or siding sheet. When using the pellets as the sole veneer coating material, water is added to the base sheet, as by spray 22, in amount sufficient to insure complete wetting and hydration of the cement in the base layer and in the crushed pellet material which forms the veneer coating. The amount of added water is limited so as to avoid complete wetting of the upper surfaces of the top layer of the crushed pellet material prior to completion of the densifying and embossing operation.

That modification of the process which is hereinafter described contemplates addition of the veneer coating in two stages, with the first stage consisting of spreading over the top surfaces of the segments 18 a primary veneer coating 24 in the form of an aqueous slurry of finely divided mineral pigment and finely divided hydraulic cement. It will be understood, however, that this primary veneer coating may consist of a dry mixture of the pigment, cement and asbestos fibers, and when such a dry mixture is employed, sufficient water is added by direct application to the dry veneer or by prior addition to the base sheet by sprays 22, to insure absorption wetting of the cement in this added dry veneer coating, as well as of the cement in the base segments.

When a primary veneer coating is added in the form of a wet slurry, time is allowed for removing excess water in this slurry and using some of said excess for wetting the base sheet material, before adding the parting and surfacing pellets 20, in order to avoid absorption of excess water

into the top pellet layer of the veneer during the densifying and embossing operations. The primary veneer coating 24 may be applied to the top surfaces of the base segments 18 as a wet slurry by means of distributor 26. The distributor should be designed for effecting even spreading and distribution of the primary veneer material over the upper surfaces of the base layer segments. Water which is present in the base layer, and the water which is added with the primary veneer coating when using a wet veneer, insures development of a temporary bond between the primary veneer coating and the base layer. In the event that the primary veneer coating is applied as a dry mixture, uniform distribution and levelling of the veneer coating over the top surface of the base segments is effected by means of press rolls 28. Press rolls 28 may be omitted when the primary veneer coating is added in the form of a wet slurry.

The prefabricated parting and coating pellets 20 are distributed uniformly over the top surface of the moist base segments 18, or over the previously applied primary veneer coating 24, by means of an applicator 30. For application of pellets which are coarse and not too damp, a vibratory feeder may be used. By means of a suitable applicator or spreader 30 relatively damp pellets may be applied. After the parting pellets have been thus sprinkled or spread in a layer of uniform thickness over the unconsolidated composite segments 18, such segments may be passed through the bight of a pair of hydraulic pressure rolls 32, 34, of which the upper roll 32 is a grain roll having on its surface a pattern of projections designed to emboss a corresponding pattern of indentations upon the veneer faces of the composite sheet segments. The rolls 32, 34 are designed to place the composite sheet segments under high pressure during the embossing operation, whereby to simultaneously densify the segments, emboss a pattern on the veneer face thereof, crush the pellets 20 and promote flow of water across the interface between the base or primary veneer and the crushed pellet surfacing material.

In place of the pressure or grain roll 32, a hydraulic press employing texture plates may be used in the compressing and embossing operation. When using texture plates, the unconsolidated veneer coated sheet segments 18 are removed from conveyor 12 after application of the surfacing pellets 20, and such segments are stacked in the press in the following manner: Each unconsolidated segment is placed between a smooth surfaced metal supporting plate and an inverted texture plate having on its bottom surface projections arranged in a pattern, as for example, a cedarwood grain pattern which is to be impressed on the surface of the final composite sheet. In an assembly of segments 18, supporting plates and texture plates which are stacked in the press, the veneer coating of each segment 18 is in contact with the irregularities on the texture surface of an overlying texture plate. During the operation of the press, a stack of alternating supporting plates, segments 18 and texture plates is strongly compressed under high pressure, which may range from 5000–10,000 lbs. per square inch.

When texture plates or grain rolls are used during the densifying operation, the alternate elevations and depressions which are developed in the top veneer surface of the composite sheet material carry through to the top face of the base sheet. In other words, the embossing operation

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develops alternate elevations and depressions in the top surface of the base layer 10 to match conforming irregularities at the lower surface of the veneer, as shown in Fig. 3. Thus, by this embossing operation, the veneer coating is keyed in with and locked to the veneer sheet over the complete area of the composite sheet.

The parting and surfacing pellets 20 have been found to function efficiently as parting agents which prevent sticking of the underlying plastic cement to the grain rolls or texture plates during the high pressure embossing operation. Such pellets, even after being crushed, provide a non-sticky interface which allows separation of the grain roll or texture plate from the moist sheet segments 18 as the last step in the densifying and embossing operation. After completion of the embossing operation, the consolidated sheet segments are allowed to develop a preliminary air set before being trimmed to precise dimensions. This air set is obtained, for example, by allowing the segments to stand at normal atmospheric temperature for a period of 2–5 days, after which the segments are trimmed and punched to final dimension and form. At this stage the trimming and punching operation may be carried out without scratching or chipping the veneer layer, and without separation of the veneer from the base layer 10.

The final cure of the consolidated sheets may be effected by normal air curing. Preferably, however, the composition of the base sheet, and also the composition of the parting and surfacing pellets, includes finely divided silica as well as Portland or other hydraulic cement. When silica is present the final curing operation is preferably effected by confining the sheets in a closed autoclave in the presence of saturated steam under pressure. This steam cure may be carried out at a temperature equivalent to a steam pressure range of say 70–120 lbs. per square inch gauge. A complete set can be developed by this steam curing treatment within a period of less than 24 hours. During the final curing treatment a strong adherent bond is developed between all portions of the veneer coating 24 and the base 10. The steam cured product exhibits minimum tendency to warpage or separation of the veneer from the base under weather exposure. This is because the coefficients of expansion of the veneer and the base are approximately the same, and are comparatively small as a result of the steam curing treatment.

The composition of the base layer or sheet 10 may include Portland cement and asbestos fibers in approximately the proportions normally used in the manufacture of asbestos and cement shingles, for example, 60–100 parts asbestos fibers to 100 parts of the cement. The base sheet composition preferably includes finely divided silica in amounts representing 30–70 parts of silica to 100 parts of cement. A suitable size classification of asbestos fiber for the base layer is a shingle grade fiber classifying approximately 50% retained on a 10 mesh screen and 50% passing a 10 mesh screen by the Standard Quebec wet screen test.

When a primary veneer coating is interposed between the base layer 10 and the parting and surfacing pellets 20, such primary veneer coating advantageously incorporates finely divided asbestos fibers, or equivalent fibrous material, in amount representing 20–40% of the dry weight of the veneer. The fibers in the veneer coating are preferably shorter than those in the base 10.

The primary veneer coating may also incorporate finely divided silica. The amount of pigment in the veneer coating, and the character of the pigment, depends on the color and depth of color desired. Suitable pigments are the metal oxides such as titanium oxide, chrome oxide, lead chromate and iron oxide.

The parting and surfacing pellets 20 do not include any fibers in their composition. Such pellets may comprise only finely divided pigment and hydraulic cement binder. However, a preferred pellet composition normally includes finely divided silica. All of the components of the pellets should be reduced to a particle size finer than 200 mesh. In manufacturing the pellets, the cement and pigment and silica which are used may be thoroughly mixed dry, and then further mixed after addition of water in amounts sufficient to develop agglomeration of the component particles into moist pellets during the mixing operation. Such moist agglomerate pellets may be screened and graded as to size, and then incompletely cured as by air curing for a period of say 3 days. It is not necessary that the pellets 20 shall be spherical, nor that they be formed during the mixing operation. Thus, the pellets 20 may be made by casting and incompletely air curing a block of the indicated pellet mixture composition and then crushing the block and screening to suitable pellet size.

The total weight of primary veneer coating and of surfacing and parting pellets 20 which is applied to the base layer 10, in making up a composite shingle, is preferably limited to a comparatively small fraction of the total weight of the finished shingle. In other words, the most durable shingle is one with a thin veneer coating. The dry weight of veneer material, including surfacing pellets, should not exceed approximately 8–10 ounces in relation to a dry shingle weight of 3–3½ lbs.

When embossing shingles in accordance with the present invention, it has been found desirable to use a grain roll or texture plate on which the projections forming the pattern are of rounded rather than sharp contour, and have a maximum depth of not exceeding .025 inch. When the indentation patterns on the embossing plate or grain roll surface have a maximum depth in the indicated range, surfacing pellets of a wide range of sizes below 4 mesh perform efficiently to insure separation of the grain roll or texture plate without sticking, while at the same time crushing to provide uniformly distributed fine granular coatings for the resulting patterned veneer surface.

Since many variations may be made from the illustrative details given, without departing from the scope of the invention, it is intended that the invention should be limited only by the terms of the claims interpreted as broadly as consistent with novelty over the prior art.

What I claim is:

1. In the manufacture of hard and dense fibrocementitious sheets having an embossed and finely textured veneer surface, the steps comprising, forming friable, agglomerate pellets containing finely-divided mineral pigment and hydraulic cement, distributing the friable pellets as a surfacing layer over one surface of a moist compressible asbestos-cement base sheet, and crushing the pellets while subjecting the thus surfaced sheet to densifying, embossing and curing treatment.

2. In the manufacture of hard and dense as-

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bestos-cement sheets having a finely textured veneer surface of suitable color, the steps comprising, uniformly distributing over the top surface of a moist, compressible base layer of asbestos-cement composition a layer of friable pellets comprising hydrated agglomerates of finely divided mineral pigment and finely divided hydraulic cement, and highly compressing the composite sheet thus formed thereby crushing the pellets.

3. The method of manufacturing hard and dense veneer coated structural sheets while inhibiting development of surface blisters and cracks in the veneer which comprises, uniformly distributing over the moist face of a compressible uncured fiber-cement base sheet as a parting and coating material, friable pellets comprising agglomerates of finely divided mineral pigment and finely divided hydraulic cement, highly compressing the composite sheet thus formed thereby crushing the pellets while simultaneously densifying the base sheet and distributing water from the base sheet into the crushed pellet coating, and subsequently curing the composite sheet to develop a hardening set of the cement binder.

4. The method of manufacturing hard and dense veneer coated structural sheets as defined in claim 3, including the step of incorporating finely divided silica in the base sheet and in the friable pellets, and curing the densified sheets by heating them in an atmosphere of saturated steam under superatmospheric pressure.

5. The method of densifying and imparting a finely grained veneer coating to a moist compressible asbestos-cement base sheet while inhibiting development of surface blisters and cracks in the veneer which comprises, applying to a face of said sheet a veneer coating including a mixture of finely divided mineral pigment and hydraulic cement binder together with sufficient water to hydrate the binder, sprinkling over the face of the moist veneer coating as a parting

and finishing agent, friable pellets comprising agglomerated particles of said pigment and hydraulic cement, highly compressing the composite sheet thereby crushing the pellets while simultaneously distributing moisture from the veneer coating into the crushed pellet material and densifying the base sheet and the applied veneer coating, and developing a hardening set of the hydraulic cement component of the composite sheet.

6. The method of densifying and imparting a fine grained textured veneer coating to a moist compressible asbestos-cement base sheet which comprises, distributing over a face of the base sheet as a parting and veneer coating agent, friable pellets comprising agglomerated particles of mineral pigment and powdered silica in a matrix of incompletely cured hydraulic cement, highly compressing the composite sheet material thereby crushing the pellets, embossing a pattern on the crushed pellet coated face and locking the veneer coating into the base sheet, and developing a hardening set of the hydraulic cement binder.

7. The method of manufacturing hard and dense veneer coated structural sheets which comprises, distributing over a face of a compressible asbestos-cement base layer a veneer coating comprising an aqueous slurry of finely divided mineral pigment and hydraulic cement binder, distributing over the moist face of the veneer coating as a parting and surfacing agent, friable pellets comprising agglomerated particles of mineral pigment bonded with incompletely cured hydraulic cement, highly compressing the composite layer material thereby simultaneously crushing the pellets, distributing moisture from the veneer coating through the crushed pellet material, embossing a pattern on the pellet coated face and locking the veneer coating into the base sheet, and developing a hardening set of the hydraulic cement binder.

ERNEST WAYNE REMBERT.

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