Dec. 23, 1941. A. ELMENDORF 2,266,746

WALL STRUCTURE

Filed Oct. 25, 1939 2 Sheets-Sheet 1

Fig. 1.

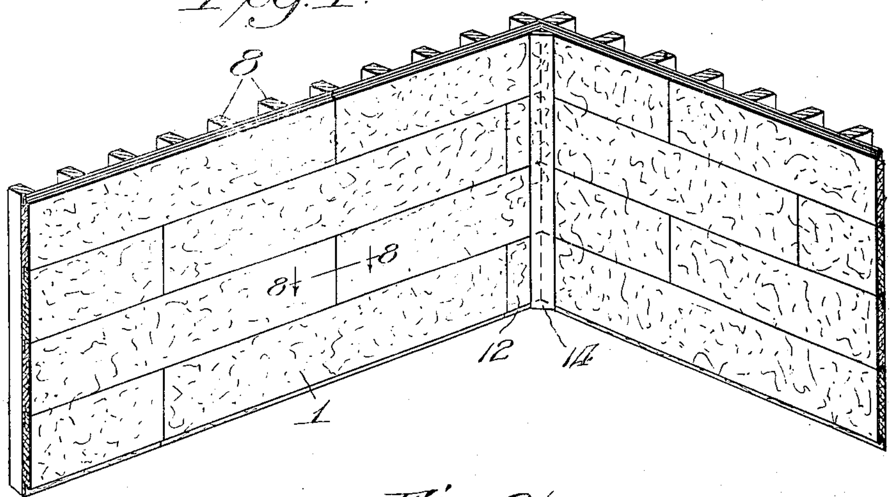

Fig. 2.

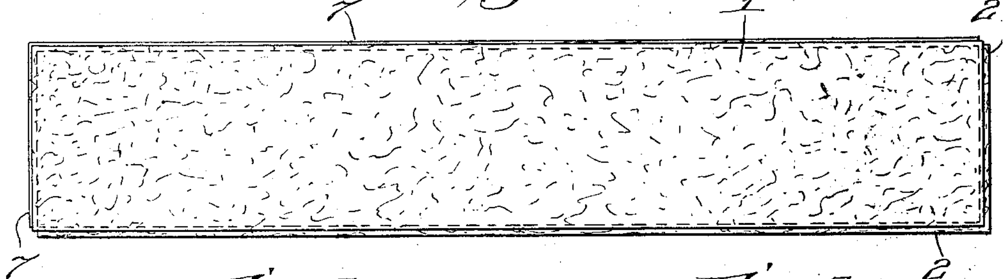

Fig. 3.

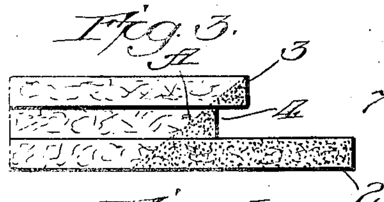

Fig. 4.

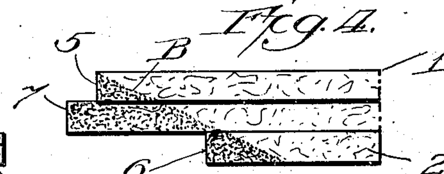

Fig. 5.

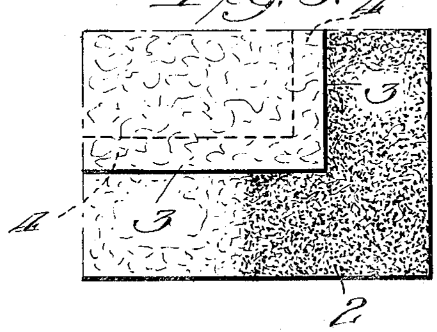

Fig. 6.

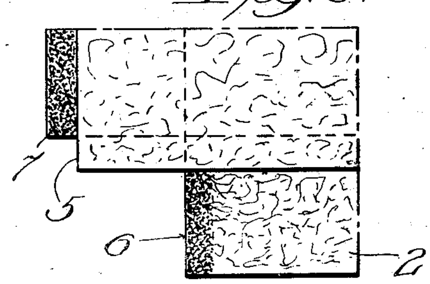

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Fig. 7.

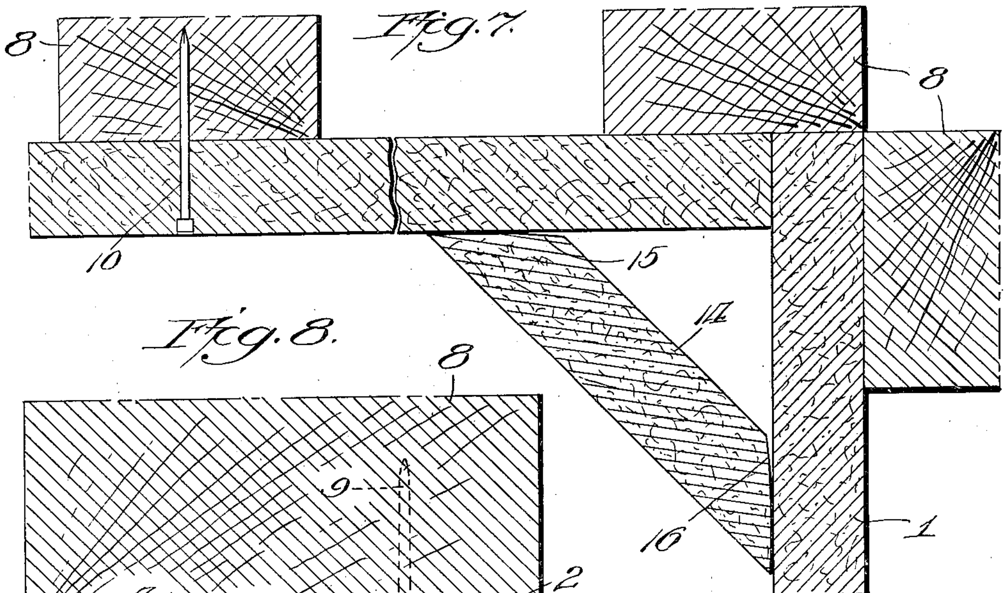


Fig. 8.

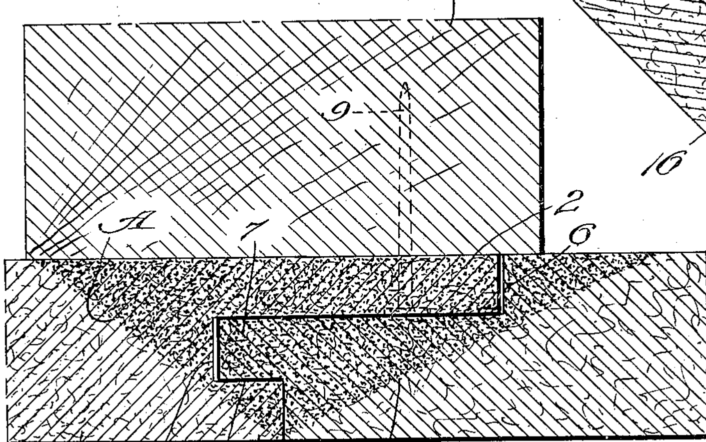


Fig. 9.

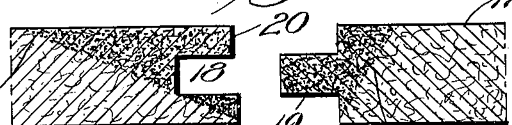


Fig. 10.

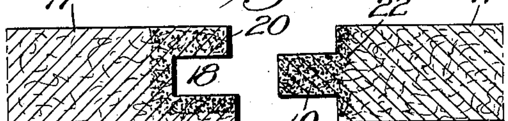
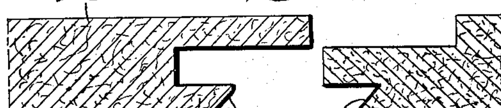


Fig. 11.



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UNITED STATES PATENT OFFICE

2,266,746

WALL STRUCTURE

Armin Elmendorf, Winnetka, Ill.

Application October 25, 1939, Serial No. 301,143

7 Claims. (Cl. 20—4)

Even though wall coverings or facings composed of panels of the fibrous insulation board type are widely used, it has not heretofore been possible to obtain wall surfaces that possess the continuity of plaster, for example; but such fibrous walls or facings, each composed of a number of individual pieces or panels, as must be the case with a wall of a room of any substantial size soon contain open joints, even though the individual pieces are applied in edge to edge contact with each other initially.

The object of the present invention is to make it possible to produce a wall or wall facing of any desired size from fibrous material of the insulation board type, without danger that the joints between adjacent boards or panels will subsequently open.

The essential thing in the production of my imrovped wall or wall facing is the creation of joints which, while serving to unite any desired number of panels into a monolithic structure approximately as strong at the joints as elsewhere, do not require greater skill than that possessed by the ordinary workman for the building of the wall or wall facing. Therefore, viewed in one of its aspects, the present invention may be said to have for its object the creation of such a joint.

If ordinary panels of the insulation board type are joined together by tongues or grooves or by lap joints, with glue interposed between the meeting surfaces, no width of the meeting surfaces that parallel the faces of the panels or boards, which it is practicable to use, will provide the necessary tensile strength across a joint and in the plane of the panels or boards to insure against rupture under forces much smaller than those required to tear or rupture the body portions of the panels. This is because the fibrous material shears easily along planes adjacent to and parallel with the glue lines. One of the objects of the present invention is to overcome this defect.

I have found that by indurating the cooperating marginal portions of panels or boards meeting edge to edge, they may be bonded together in the usual or any desired way and be substantially as strong at the joints as elsewhere, when placed in tension transversely of the joints in the planes of the boards or panels. To this end I treat the individual panels or boards with a hardening material which is caused to penetrate far into the fibrous structure adjacent to the joint-forming surfaces. The hardening material conveniently takes the form of a glue, preferably animal glue that is made quite thin and is then applied in a heated condition so as to have good penetrating qualities. After this glue has set, the tongues and the lips which constitute complementary joint elements become hard, strong and tough. The hardening agent may be applied in any suitable way as, for example, by dipping the marginal portions of the panels in a bath in such a way that the hardening agent does not cover any part of the faces of the panels which are the exposed faces in a wall or facing; or, the hardening agent may be sprayed on.

In building a wall or wall facing with my improved material, the first board or panel is placed against the studs or other backing and is nailed thereto by means of finishing nails of small diameter. A suitable adhesive is then applied in the joint-forming area at the edge where the next board or panel is to be located. The second panel then has a coating of adhesive applied to that portion which is to cooperate with the glue coated part on the first panel, and the second panel is laid against the studs and pushed laterally until the two panels are interlocked. This process is repeated in the vertical and horizontal directions until the entire wall or facing is in place.

Expansion and contraction inevitably takes place under changes in the moisture content of the fibrous wall or wall facing. Since the joints do not permit separation in those regions, each complete wall or wall facing must expand and contract as a unit. This is permitted by the relatively small nails which make it easy for the fibrous material to be compressed at the nails in contracting. However, where an entire wall contracts as a unit, cracks will appear in the corners where two walls meet each other. A further object of the present invention is to permit the expansion and contraction of walls as units, as aforesaid, without opening in the corners cracks or joints that are visible to the occupants of a room to which such walls belong.

The various features of novelty whereby my invention is characterized will hereinafter be pointed out with particularity in the claims; but, for a full understanding of my invention and of its objects and advantages, reference may be had to the following detailed description taken in connection with the accompanying drawings, wherein:

Figure 1 is a perspective view showing fragments of two walls of a room meeting at a corner; Fig. 2 is an elevational view of an individual board or panel arranged in accordance with the present invention; Fig. 3 is an edge view showing, on a larger scale, one corner of the board or panel of Fig. 2; Fig. 4 is a view similar to Fig. 3 and may be regarded as showing either the corner of the panel of Fig. 3, at the same end but on the opposite side of the panel, or the near corner of a second board or panel which is to be interengaged with the panel of Fig. 3; Fig. 5 is a top plan view of the board or panel fragment shown in Fig. 3, whereas Fig. 6 is a similar view of the corner appearing in Fig. 4; Fig. 7 is a horizontal section, on an enlarged scale, taken through the corner between the walls in Fig. 1; Fig. 8 is a section on a still larger scale than Fig. 7, taken on line 8—8 of Fig. 1; Fig. 9 is a view showing in cross section the complementary tongue and groove edges of two boards or panels adapted to be engaged with each other, illustrating the type of induration obtained by dipping; Fig. 10 is a view similar to Fig. 9, showing the same board fragments in which the hardening agent has been applied by spraying; and Fig. 11 shows in cross section fragments of two boards, untreated, only slightly different in form than those in Figs. 3 and 4.

Referring to Figs. 2 to 6 of the drawings, 1 represents a board or panel of the fibrous insulation board type, possessing any desired thickness and being of any desired length and width. The material is preferably fairly thick. An example of a board or panel adapted for a wide range of use is one about three-fourths of an inch thick, two feet wide and ten feet long.

In accordance with my invention I provide the panel along each edge with a marginal portion which is complementary to a marginal portion on another panel, whereby a lapped or interlocked joint, containing contact faces generally parallel with the planes of the two panels, may be effected. In the arrangement shown, the joint to be produced is of the tongue and groove type. Thus, the material along one edge of a panel is cut away to produce a wide lip 2 flush with one of the broad faces, and a narrow lip 3 flush with the opposite face but set far back from the corresponding edge of the panel; there being between the lip 3 and the base or inner part of the wide lip 2 a groove 4. The panel along the opposite edge is shaped as shown in Fig. 4; the material being cut back from the edge a distance slightly less than the width of the narrow lip 3 to provide a shoulder 5; and the material of the panel being cut away on the opposite face for a distance slightly greater than the length of the lip 2, and thereby providing a shoulder 6. The central stratum of a panel is unmutilated to provide a short tongue 7. The parts are so proportioned that when what may be termed the tongue edge of a panel (as shown in Fig. 4) is placed in edgewise engagement with what may be termed the grooved edge of another panel, (the edge shown in Fig. 3), the shoulder 5 will abut against the edge face of the lip 3, while the short tongue 7 will not bottom in the groove 4, nor will the shoulder 6 come in contact with the end edge of the lip 2. However, the under marginal face of the one panel, extending from the outer edge face of the tongue 7 to the shoulder 6 lies on top of the lip 2. Assuming that Fig. 3 illustrates the righthand vertical edge, then the same lip and groove formation also extends along the bottom edge of the panel. Fig. 4 then represents the formation of the lefthand vertical edge and the top edge of the panel in Fig. 1. The panels being shaped as described, they may be assembled as illustrated in Fig. 1, with their vertical joints staggered; one panel in each row being of course cut off if the length of the wall be not an exact multiple of the length of a panel; and the piece thus cut off in one row being available to start the next row.

If the panels such as have just been described are simply glued together, in their natural state, in locked relation to each other, a pull in the planes thereof, in the direction tending to separate them will rupture the joint or joints long before there is any danger of a rupture in the body portions of the panels. This is because the shearing strength of the fibrous material, parallel with the faces of the panels, is not great and, therefore, the material of the panels will shear adjacent to the glue layer covering the inner broad face of each lip 2, even though this layer have a width greater than the panel thickness, as illustrated. In order to strengthen the marginal portions of the panels so as to make them capable of resisting the shearing stresses to which the material at the joints may be subjected in actual service, I impregnate the marginal portions of the panels with a suitable toughening and hardening agent. Almost any binding material is suitable for this purpose, as long as it can readily be made to penetrate deeply into the fibrous material. In actual practice I have obtained very good results with animal glue mixed with water in the proportion of one part of glue to five parts of water.

It is important that the hardening and toughening agent penetrate deeply into the body of the fibrous material instead of forming a surface coating in the nature of so-called "glue-sizing.' Therefore, if the process of treating the panels consists in dipping their marginal portions into a bath of binding material, that material must be of a character to insure that it will readily pass into the interstices of all that part of any panel that lies below the surface of the bath. In the case of the aforesaid animal glue, the bath must be hot and, even then, it is advisable to use a wetting agent to increase the speed of penetration. Good results have been obtained by adding to the bath about two percent of sodium lauryl sulphonate. Obviously, the marginal portions of the panels could first be made wet with the wetting agent and then be dipped into the hot glue bath. The hardening and toughening agent may also be introduced into the interior of the panels by spraying. For that type of treatment the wetting agent should be mixed with the hot glue prior to spraying. Also, while the toughening and hardening agent must penetrate deeply, no complete filling of the interstices but only effective coating of the fibers in the treated portions of the panels is required. Therefore, when I refer to an indurated body or element, I do not mean that it must be in the nature of a solid composed of binding material with fibers distributed through it, but simply that it has been hardened and toughened.

In Figs. 3 and 4 the panels are shown as having been treated through the dipping of their marginal portions into a bath so as to impregnate them throughout their entire thicknesses outwardly from broken lines A and B, respectively, each of which extends diagonally from the edge of the corresponding panel at or slightly below the face of the panel which is to be exposed in a wall or the like. Thus, the entire lip 2 and a considerable portion of the panel inwardly therefrom, as well as the lip 3 and the material lying inwardly from the bottom of the groove 4, contain the hardening and toughening material; while the short lip 7 and the portion of the body of the panel lying inwardly from the same, and extending throughout the entire thickness of the panel, likewise contain the hardening and toughening material.

After the glue or other binding has become hard, the joint-forming surfaces that lie parallel with the faces of the panels are preferably sanded or otherwise smoothed, so that the tongue edge of one panel can readily be interengaged with the complementary edge of another panel.

The panels formed and treated as heretofore described reach the consumer in such a condition that they need only be assembled in a wall or wall facing in the manner of any panels provided with tongues and grooves and which are to be bonded together. In other words, as shown in Figs. 1 and 8, the panels may be secured in interlocked relation to each other against ordinary studs 8 with their long dimensions horizontal; the first panel being laid with the lip 2 along one end on the side toward the studs. If this lip happens to lie against a stud as in Fig. 8, nails 9 may be driven through the lip and into the stud; this nail being concealed when the next panel in that row is applied. Finishing nails of small diameter, as indicated at 10 in Fig. 7, may be driven through the panel and into the studs, wherever the panel crosses the latter. After the first panel has been secured in place, the joint forming surfaces are coated with a layer of adhesive and the complementary marginal portion of the next panel is similarly coated. The second panel is then placed against the studs and is moved laterally until the two panels are interlocked, as shown in Fig. 8, with a layer of bonding material between the same. It will be seen that by reason of the proportions of the joint-forming elements heretofore described, the only edge faces at right angles to the broad faces of the panels that need engage with each other are the edge face of the short lip 3 and the shoulder 5, so that the actual joint as viewed from the room side need only be a hairline.

The width of the wall may not be equal to a multiple of complete panel lengths so that, as indicated in Fig. 1, only a part 12 of a panel is needed to finish the first row. Obviously, the panel part that is not needed in the first row can be utilized to start the second row. In applying the second row, it is of course necessary to bond the lower long edge of each panel in that row with the long upper edge of a panel or panels in the lower row, as well as to effect bonds between the meeting ends of the panels in the second row.

After a wall has been placed in position, any adhesive that may have been squeezed out of the joints at the exposed face of the wall is scraped off. Then, by giving the wall a rough sanding across the joints, fibers are worked into joints and the face of the wall assumes a uniform texture throughout.

I have obtained best results with casein-latex adhesives as the material for bonding the treated panels together. In fact, as far as I can now determine, this is the best adhesive for my purpose. Actually, the joint between the indurated marginal portions of two panels is so strong that when the panels are pulled in tension across the joint until something gives way, the failure occurs in the body of the specimen and not at the joint. This is accomplished without requiring that the overlapping elements, whose meeting surfaces are bonded to each other, be pinched or clamped together in making the bond. In other words, the mere act of forcibly interengaging the meeting edges of the panels in assembling them in a wall provides all the pressure needed for bonding. An important characteristic of my new construction is that the joint has a strength of from eighty-five to ninety percent as great as that of the full cross section of one of the panels on a plane parallel to the joint, even though the workman leaves a gap between the end of the lip 3 and the shoulder 5 with which it is intended to engage.

While I prefer that such an adhesive shall contain from thirty percent to forty percent solids, the proportion of solids may be varied as long as the adhesive is tough or rigid after setting. Alcohol soluble adhesives such as manila gum can also be used as the bonding material; although these should contain plasticizers to prevent them from filming over too rapidly.

Walls formed as heretofore described will not crack open at the joints therein due to variations in the moisture content thereof, although they will expand and contract more or less as unitary structures, due to the fact that the material thereof is soft enough to yield at the nail holes. Each wall may therefore be regarded as a single, large floating panel. Where two of these walls meet, namely in the corner of a room, a noticeable gap may develop when the walls become very dry. In order to permit the walls to expand and contract naturally and yet prevent the formation of a visible open joint or gap in the corner, I place a strip 14 of wall board material diagonally across each corner, as shown in Figs. 1 and 7. This strip has its long edges bevelled, as indicated at 15 and 16; these edges preferably converging at a somewhat greater angle than the angle between the two meeting walls so that even though the edge faces of the strip be wholly or partly bonded to the walls, the marginal portions of the walls behind the strip may swing a short distance into the room and the strip itself may rock, so as to permit the natural shrinkage to take place in the walls without opening the joints between the corner filler strip and the walls.

In Fig. 9 I have shown complementary marginal portions of similar panels 17 of the plain tongue and groove type; one edge containing a simple groove 18 and the other edge a projecting tongue 19 slightly shorter than the depth of the groove. The lip 20 that bounds the groove on the rear side of the panel is a little shorter than the lip on the front side, so that only a hairline joint is visible when two panels are properly joined together. As in the form of panel heretofore described, Fig. 9 illustrates a panel or panels in which the marginal portions have been toughened and hardened up to the diagonal broken lines A and B, through dipping.

In Fig. 10 there is shown the same panel structure as in Fig. 9 except that the toughening and hardening has been effected by spraying the binding material upon the edges of a panel. When the binding agent is sprayed against the surfaces bounding the groove 18, it will penetrate the fibrous material in the manner indicated by the stippled area 21. Likewise, if the binding agent be sprayed upon the tongue and the shoulders at the base of the tongue, the panel is toughened and hardened as indicated by the stippled area 22.

In Fig. 11 I have shown the opposite marginal portions of a panel or the complementary marginal portions of two panels similar to those in

Figs. 3 and 4; the only difference being that the edge of the lip **25**, corresponding to the lip **3** in Fig. 3, is beveled, as indicated at **26**, and that the shoulder **27**, corresponding to the shoulder **5**, is undercut. Fig. 11 is a sectional view so that the faces toward the observer are not edge faces. Furthermore, there has been no toughening and hardening treatment of the panel as shown in this figure; the panel being shown in its virgin condition before the hardening and toughening treatment.

I claim:

1. A panel of the fibrous insulation board type having in one edge a groove the sides of which are parallel to the faces of the panel, and in the opposite edge a tongue complementary to the groove, and a non-plastic hardening substance permeating the tongue and the material adjacent to and bounding the groove.

2. In combination, two parallel panels of the fibrous insulation board type engaged edge to edge through a tongue and groove joint containing cooperating surfaces parallel to the faces of the panels, a non-plastic hardening and toughening agent distributed through the marginal portions of the panels at the joint, and a casein-latex bonding material between and uniting said cooperating surfaces.

3. A panel of the fibrous insulation board type having complementary elements for forming a lap joint extending along opposite edges thereof, each of said elements having a bearing face of substantial width, and the marginal portions of the panel along said edges being permeated with a hard, non-plastic binding material throughout substantially their entire thicknesses while leaving the texture of an entire face of the panel in its original state.

4. A panel of the fibrous insulation board type having complementary joint-forming elements extending along opposite edges thereof, each of said elements having a bearing face of substantial width parallel to the faces of the panel, and the marginal portions of the panel along said edges being permeated with a hard, non-plastic binding material throughout substantially their entire thicknesses while leaving the texture of an entire face of the panel in its original state.

5. A panel of the fibrous insulation board type having complementary joint-forming elements extending along opposite edges thereof, each of said elements having a bearing face of substantial width lying parallel to the faces of the panel, and the marginal portions of the panel along said edges being permeated with an animal glue.

6. A panel of the fibrous insulation board type having complementary elements for forming a lap joint combined with a tongue and groove joint extending along opposite edges thereof, each of said elements having bearing faces of substantial width lying parallel to the faces of the panel, and the marginal portions of the panel along said edges being permeated with a hard, non-plastic binding material throughout substantially their entire thicknesses.

7. In combination, two parallel panels of the fibrous insulation board type engaged edge to edge by means of a joint containing cooperating surfaces parallel to the faces of the panels, a non-plastic hardening and toughening agent distributed through the marginal portions of the panel at the joint, and a hard, non-plastic bonding material between and uniting said cooperating surfaces.

ARMIN ELMENDORF.