

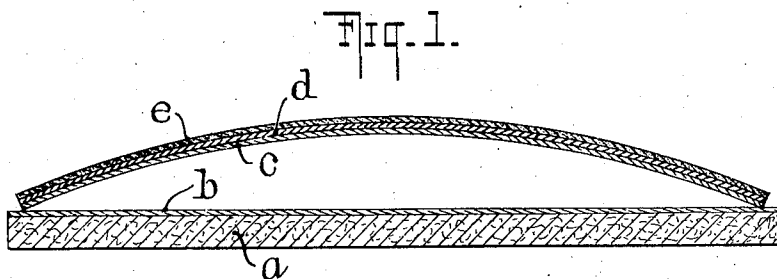
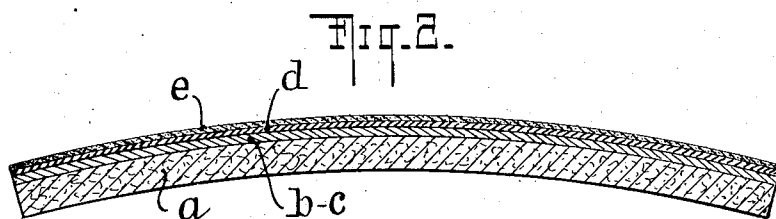
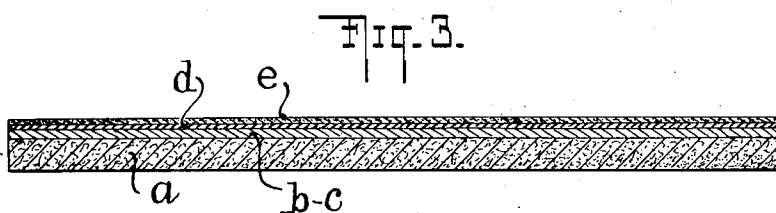
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STEEL COATED BOARD

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WITNESS

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STEEL-COATED BOARD.

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My invention relates to a board, one side of which has applied thereto, by suitable cementing means, a sheet of enameled steel. This kind of board may be used for many purposes, for instance, the lining of railroad cars, dairies, bathrooms, kitchens, pantries, etc., and has the advantage of being sanitary, easily cleaned, fire-resisting and not liable to be damaged by any but hard blows.

Enameled sheet steel is well known in the art of steel treatment. As is known to those skilled in such art, steels of a special type are used for this purpose, which are subjected to a stretching operation and a preliminary surfacing operation (ground coating). The enamel powder is then placed upon the steel so treated and fused thereon in a kiln or furnace heated to a temperature sufficient for this purpose, usually in the neighborhood of 2500° F. When the steel is thereafter cooled it assumes a distorted form, unless it has been reinforced in some manner.

Such steel, when subjected (prior to enameling) to the pressing operation which forms it into utensils of various kinds (pans, table tops, etc), is capable of assuming and maintaining such forms as the presses may give to it, in part, at least, by reason of reinforcement by the angles and other supporting shapes formed by the pressing. If, however, the steel sheet is of a substantial size and is to be employed in a flat form only, there is no practicable process known to the art by which such steel can be made to assume and maintain such form without the aid of additional material. Such steel will, of course, when held flat, always tend to assume the shape which it had immediately after the completion of the cooling. I am speaking, of course, only of a steel sheet of such thickness and size as will, after enameling and subsequent cooling, assume without the application of a bending process a substantially curved form. Comparatively small sheets even of relatively thin steel, will not be distorted to a substantial degree during the enameling process, and sheets of larger size, but thicker material, will also not be distorted to any substantial degree. My preferred size of sheet is, for instance, ten feet long, four feet wide and of a thickness indicated by gauges 18 to 40. It is to this type of sheet that I refer in my claims as "enameled steel which normally assumes a

curved shape". If such sheet is mounted on a backing of weaker material this tendency will cause or tend to cause such backing to assume a form which, when looked at from the armored side, will be convex.

My invention in its preferred form contemplates the application of a sheet of enameled steel by a suitable cementing means to a backing of material which is affected by atmospheric moisture and is capable of being distorted thereby to a substantial extent. My backing may consist, for instance, of pulp board or fibre board, preferably pulp board which may be made by running a mixture of pulp and water, to which a binder may have been added, into a mold, removing the majority of the water by pressure, removing the remainder of the water by the application of heat, preferably in a suitably constructed drier (see United States Letters Patent No. 971,936 dated October 4, 1910 and No. 1,272,566 dated July 16, 1918). When fibre board and particularly a pulp board such as hereinbefore specifically described, is subjected to moisture equally on both sides, it tends to stretch with only a comparatively slight tendency to distortion. If it is subjected to moisture on one side only, the exposed side tends to expand and will therefore tend to give the board a concavo-convex form, the exposed side forming the convex side. Instead of a pulp board I may use any other suitable material for my backing, for instance, wood.

As already explained, non-reinforced enameled sheet steel will be distorted by the heat treatment necessary to permit the enamel to fuse and the subsequent cooling. For instance, if the sheet is oblong, it will take a curve along its minor axis, the major axis lying substantially in a straight line. If an oblong sheet of steel is cemented to a backing such as I have described, it will draw, or tend to draw, the backing into concavo-convex form, the convex side being the one to which the steel is attached. If, now, the exposed side of the backing be humidified, such backing will tend to be drawn into concavo-convex form but with the exposed side forming the convex side and will thus tend to draw in a direction opposite to that in which it is pulled by the steel. If the backing is of such a nature and of such proportions that the addition of a suitable

amount of moisture to this exposed side will cause it to neutralize the pull of the steel sheet, a flat panel will result, whereas if conditions are such that the pull of the steel is more than overcome, the panel will be concavo-convex with the steel on the concave side. Again, if the pull of the steel is not entirely overcome, the panel will remain concavo-convex but not so much as before the application of the moisture.

In the accompanying drawings, Fig. 1 shows a cross-section of a backing, having applied thereto a layer of cementing material and a cross-section of a sheet of enameled steel also provided with a layer of cementing material, and ready to be stretched flat and pressed upon the backing. Fig. 2 shows a cross-section of the assembled board before moisture has been applied to the exposed side of the backing only and in which the steel is strong enough to distort the backing. Fig. 3 shows the completed board after a suitable amount of moisture has been applied to the exposed side of the backing, after the panel has been assembled.

In the figures *a* represents the backing, *b* the cement on the backing, *c* the cement on the steel, *d* the steel and *e* the enamel coating. The cement may be of any suitable type and is preferably a rubber cement.

I shall now describe an example of the practice of my invention for use in making a composite panel having a substantially flat form. I employ a sheet of steel and a backing having such relative strength that the steel will actually distort the backing when the latter is in the bone-dry condition in which it usually comes from the drier. The backing, when subjected to the average degree of atmospheric moisture at the place at which the panel is to be used, must be capable of pulling the steel sheet to flat form or to almost flat form. I then apply the sheet to the backing by means of the cement described, while such backing is bone-dry. I then expose the composite panels to conditions of average atmospheric moisture to be met at the point of use. I may do this either by trying out the panel at the point of use or by subjecting it at the factory to air-conditioned apparatus in which such average conditions are reproduced. If I find upon such test that the panel will be pulled into and remain substantially in a flat form, I manufacture the panels for use at such point by applying steel to bone-dry backing. If, on the other hand, I find that the backing pulls the steel from the convex form into the concave form, I make another panel using a backing to which a slight amount of moisture has been added by subjecting the same on both sides to a humidifying process and repeat the test, continuing, if necessary, with increased amounts of moisture in the backing before attaching until a flat panel is

produced. By this trial and error method I determine what is the proper moisture content of the backing before attaching the steel sheet thereto so that the additional strain set up by the additional moisture applied to the exposed side under average atmospheric conditions at the point of use, will be just sufficient to draw the panel into straight form or into almost straight form. In practice I have found that it is always advisable to have some moisture in the backing before applying the steel thereto because I contemplate the use of as thin a sheet of steel as feasible and as strong a backing as commercially feasible. By increasing the moisture content of the backing before the steel is applied, I diminish the amount of additional moisture taken from the atmosphere by the panel and therefore diminish the tendency of the panel to assume a concave form. I prefer to have the completed panel, after exposure to such average atmospheric conditions, slightly convex, considered from the steel side, because a temporary excess of moisture in the atmosphere will then do no more than draw the panel quite flat and a temporary deficiency will tend to draw it into slightly more convex form. I have found that the human eye is disturbed by a panel which is concave as a whole or in part or parts (for instance, when applied to the strainers of a delivery wagon body) whereas it is not offended by convexity.

Of course, if for some special reason I desire to have the panel either permanently substantially convex or permanently substantially concave, I modify the various conditions so as to obtain this end without, however, departing from the principle of my invention. The preferred form of my invention, wherein a sheet of enameled steel is cemented to a relatively thin and flexible backing composed of hygroscopic material, is important because for the manufacture of armored panels on a large scale it is desirable to have a backing of as light weight as possible.

If the conditions at the point of use are such that the steel is subjected to a very high heat or a high degree of cold, which would tend to expand or contract the steel, I so regulate the initial moisture content of the backing as to compensate as much as possible for such expansion or contraction. I have found, furthermore, that the tendency of the enameled steel to become curved after cooling can be counteracted to a very large degree, and perhaps entirely, by compressing certain portions of the steel prior to the enameling process so as to form strengthening ribs—for instance, by compressing the steel along the lines which will form square or lozenge patterns. This discovery will form the subject-matter of a separate application for Letters Patent. To the extent to

which the tendency of the steel to bend is diminished by this method, or possibly by more careful methods of supporting the steel in the furnace, during the enameling process, or possibly to the subjection of the steel to lower temperatures during such process, the initial moisture content of my backing will have to be increased, other things being equal. If the enameled steel after cooling should be substantially flat and if substantially no tendency to assume a curved shape exists, then my process will obviously have to be so modified, that is to say, so restricted that the original moisture content of the backing is determined only by the conditions to be met at the point of use without taking into consideration the necessity of overcoming the tendency of the panel as a whole to assume a convex form. In other words, the more nearly the steel tends to remain in a flat form, the more nearly the original moisture content of the backing should be such that no additional moisture is absorbable thereby at the point of use.

If the pulp board used by me contains a fusible binder, I prefer not to subject the backing to the usual heat and pressure (see, for instance, United States Letters Patent No. 1,598,260) before cementing the steel thereto, but to perform such operation when I press the steel thereon; in other words, instead of forming an assembled panel by pressure only, I form it by applying heat and pressure sufficiently high to fuse the binder and to compact the backing, but not so high as to drive away an appreciable proportion of the moisture in the board. Of course, I may allow, when applying moisture to the backing in the first place, for loss of moisture during such compressing operation by adding an excess of moisture approximately equal to that which would be evaporated during the pressing operation. I also permit the press to cool, before releasing pressure, to an extent sufficient to condense any steam which may have formed within the board. In practice, however, I find it unnecessary to subject the board to as high a degree of pressure as might be thought essential and therefore do not expose it to the high temperature long enough to have steam form as the sheet steel will supply the strength which would otherwise have to be supplied by longer subjection to heat and pressure.

I may attach the enameled steel sheet by a suitable cement to a backing which is strong enough to hold it so that the composite panel will not be distorted by the steel. Such backing may comprise a wooden board, or a pulp or fibre board, or a platser board, or an asbestos board, of such strength as to be capable of resisting the bending stresses in the enameled steel facing, or it may comprise a relatively thin board suitably rein-

forced to resist bending. All of the foregoing backing materials, and many equivalents that may suggest themselves as substitutes therefor, are included in my claims by the expression "fibrous hygroscopic material". It is of course understood that when an exceedingly porous type of backing is used, a coating of varnish or the like may be found desirable to prevent transfer of moisture between the backing and the atmosphere.

When I refer in my claims to steel I desire it to be understood that such term includes not only steel but any other metallic material, such as iron, which assumes a curved form when cooled after enameling, whether or not it has been subjected to the particular treatment of stretching and ground coating hereinabove described. It is, of course, to be understood that the enamel powder used must be of such a nature, and applied in such a manner, that the baked enamel is capable of being flexed with the steel without crazing. Such enamel, and the method of applying it in such manner, are well known to manufacturers of enameled steel.

I claim:

1. In a composite panel a facing of enameled sheet steel, a backing of fibrous hygroscopic material attached thereto, the internal structure and stresses of said facing being such as to cause it to assume a distorted form in the absence of any counteracting external influence, and moisture distributed substantially throughout the backing in such predetermined quantity that the internal stresses developed in the backing are sufficient to substantially counteract the internal stresses of the facing and thereby prevent distortion thereof.

2. In a composite panel a facing of enameled sheet steel, a backing of fibrous hygroscopic material cemented thereto, the internal structure and stresses of said facing being such as to cause it to assume a curved form in the absence of any counteracting external influence, the said backing being weaker than the facing so as to be capable of being distorted thereby, and moisture uniformly distributed in the outermost side of the backing in such predetermined quantity as to cause said side to expand and draw upon the facing to limit the curvature thereof.

3. The method of making a composite panel, consisting in selecting a facing of enameled steel, which normally assumes a curved shape, attaching thereto a backing of fibrous hygroscopic material, which backing is weaker than such facing so as to be capable of being distorted thereby, and adding moisture to the portion of the backing which lies immediately behind the side opposite the facing sufficient in quantity to cause the

backing to draw the facing and thus alter the curvature of the panel.

4. The method of making a composite panel consisting in selecting a facing of
5 enameled steel, which has a normal tendency to assume a distorted shape, attaching thereto a backing of fibrous hygroscopic material, which backing is weaker than such facing
10 so as to be capable of being distorted thereby, adding moisture to the backing, before it is attached to the facing, distributing said moisture substantially throughout the backing in such quantity that after the panel has
15 been assembled such backing, at the point of use, will absorb no more moisture from the atmosphere than is sufficient to cause it to draw the panel to a predetermined shape.

5. The method of making a composite panel from a facing of enameled steel, which normally assumes a curved shape, con-
20 sisting in cementing thereto a backing of fibrous hygroscopic material, which backing is weaker than such facing so as to be capable of being distorted thereby, adding to
25 the backing, before it is attached to the facing, moisture in substantially uniform distribution throughout the backing in such quantity that after the panel has been as-
sembled such backing, at the point of use, will absorb no more moisture from the at-
30 mosphere than is sufficient to cause it to draw the panel to substantially flat shape.

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