Dec. 14, 1948. W. F. FAIR, JR 2,455,923

BITUMINOUS LAMINATED MATERIAL

Filed Feb. 4, 1944

Fig. 1.

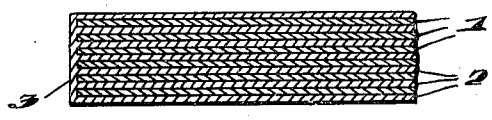


Fig. 2.

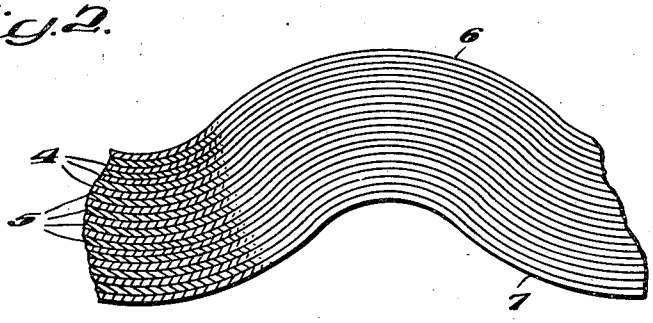


Fig. 3.

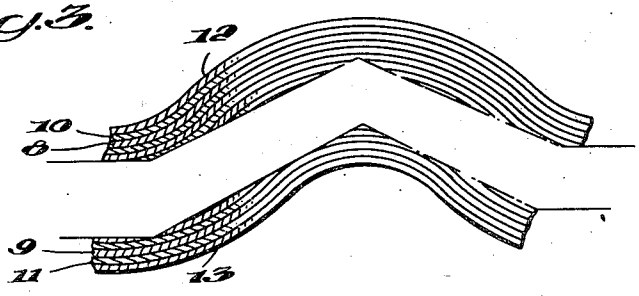


Fig. 4.

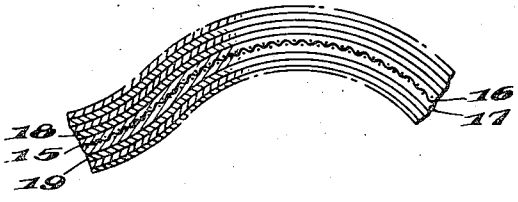


Fig. 5.



Fig. 6.

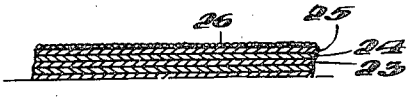
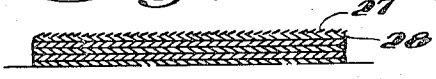


Fig. 7.



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Patented Dec. 14, 1948

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UNITED STATES PATENT OFFICE

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BITUMINOUS LAMINATED MATERIAL

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Application February 4, 1944, Serial No. 521,107

3 Claims. (Cl. 154—51)

1

This invention relates to improvements in construction material and methods of preparing the same. More particularly the invention relates to the production of weather-resistant, relatively light-weight and inexpensive laminated sheet material that has wide use in building and other structures, or enclosures of large or small dimensions.

Panel-like sheet metal members have long been used for the roofing and siding of buildings in temporary as well as permanent construction. Various materials have been proposed for use in substitution of metal, particularly for temporary structures. It has been difficult prior to the present invention to provide a low-cost, non-metal-containing material of sufficient strength and also of desired weather-resistance to be practical for outdoor use.

Various destructive effects of the atmosphere due to moisture, changes in atmospheric temperature, oxidation, light rays, etc., are readily minimized by means of the present invention in which a so-called coal-digestion pitch is applied in relatively thin layers between layers of paper or the like. The coal-digestion pitch employed adheres tenaciously and closely to a paper surface in hot or cold weather without embrittlement, or separation of the laminae attended by embrittlement, and without flow of the coal-digestion pitch between the paper layers particularly when in vertical or slanting positions. Furthermore the fibers of the paper layers are rendered non-water absorptive and retain their strength and toughness. No other special treatment of the fibers is necessary. These and other advantageous characteristics of the sheet product combine to provide a desired solidity and rigidity, particularly in wall structures.

It is found that in employing the coal-digestion pitch to be described, the pitch layers to be amply effective between the paper layers need be only as thin as layers of the pitch which are obtained by dripping the paper in a hot, molten bath of the pitch and by permitting hardening of the pitch retained on the surface of the paper withdrawn (preferably at a decelerating rate to obtain coatings of uniform thickness) from the bath and while in vertical position. Such thin coatings may also be applied by spraying or roller coating or by passage of the paper through a bath of the molten pitch, the temperature of the bath depending on the softening point of the pitch and being sufficiently high to maintain the pitch fluid, usually at about 350° F. to about 370° F. Sheets of the coated paper are superposed on each other and squeezed together under moderate heat and pressure. This may be accomplished either before or after hardening of the pitch. Various surface treatments are applied as indicated below.

2

A laminated sheet material comprising a plurality of paper sheets bonded by means of ordinary bituminous layers, such as asphalt or coal tar pitch coatings, is considerably improved by covering the outer surfaces and edges of such laminated material with a coating of the coal-digestion pitch, or at least partially impregnating such prelaminated sheet material with the coal-digestion pitch, or by applying to the laminated sheet material on either or both sides thereof a plurality of alternate layers of the coal-digestion pitch and paper. The improved effects of the outer layers of the coal-digestion pitch are thereby imparted to a laminated sheet preformed with ordinary bitumens, shielding the latter from the destructive influences of light, moisture, air, and especially temperature changes.

The laminated product of the present invention may assume various forms as shown by way of example in the accompanying diagrammatic drawings in which,

Figure 1 is a section through the thickness of a fragment of a laminated sheet including an edge thereof; and Figures 2 to 7 are sections of fragments of various modifications of the sheet.

Any number of paper sheets may be provided in the laminated product but for certain structural purposes it is preferable to include from ten to twenty plies of paper. In Fig. 1, a plurality of sheets of paper 1 are bonded together by layers of the coal-digestion pitch 2. The outermost paper sheets on top and on the bottom of the laminated product have an outer coating of the coal-digestion pitch which extends over the edges of the paper sheets at 3.

The finished product may be flat as shown in Fig. 1 or corrugated as shown in Figs. 2 to 4. A corrugated or other shaped product may be formed from flat layers while simultaneously compressing the plies together.

As shown in Fig. 2, a corrugated sheet comprises thin layers 4 of a coal-digestion pitch composition, alternating with thin paper sheets 5, such as kraft or other paper. The outer surface layers 6 and 7 are coal-digestion pitch composition which is of the same or different penetration or temperature susceptibility characteristics as the inner layers 4 depending upon conditions to which the finished product is to be subjected. The layers 6 and 7 may also be a

thin ply of mastic prepared from the coal-digestion pitch (25% to 60% by weight), fibers (at least about 10% by weight), and finely divided filler (up to about 65% by weight).

An article represented by Fig. 3, is one in which the third layer 8 from the top and the third layer 9 from the bottom are paper sheets, and every other layer towards the interior is a paper sheet. The bonding layers for the embedded paper sheets, depending on the use of the product, is the coal-digestion pitch, or in certain cases asphaltic, coal tar pitch or tar or other bituminous compositions. Bituminous compositions other than the coal-digestion pitch may be used for any desired number of the innermost paper sheets, and the coal-digestion pitch for one or more of the outermost paper sheets. In any case, it is preferred that at least the first paper sheet from either side of the laminated product be coated with the coal-digestion pitch, as in the layers 10 and 11. If these layers 10 and 11 are of other bituminous compositions, a coal-digestion pitch dip-coat or roller coat 12 and 13 serves to improve the laminated product.

Alternatively, the outer coats 12 and 13 may be a bituminous paint coat containing filler or such paint coat may be applied over coal-digestion pitch coatings 12 and 13. This paint coat is applied by dipping or spraying or brushing and has as a base the coal-digestion pitch.

A reenforcing means 15 (Fig. 4), such as wire mesh or woven wire or perforated metal sheeting, may be positioned between two intermediate plies of paper in the body of a laminated sheet. The reenforcing means may be shaped simultaneously with the shaping of the laminated sheet. Before insertion, the reenforcing means is preferably coated with a bituminous material which is preferably the coal-digestion pitch, as illustrated by layers 16 and 17. This pitch, besides preventing corrosion of the metal, is a firm bonding medium between the paper sheets 18 and 19 and the metal reenforcement. Any tension on the paper does not result in separation of the pitch from the metal while shaping on corrugating rolls or other shaping means, or while the laminated product is in use. The outer plies of the laminated material, are not shown in Fig. 4. Such plies are affixed in any desired number, and the outer surfaces of the material may be finished as shown in other figures in the drawings.

Figs. 5, 6 and 7 illustrate various surfacings for the laminated product. In Fig. 5, the top layer 20, superposed on a paper ply 21, is the coal-digestion pitch. Colored granules or opaque particles or dusts 22 are impressed in the layer 20. In Fig. 6, two applications of coal-digestion pitch compositions serve to coat the outermost paper ply 23. The first application 24 is the coal-digestion pitch received by the paper in dipping, and the second application is a filled paint 25 prepared from the coal-digestion pitch or other filled bituminous paint prepared from coal tar and/or water gas tar products. Colored particles 26 or opaque granules or dusts of sand, slate, granite, limestone, marble, etc. are cast on the paint layer 25. Fig. 7 illustrates the application of mica or metal in the form of overlapping flake particles 27 on the outer layer 28 of coal-digestion pitch composition or a bituminous paint on the laminated product.

The paper sheets may be substituted in the laminated article by thin felted sheets or thin woven fiber sheets or thin fiber-containing bituminous mastic sheets. Thin sheets of wood may

be employed in flat or laminated articles. The fibrous sheets may, if desired, be presaturated with a bituminous saturant, preferably containing a major proportion of aromatics, thus promoting adhesion of the pitch to the plies. Untreated fibrous plies may be partially or completely saturated with the coal-digestion pitch.

Coal-digestion pitch comprises a heat-liquefiable bituminous medium in which coal is dispersed by thermal digestion. The bituminous media employed include tars and pitches such as those derived from the destructive distillation of coal, or produced in gas manufacture wherein hydrocarbon oils or tars are employed. The coal employed is a bituminous coal such as coking coals including either high or low volatile bituminous coal, and certain commercial non-coking bituminous coals. The coal and the liquefiable bituminous medium are heated together, while stirring, to a temperature in the approximate range of preferably 300° C. to 310° C., though temperatures of 270° C. to 350° C. have been employed.

In the preparation of the thin plies of coal-digestion pitch in the above laminated product, it is found particularly advantageous to include in the coal-digestion pitch a heavy hydrocarbon oil of high aromatic content. A particularly desirable combination from the standpoint of improved penetration, temperature susceptibility, and other characteristics pointed out above, is coal, heavy water gas tar or a pitch residue derived from this tar, and heavy water gas tar heavy oil obtained by distilling heavy water gas tar. Heavy water gas tar is obtained from water-gas generator plants in which Bunker-C or similar grades of residual petroleum fuel oil are used for carbureting. This tar contains mostly aromatic constituents. Other heat-liquefiable bitumens such as coal tar, light water gas tar (produced in the carbureter of a water gas plant when petroleum distillates are used as carbureting materials), oil-gas tar, Pintsch gas tar, wood tar, and the corresponding pitches of these tars, may be added to heavy water gas tar, or may be substituted in whole or in part for the latter tar.

Heavy water gas tar heavy oil contains a major proportion of constituents that boil above 300° C. The following table is representative of its distillation characteristic:

Temperature	Distillate
°C.	*Per cent*
270	3.9
300	15.8
355	68.9
375	82.6
400	92.9

Heavy oil from light water gas tar and from coal tar may be substituted for heavy water gas tar heavy oil but the latter is preferred because of the improvement obtainable in rheological properties and temperature susceptibilities of the finished pitch due to the superior plasticizing properties of heavy water gas tar heavy oil.

The proportions of coal, heat-liquefiable bitumen, and heavy oil vary widely depending upon the conditions to which the laminated product is to be subjected. The greater the proportion of dispersed coal, the harder the coal-digestion pitch, and the greater the proportion of heavy oil the softer the pitch.

An example of how the coal-digestion pitch is prepared is as follows:

About 187 parts by weight of heavy water gas tar

and about 47 parts by weight of powdered bituminous coal are heated together in a still preferably while stirring. The temperature is gradually raised to a temperature of about 305° C. over a period of approximately five and one-half hours. This temperature is maintained for about four hours during which time there results a distillate of about 5 to 6% based on the tar. At the end of this time heating is discontinued and the mixture permitted to cool. After about forty minutes and while the temperature is slowly dropping, about 54 parts by weight of heavy water gas tar heavy oil are stirred into the heat-treated coal and tar mass. The resulting product is discharged from the still at around 225° C. The softening point of this product is about 102° C., and the penetration at 32° F. is 14; at 77° F., 20.5; and at 115° F., 40.

The softening points of the coal-digestion pitch plies in the laminated product may range from about 35° C. to about 150° C. but preferably about 80° C. to about 120° C., and the penetrations are above 10 or about 15 to 25 at 32° F., 200 grams, 60 seconds, and generally not more than about 70 at 115° F., 50 grams, 5 seconds. For service exposure at low atmospheric temperatures the softening point may be from 80° C. to 90° C. or in a range embracing substantially these points and the penetration at 32° F. may be at least 30. For service exposure at the higher atmospheric temperatures the softening point may be approximately 95° C. to 110 C. and the penetration at 115° F. not more than about 65.

For certain structures the coal-digestion pitch in at least the first outer pitch ply in the laminated product, has different softening point and penetration characteristics from those of the intermediate plies. The softening point and penetration characteristics of the outer pitch plies may be higher or lower than those of the inner pitch plies depending on conditions. These characteristics may also vary successively one from the other as one proceeds inwardly from the outer to the inner plies. Where a panel is subjected to conditions under which there is a temperature differential between one outer surface of the laminated product and the other outer surface, the characteristics of at least the outer ply of pitch on the one side and of at least the outer ply of pitch on the other side may differ over the ranges indicated above.

Besides having good heat-insulating and soundproofing properties, the laminated product is an excellent waterproofing means. The thin plies of coal-digestion pitch are not affected by moisture in the fiber plies or by moisture in the atmosphere because of its extremely low water absorptivity. Furthermore, expansion of contraction of the laminated product is practically negligible and an article made therefrom retains its shape at normal temperatures indefinitely irrespective of reenforcing means. Sheets of the product therefore find extensive use in factory buildings, warehouses, storage and machine sheds, dairy barns, drying sheds, and other structures.

What is claimed is:

1. A compressed laminated product comprising: alternate layers of thin fibrous sheets and of coal-digesting pitch of uniform thickness that is non-flowing from vertical surfaces of said sheets

and non-embrittling throughout the range of atmospheric temperatures and containing heat-digested coal and heavy hydrocarbon oil and having in combination a softening-point in the range of about 80° C. to 120° C., a penetration at 32° F., 200 grams, 60 seconds, of at least 10, and a penetration at 115° F., 50 grams, 5 seconds, of not more than approximately 65, and a layer of said coal-digestion pitch on one side of said laminated product having a softening-point in the range of about 95° C. to 110° C. and a penetration of not more than about 65 at 115° F.

2. In a compressed bituminous laminated product in which a plurality of thin paper sheets are bonded together with thin layers of bituminous material, the said laminated product comprising: about ten to twenty of said paper sheets providing a rigid, solid panel structure with said layers of bituminous material which consists of coal-digestion pitch containing heat-digested coal and heavy hydrocarbon oil and having in combination a softening-point in the range of 80° C. to 120° C., a penetration at 32° F., 200 grams, 60 seconds, of about 15 to 25, and a penetration at 115° F., 50 grams, 5 seconds, of not more more than about 65, and non-embrittling and non-flowing from vertical surfaces of said sheets throughout the range of atmospheric temperatures, a layer of said bituminous material on one side of said laminated product having a softening-point on the range of about 95° C. to 110° C. and a penetration of not more than about 65 at 115° F. and the layers of said pitch in said product being of a uniform thickness.

3. In a compressed laminated product in which a plurality of thin fibrous sheets are bonded together with thin layers of bituminous material, an outer layer of bituminous material on one side of said laminated product consisting of coal-digestion pitch having a softening-point in the range of about 80° C. to 90° C. and a penetration of at least 30 at 32° F. for service exposure at relatively low atmospheric temperatures, and an outer layer of bituminous material on the other side of said laminated product consisting of coal-digestion pitch having a softening-point in the range of about 95° C. to 110° C. and a penetration of not more than about 65 at 115° F. for service exposure at relatively higher atmospheric temperatures, the said product thereby providing means for application to structures subjected to conditions under which there exists a temperature differential.

WILLIAM F. FAIR, JR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,477,532	Bird	Dec. 18, 1923
1,916,333	Rose	July 4, 1933
2,124,843	Anderton	July 26, 1938
2,212,122	Miller	Aug. 20, 1940
2,304,773	Anderton	Dec. 15, 1942

FOREIGN PATENTS

Number	Country	Date
374,298	Great Britain	June 9, 1932