United States Patent [19]

Plumberg

[11] **3,922,425**

[45] **Nov. 25, 1975**

[54] **ROOFING BOARD FOR INTEGRATION IN A BUILT-UP ROOFING STRUCTURE**

[75] Inventor: **Leonard J. Plumberg,** Kansas City, Mo.

[73] Assignee: **Owens-Corning Fiberglas Corporation,** Toledo, Ohio

[22] Filed: **Sept. 14, 1970**

[21] Appl. No.: **72,059**

[52] **U.S. Cl.** **428/291;** 52/309; 156/71; 156/154; 156/155; 156/289; 156/337; 427/289; 427/429; 428/339; 428/489

[51] **Int. Cl.². E04D 5/10;** D06N 5/00; B32B 11/04; B32B 3/10

[58] **Field of Search**..... 117/168, 111 C; 156/71, 156/154, 155, 337, 289, 321; 161/156, 236, 93, 165, 247, DIG. 4; 52/309

[56] **References Cited**

UNITED STATES PATENTS

1,994,262	3/1935	Winding	156/71
3,144,376	8/1964	Plumberg et al	161/156
3,480,497	11/1969	Morse et al	156/155
3,581,779	6/1971	Sylvia	138/141

FOREIGN PATENTS OR APPLICATIONS

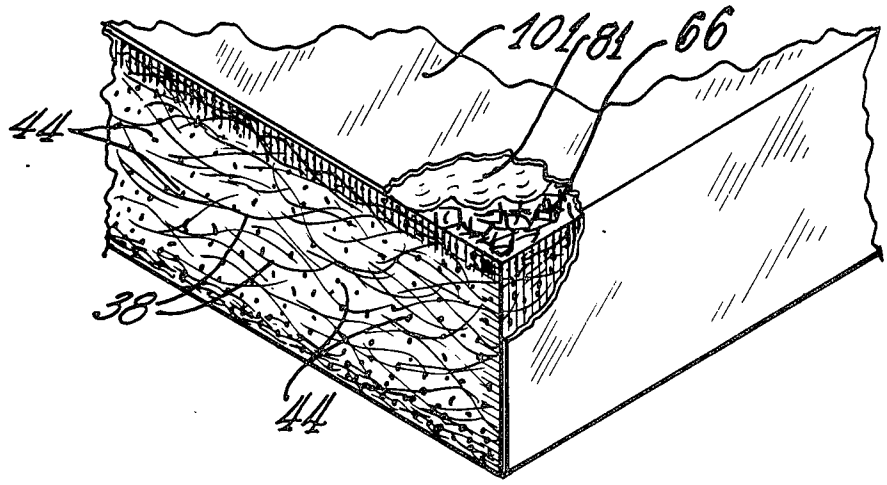
1,042,107	10/1953	France

Primary Examiner—Charles E. Van Horn
Assistant Examiner—Robert A. Dawson
Attorney, Agent, or Firm—Carl G. Staelin; John W. Overman; William P. Carr

[57] **ABSTRACT**

A thermal insulating roofing board preferably of bonded glass fibers, and with an asphaltic saturated surface layer under a top surfacing sheet, produced by discharging fibers downwardly with binder intermingled therewith to form a pack upon a receiving surface, compacting the pack in board form and curing the binder to dimensionally stabilize the pack, applying asphalt to the upper surface of the pack to impregnate the upper stratum thereof, and applying a thin, impervious surfacing sheet over the applied asphalt, said sheet being preferably between one fifth of a mil and one mil in thickness, and softenable, fusible or dissolvable at the temperature of melted asphalt whereby on the mopping deposit of a melted asphalt over the roofing board in constructing a built-up roofing the sheet is at least weakened by the heat of the asphalt and opened by dispersion or disruption and permits integration of the melted asphalt therethrough with the asphalt of the board.

6 Claims, 5 Drawing Figures



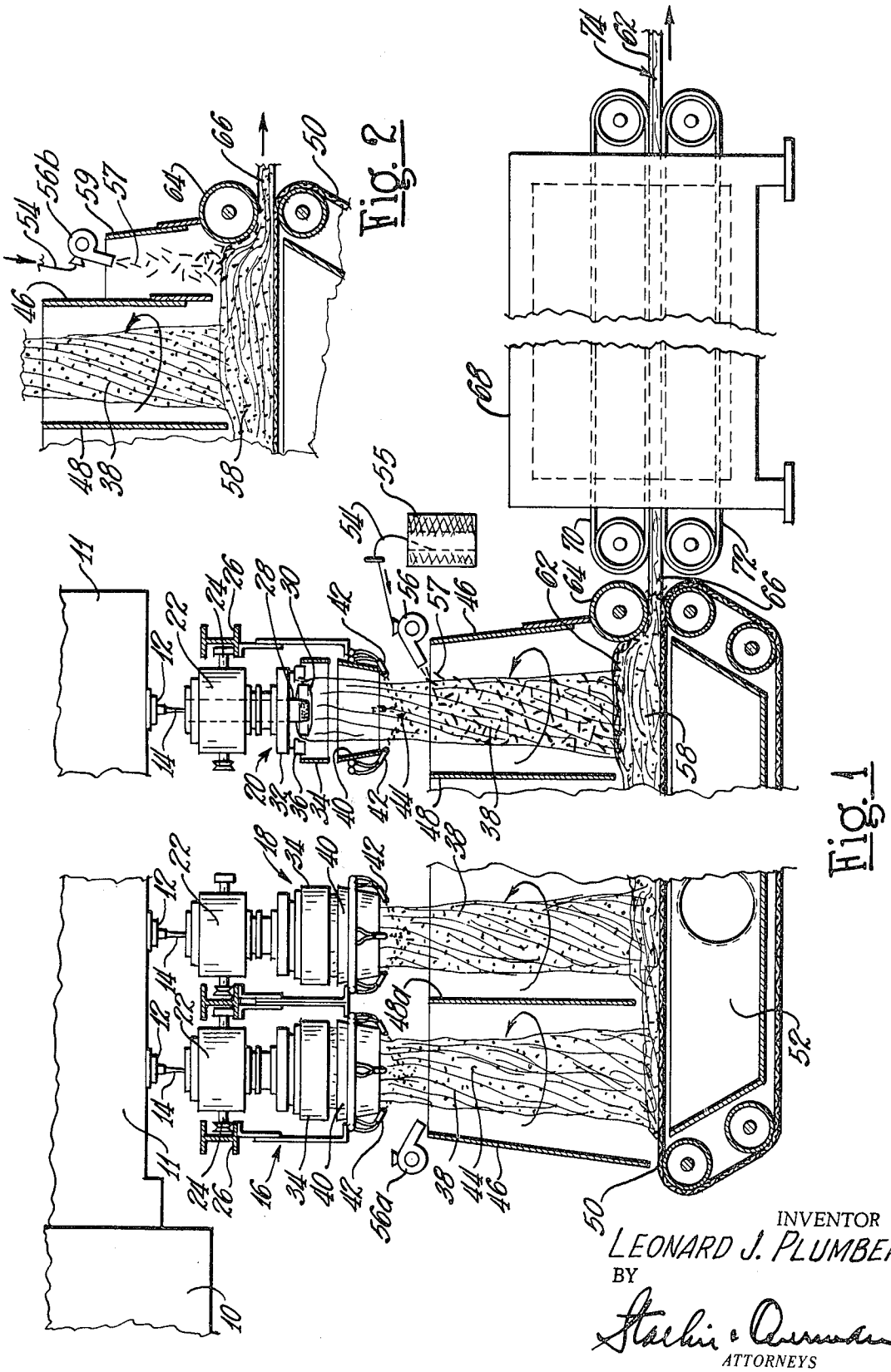


Fig. 1

Fig. 2

INVENTOR
LEONARD J. PLUMBERG
BY
Stachis & Ammerman
ATTORNEYS

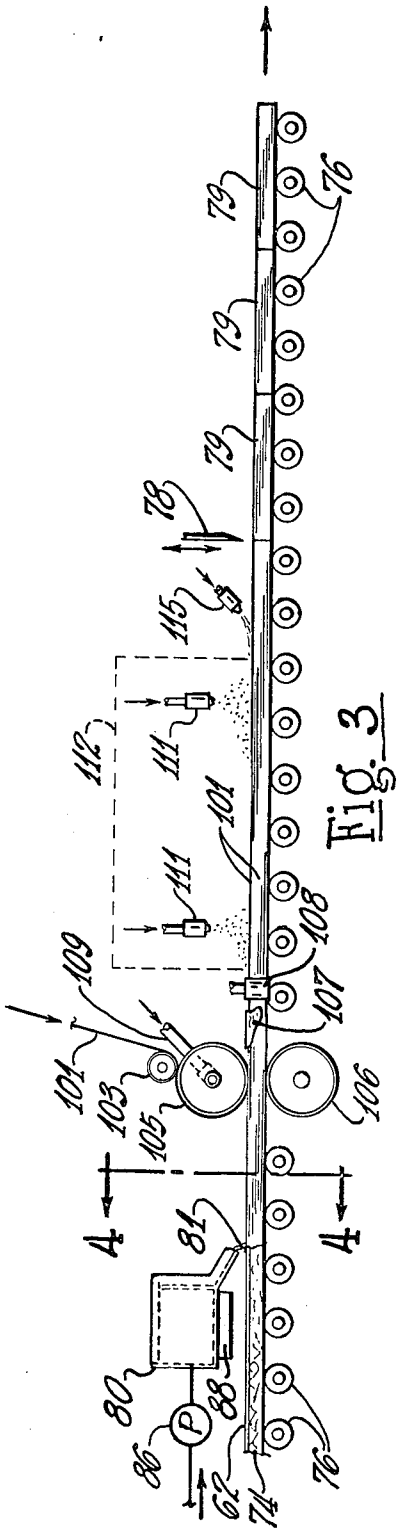


Fig. 3

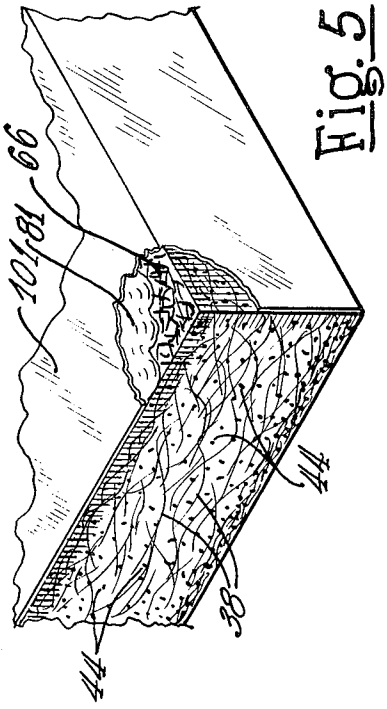


Fig. 5

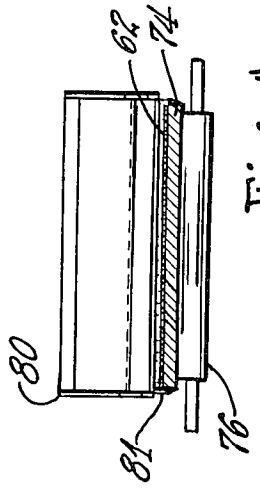


Fig. 4

INVENTOR
LEONARD J. PLUMBERG
BY
Staelin & Overman
ATTORNEYS

ROOFING BOARD FOR INTEGRATION IN A BUILT-UP ROOFING STRUCTURE

BACKGROUND OF THE INVENTION

This invention relates to a thermal insulating roofing board composed of fibrous glass or other insulating material and with the top surface impregnated with asphalt and covered by a surfacing sheet and to such a board intended for roof insulation.

The roofing boards of this invention are designed mainly for flat or low-pitched roof decks that may be surfaced with a built-up bitumen-bonded roofing. The boards are laid directly over the roof deck whether wood, steel, concrete or precast slabs.

BRIEF SUMMARY OF THE INVENTION

The main object of this invention is a roofing board which has an upper impregnation of asphalt and an impervious top surfacing sheet, the sheet normally having sufficient resistance to impact and puncturing to protect the board during packaging, storage, shipment and installation but being fracturable, dissolvable, or meltable and preferably thin whereby it is disrupted, dissolved or otherwise dispersed under the stress and contact with melted asphalt when the latter is mopped, brushed or otherwise applied over the board in the construction of a built-up roofing.

The newly applied asphalt then may pass through the sheet and merge with the asphalt impregnation of the board and thus provide a more unified and homogeneous roof structure including other superimposed elements.

In the conventional roofing board the surface sheet is kraft paper and remains in place after installation of the board, and being of an absorbent nature it may originally carry moisture or wick moisture from edges of the board. This water is likely to gasify under solar heat and cause bubbles or openings in the asphalt surface. The contraction of the kraft paper accompanying drying thereof in frequent cases will draw the board into saucer shape, raising its edges. Other impervious covering sheets of extra thickness and inert synthetic composition may similarly trap air or moisture which are apt to expand and weaken the weatherability of the roofing structure. In any case the kraft paper or other permanent covering sheet constitutes a lamination subject to cleavage.

A further object of this invention is a method of producing a roofing board in which the board may be economically and completely fabricated in a continuous production line utilizing a reduced number of components and fewer steps in the manufacturing process.

A concomitant purpose is to provide an insulating board that amplifies the overall strength of a built-up structure.

Another object of the invention is the processing of a roofing board with sufficient rigidity and attachment characteristics to withstand uplifting or cleavage under high winds from its installed position in a roof structure.

These and other objects and advantages of the invention are attained principally through a method of constructing a fibrous board with randomly positioned, individual, non-continuous glass fibers extending in spaced and resinously bonded relation throughout the main area of the board, preferably having strands of glass fibers upon the upper surface of the board, having

the individual glass fibers of the top surface area with or without the strands of glass fibers bonded together by an asphaltic impregnation, and finally, covering the upper surface of the board with an impervious top surfacing sheet, the surfacing sheet being preferably one fifth to one mil in thickness and being softened, fusible, or dissolvable in the region of 300°F. and composed of polyethylene, polypropylene, or materials of similar thermal or chemical characteristics.

BRIEF DESCRIPTION OF THE DRAWINGS

The successful practice of the invention is further promoted by supplemental features set forth in the subsequent description and accompanying drawings in which:

FIg. **1** is a longitudinal, partly sectional, elevational view of a fiber forming and collection apparatus including a series of rotary type fiber forming units, a fiber collecting conveyor, and compressing conveyor flights passing through a binder curing oven;

FIG. **2** is a longitudinal, vertical sectional view of a modified form of apparatus including the lower portion of the last fiber forming unit of FIG. **1** with a chopped strand applicator above a chamber adjacent thereto.

FIG. **3** is a diagrammatic side elevation view of apparatus comprising a continuation of the production line starting with the apparatus of FIGS. **1** or **2** and including a conveyor, an asphalt applicator and other processing devices;

FIG. **4** is a cross section of the apparatus of FIG. **3** taken on the line **4 – 4** thereon; and

FIG. **5** is a perspective broken view of a corner of a roofing board embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring in more detail to the drawings, suitable equipment and processing procedure for fabricating the boards are presented in FIGS. **1, 2, 3** and **4.** At the start of the production line of FIG. **1** there is shown a portion of a glass furnace **10** with a forehearth **11** extending therefrom. A series of ported bushings **12** are mounted upon the lower side of the forehearth **11.** Streams **14** of molten glass issue downwardly from the bushings into a series of seven rotary fiber forming units of which only three, **16** and **18,** the first two, and **20,** the last of the series, are here illustrated.

The rotary forming units are all alike and of a conventional design including an upper housing **22** supported upon a carriage **24** movably mounted upon tracks **26.** This arrangement permits each unit to be temporarily transferred from the hot area of the forehearth for inspection and maintenance requirements.

As may be seen in the sectioned portion of rotary unit **20,** the stream **14** of molten glass is directed downwardly through a hollow tube or quill **28** extending from the upper end of housing **22** down to a centrifuge **30** to which it is joined. The quill and centrifuge are rotatably driven by a motor within housing **22.** The molten glass in fiberized by being centrifugally forced through orifices in the peripheral surface of centrifuge **30.** From chamber **32** hot combustion gases are discharged down upon the upper surface of the centrifuge **30** to maintain it at molten glass temperature.

The primary fibers issuing laterally from the orificed peripheral surface of the centrifuge **30** are blown downwardly within the cylindrical shield **34** and are further attenuated therein by a blast of combustion

gases from the annular burner **36.** The resulting whirling veil of fibers **38,** with the combined streams of hot gases from chamber **32** and burner **36,** descends thorugh guiding spout **40.** The fibers may be between 25 and 60 hundred thousandths of an through in diameter but preferably have a diameter of approximately 39 hundred thousandths.

A series of nozzles **42** around the lower edge of spout **40** project resinous binder particles **44** into the veil of fibers **38** prior to the entry of the fibers into the forming hood **46.** In this instance a vertical partition **48** within the hood secludes the fibers from the last rotary unit **20** the fibers produced by the preceding rotary units in their descent to the foraminous conveyor **50,** traveling over suction chamber **52.** Similarly a partition **48***a* sequesters the fibers delivered from the first unit **16.**

Phenol formaldehyde is the preferred bonding agent, but it has been well established that various other resinous materials such as epoxies, urea and melamine formaldehydes also give excellent results. The amount of the binder utilized is advisably in the region of 9 percent by weight of the full fibrous pack but may be varied within a range roughly of 5 to 15 percent with the cost factor tending to discourage higher quantities, and diminishing strength accompanying the use of lower amounts.

Chopped strands **57** are mixed with the fibers produced by rotary unit **20** by the combination chopper and blower **56.** This draws strands **54** from an aligned series of strand packages such as the single spool or bobbin **55** illustrated and projects the chopped strands into the upper end of the portion of the hood **46** which is confined by partition **48.**

The chopped strands **57** are desirably cut to lengths between 2 and 4 inches and in the example of processing herein selected for purposes of explanation amount in weight to at least ten percent of the weight of the non-continuous fibers from rotary forming unit **20** with which they are combined. With a conveyor speed of 60 feet per minute and a deposited fibrous pack 4 feet wide intended for forming a roofing board one inch in thickness, the chopped strands would be introduced at the rate of roughly 2½ pounds per minute.

The basic strands **54** may be of a size providing about 15,000 yards per pound and be composed of 200 continuous filaments of an approximate diameter of 37 hundred thousandths of an inch. Alternately, the individual strands may contain some 400 continuous filaments with a diameter around 25 hundred thousandths of an inch.

Feeding of the chopped strands may be considerably advanced by bundling them into loose rovings upon the packages **55** and passing the rovings through the chopper **56.** Sixty strands ends may, for example, be so gathered together in each roving and six or more of such rovings be fed in spaced relation through the chopper **56,** the latter being of appropriate length, such as 4 feet in this instance, to discharge the chopped strands across the width of the hood **46.** Through the whirling and turbulent downward movement of the veil of the fibers **38** and binder particles **44** in the accompanying combustion gases, the chopped strands **57** are thoroughly intermixed with the fibers.

Other forms of strands of filaments in side by side, parallel relation including fibrous glass yarns and cords in short or continuous lengths may be utilized by differing quantities for effective practice of the invention.

The pack **58** accumulated within hood **46** includes the fibers produced by the full series of seven rotary fiber forming units. As the fibers from rotary unit **20** are the last to be deposited upon the pack **58** there is formed a distinct upper stratum **62** constituting a definite proportion, in this instance one seventh, of the total thickness of the pack **58,** throughout with the chopped strands are exclusively distributed.

If it is desired to have a strengthening stratum on the bottom of the pack **58,** in addition to the upper stratum **62,** strands are fed to the chopper **56***a* to project chopped strands into intermingling relation with the fibers downwardly discharged from the first fiberizing rotary unit **16.** The fibers from this unit and the chopped strands added thereto are segregated during their descent and deposit upon the conveyor **50** by the partition **48***a.*

The pack **58** is carried by conveyor **50** under roller **64,** which is preferably heated to decrease to propensity of the fibers to become attached thereto, and the pack is preliminarily reduced thereby to a compressed state **66** for introduction between upper and lower compression conveyor flights **70** and **72** within oven **68.** The thickness of the pack is permanently established by the setting of the binder within the oven. A continuous rigid panel **74** with a strand reinforced upper stratum **62,** and in the thickness of one inch in this instance, is accordingly discharged from the oven.

Should a surfacing layer of bundles or strands of fibrous glass unmixed with the single fibers of the pack to desired they may be deposited after the formation of the pack as shown in the apparatus of FIG. **2.**

In this arrangement, chopped strands **57** are discharged from the combination chopper and blower **56***b* down within chamber **59** upon the surface of the pack **58.** This deposit **66** of chopped strands lies rather loosely but is held in position by the portion of the binder upon the surface fibers of the pack and remains in distributed position upon the pack through the oven **68.** The subsequent surface inpregnation of asphalt amounting to three thirty seconds of an inch for stratum **66** of loose strands integrates the chopped strands and the cured pack.

Alternately the chopped strands may be placed upon the pack after it has passed through the oven just prior to the application of asphalt. One pound of chopped strands per one hundred square feet of surface serves ver adequately.

The density of the panel **74** in its final compressed state should not be below 7½ pounds per cubic foot in order to maintain high compressive strength in the fibrous boards, and perferably should not exceed 9 pounds for retention of the porosity required for superior thermal insulation.

In travel through the oven there is migration of binder to the bottom of the pack which, with the pressure exerted by the compression of the conveyor flights and some concurrent reorientation of the fibers, effects an extra smooth and tougher surface on the bottom of the panel **74.** This assures easier and better conforming installation of the roof boards on smooth roof surfaces as particularly presented by metal roofs.

From the oven **68** of FIG. **1** the panel **74** with its upper stratum **62,** or alternately stratum **66,** reinforced with chopped strands **57** moves along the conveyor line **76** diagrammatically shown in FIG. **3.** As a final step of the processing procedure along conveyor line **76,** a vertically reciprocating chopping knife **78** severs the panel **74** crosswise into individual board units **79.** The panel **74** is usually 4 feet in width, a standard fixed dimension

of the roofing boards. According to the timing of operation of the knife **78** the other planar dimension of the boards may be within a broad range but most commonly is 2, 3, 4 or 8 feet.

Residual heat from the binder curing temperature utilized in the oven is retained in the panel **74** as it passes beneath the asphalt coater **80** to which asphalt in a controlled volume is delivered by pump **86.** The desired fluidity of the asphalt passing through the coater is maintained by an associated heater **88.**

A thin continuous curtain of asphalt **81** flows downwardly from the coater across the upper surface and slightly over the edges of the boards **79** whereby the side edge surfaces are also coated as may be best seen in FIG. **4.**

Due to the porosity of the panel **74** the asphalt sinks into the upper stratum **62** or **66** thereof and slightly into the surfaces of the opposite side edge portions. The penetration of the asphalt is predetermined by the amount thereof, its controlled fluidity and supplementally by the speed of hardening of the asphalt.

Through this controlled entry, the asphalt impregnation is restricted to the full or major portion of the thickness of upper stratum **62** amounting in this example to one-seventh of the full thickness of the panel **74** or to the narrower surface stratum **66** when the penetration is preferably no more than three-sixteenths of an inch. The high porosity and attendant thermal insulating capacity of the main portion of the panel is thus preserved.

The preferred asphalt for impregnation of the upper stratum is a steep asphalt having a softening point between 180°F. and 190°F. One having a softening point below 170°F. is not recommended while asphalts with melting points as high as 250°F. would ordinarily give very satisfactory service. In the applicator **80** that asphalt is maintained at the desired fluidity by being heated to between 340°F. and 425°F. and normally between 350°F. and 375°F.

From approximately 6 to 7½ ounces of the asphalt is applied to each square foot of surface of the panel **74.** The maximum is sufficient to thoroughly saturate the upper stratum, with some asphalt likely retained upon the surface of the units.

While a steep asphalt is preferably utilized other bituminous materials may serve adequately and the term "asphalt" when appearing herein should be intepreted as possibly containing asphaltenes, tarry substances, petroleum residues, pitches, road oils, albino asphalt, cutbacks, solutions or dispersions and cracked, straight run or natural asphalts.

Following the application of asphalt **81** a polyethylene film **101** is directed down upon the panel **74** by rolls **103** and **105.** The pressure of roll **105** against the panel is opposed by roll **106** directly below the panel. Guides **107** and rollers **108** turn the edges of the polyethylene film **101** downwardly and presses them in adhering relation against the side edges of the panel **74.**

This edge adherence is not, however, necessary as it has been found that the objectives of the invention may be satisfactorily secured with a panel having the film slightly overhang the edges.

Roll **105** is chilled by water at a temperature of 40°F. to 70°F. passed therethrough from inlet pipe **109.** The film **101** is thus cooled and therethrough reduces the temperature of the asphalt impregnation of the panel **74** to about 150°F. which is well below the melting point of the film composition. The attaching face of the film may be softened to a slightly tacky condition by the residual heat of tha asphalt and is thereby better attached to the panel while the outer side of the film is kept cooler by the applicator roll. Additional water and air cooling treatment is provided by water nozzles **111** and air nozzles **115.** The air from nozzles **115** also helps dry or blow the water from the top of the board.

The film and roll **105** have a smoothing effect upon any concentration of asphalt left upon the surface of the panel **74.** Besides serving as a parting agent when the resulting boards **79** are stacked for shipping or storage, the film also opposes injury of the board during handling and installation of the boards. A corner of the board is illustrated in FIG. **5.**

Because of its lower melting point of around 220°F. the low or medium density polyethylene film is subject to liquefication and disintegration under hot asphalt that may be later mopped over the boards, the temperature of which usually ranges between 375°F. and 425°F. Entry through the film is thus effected and a direct bond is thus secured between the mopped asphalt and the asphalt surface coating of the board. This ties in the board with subsequent material laid over the mopped asphalt.

A polyethylene film from 0.0002 to 0.001 or one mil in thickness is preferred for the surface sheet. Films within this same thickness range of other compositions such as polypropylene also are weakened sufficiently to be easily disrupted and to permit union between the asphalt topping of the board and heated asphalt applied in building a built-up roofing structure.

Polyethylene is soluble in hydrocarbons and is accordingly affected by the residue of higher boiling petroleum derivatives in asphalt, particularly at high temperatures. Should it be desirable to promote its dissolution more active solvents may be added to the asphalt or first sprinkled upon the board surface.

The surfacing sheet should be normally impervious, non-absorbent, and strong enough to strengthen the surface of the board in resistance to rough treatment as well as to act as a parting medium to prevent sticking of adjacent boards stacked for shipment or storage, and further present a smooth, comfortable surface for handling during installation. The sheet should also be of a composition and thinness that makes it easily ruptured through dissolving, melting, friction of mopping, wire brushing or other simple tearing, puncturing or perforating action to cause opening thereof for access therethrough of the hot mopping asphalt and the union thereof with the asphalt impregnation of the board.

The ordinary covering of paper is susceptible to absorption of moisture. Such water carried by the paper may expand under solar heat to cause blistering in the roofing structure and thus weaken the integrity thereof. Also if moisutre has been absorbed by the paper prior to installation the drying thereof will contract the paper and is apt to bend the board and raise its edges from the underlying roof surface. The paper lamination may additionally promote cleavage in the roof structure. Another occasional difficulty encountered with the paper covering is that under the extra high temperature which may rise to 140°F. or more on roofs the asphalt may saturate the paper and cause adherence of the boards in their stacked shipping package.

Within the scope of the invention are the concepts of having a continuous protective covering sheet over an asphalt impregnated roofing board designed for built-up roofings and effecting openings in the sheet prior to

or at the time of applying hot asphalt thereover when installed on a roofing deck for providing access to the asphalt impregnation for promoting integration of the board with the built-up roofing structure. The nature of the covering sheet is only limited to being perforatably in this basic method of the invention.

The perforation may be obtained by puncturing, scraping, or other mechanical action but practically is more desirably a result of the usual procedures of applying the mopped asphalt.

If the film is merely softened by the temperature of the melted asphalt the desired disruption would be promoted by the use of a brush having stiff bristles of wire or fibrous glass.

In following the invention the most satisfactory manner of having the film disrupted is through the temperature alone of the applied coating of hot asphalt. Dissolving or thorough melting would then be the essential effect. The thermal capacity of a heavier coating of asphalt, the thinness of the film, the composition of the film, the temperature of the applied asphalt would be important factors to be considered and arranged for reaching the desired destruction of the film and for determining the application procedures to follow to effect the destruction.

The advantages of the practice of the invention are not restricted to roofing boards of fibrous glass as the only crucial elements involved are the surfacing impregnation or coating of asphalt and the protective covering sheet. Boards of other fibers, mineral composites, wood, and other materials whether or not of insulating properties would benefit from the adaptation of the invention.

Accordingly, the following claims are directed toward the broad aspects of the invention as well as the particular methods and products which are deemed appropriate for best utilization thereof.

As those skilled in the arts involved may easily perceive, various alterations and modifications beyond these discussed herein are available without departing from the spirit and scope of the invention and the accompanying claims.

I claim:

1. A roofing board haing its upper surface impregnated by asphalt and a thin, impervious polyethylene covering sheet 0.0002 to 0.001 inch thick attached over the impregnated surface, said sheet being normally tough enough to act as a parting medium preventing the board from sticking to adjacent boards when stacked for shipment and providing a clean surface for handling and installation, said covering sheet being sufficiently thin and of a composition making it easily torn or otherwise opened by the friction of application of the mopping asphalt whereby the mopping asphalt has access to and is integrated with the asphalt of the board.

2. A roofing board having its upper surface impregnated by asphalt and a thin, impervious, non absorbent polyethylene 0.0002 to 0.001 inch, covering sheet attached over the impregnated surface, said sheet being normally tough enough to act as a parting medium preventing the board from sticking to adjacent boards when stacked for shipment and providing a clean surface for handling and installation, said covering sheet being sufficiently thin and of a composition disruptable by heated mopping asphalt applied thereover when the board is a base for a built-up roofing.

3. A roofing board according to claim **2** in which the composition of the covering sheet is fusible at the temperature of the heated mopping asphalt.

4. A roofing board according to claim **2** in which the composition of the covering sheet is dissolvable at the temperature of the heated mopping asphalt.

5. A roofing board for a base unit of a built-up roofing structure having a top impregnation of asphalt, and an impervious protective covering sheet of polyethylene composition and in a thickness between 0.0002 and 0.001 of an inch and being thermoplastic and softenable at 220°F and hence easily destructable at the temperature of mopping asphalt applied thereover whereby the sheet may be apertured for union of the mopping asphalt with the asphaltic impregnation.

6. A roofing board for a base unit of a built-up roofing structure having a top impregnation of asphalt and an impervious protective covering sheet 0.0002 to 0.001 of an inch in thickness over the asphaltic impregnation, the covering sheet being low to medium density polyethylene dissolvable by the oils of asphalt and hence destructable by hot mopping asphalt applied thereover whereby the sheet may be apertured for union of the mopping asphalt with the asphaltic impregnation.

* * * * *