July 25, 1967 J. A. TOMLINSON ETAL 3,332,830

ASPHALTIC WEATHERING SHEET INCLUDING CONTINUOUS GLASS FIBERS

Filed April 29, 1963 2 Sheets-Sheet 1

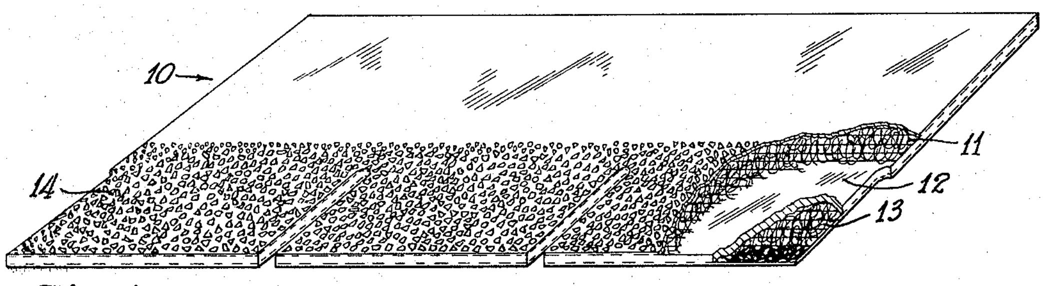

Fig. 1

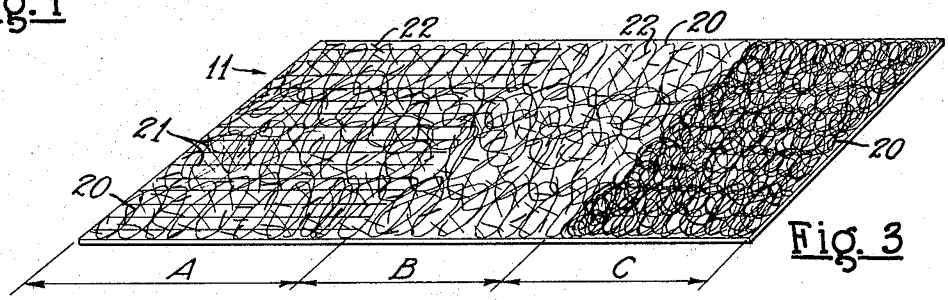

Fig. 3

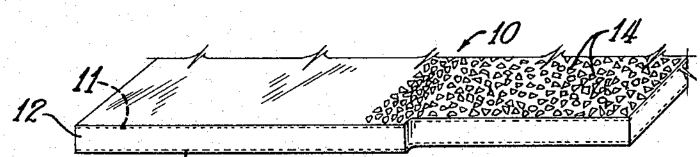

Fig. 2

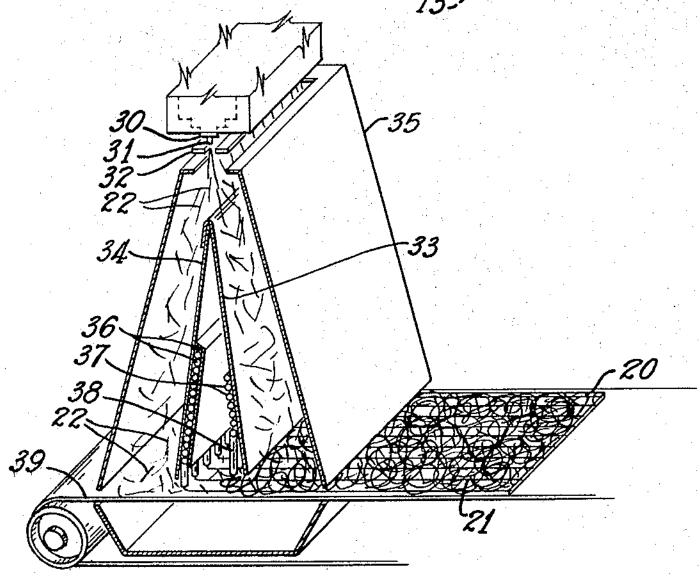

Fig. 4

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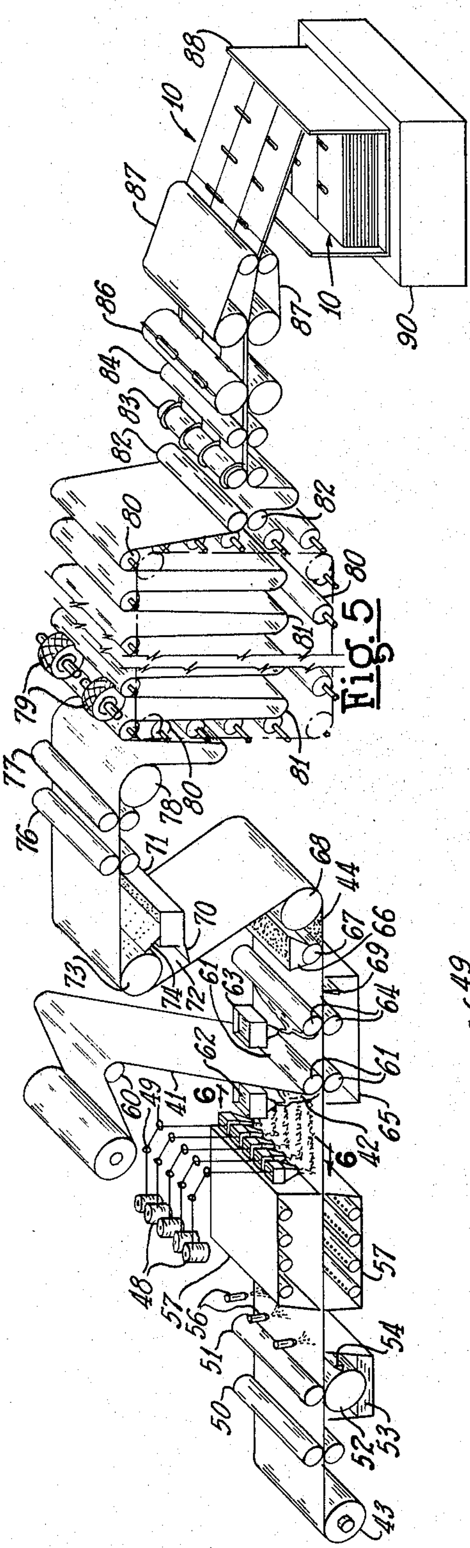

Fig. 5

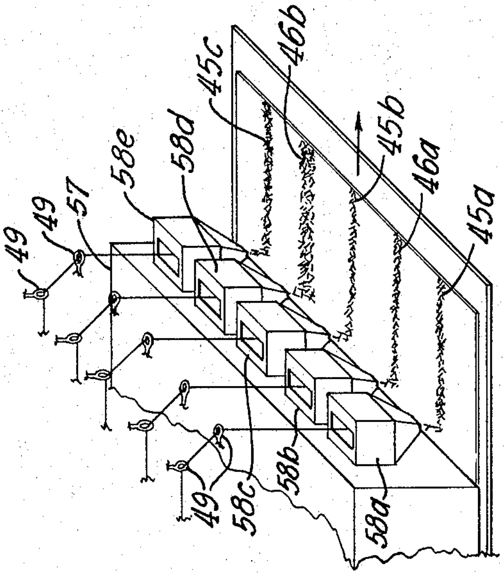

Fig. 6

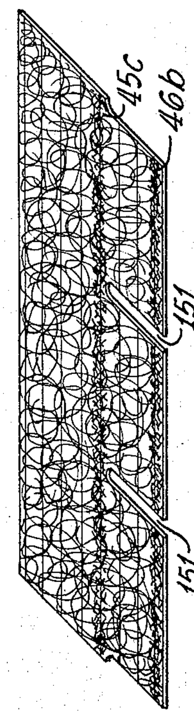

Fig. 7

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United States Patent Office

3,332,830

Patented July 25, 1967

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3,332,830
ASPHALTIC WEATHERING SHEET INCLUDING CONTINUOUS GLASS FIBERS

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Filed Apr. 29, 1963, Ser. No. 276,369
9 Claims. (Cl. 161—83)

This invention is related to the new roofing and siding sheet and its manufacture and more particularly to a weathering sheet made of asphalt reinforced by glass fibers.

In being one of the lowest cost water-proofing materials available, bituminous material such as asphalt has been adopted as a standard by the roofing industry for incorporation in weathering protection products such as roofing, shingles, and siding. Asphalt of itself, however, lacks certain properties of stiffness, wear-resistance, nail-holding properties, and dimensional stability under conditions of varying temperature, so that in order to permit its adaptation for roofing and siding materials, it must be combined with other materials to compensate for these deficiencies. To take advantage of the low cost of asphalt, however, materials added thereto to make a practical product must also be of low cost, or alternately must be of such character that if higher in cost, they will provide the desired properties with an economically includable amount of the added matter.

In practice, a low cost base material such as rag felt; including scrap paper, cardboard, mechanical wood pulp, etc. is combined with a low cost asphaltic saturant of oil-like character which is necessarily of low viscosity in order to permit impregnation of the felt thereby to form the carrier base for the product desired. The rag felt base can be specially treated such as by maceration, but in each instance the saturant or impregnant must be of a character which is adaptable to the thorough combination with the rag felt. Accordingly, the saturant or impregnant is usually selected for its ability to saturate the rag felt rather than for its weatherability. A higher viscosity weathering asphalt layer is thereafter applied in a sense as an "icing" over the saturated rag felt base or carrier. The overlying asphalt is selected specifically for its weatherability since it acts as the primary weathering protection for the surface to which the product is applied. A sufficient amount of this material must also be applied to effectively protect the underlying saturated rag felt base against penetration by moisture. Granules are applied over the thin layer of weathering asphalt to protect it by acting as a sun reflectant and by providing a rugged surface against scarring of the weathering asphalt surface.

Limits on the life of such a product lie both in the thickness of the weathering surface layer applied as well as in the degree of inertness and dimensional stability of the saturated rag felt base of the product. Since the base saturant for such a product contains a lower viscosity asphalt, generally of a more volatile nature than the exterior weathering asphalt, and since it is in direct contact with organic matter of wicking character, the saturant or impregnant has an opportunity to dissipate itself at the product edges, especially with aging, while the wicking properties of the rag felt act to convey the internally embedded volatile matter to the edges so that eventually the base or carrier becomes dry and has tendencies to rot. Warping and lifelessness result which permit easy blow-offs of the product under heavy winds.

In view of the foregoing, it is the principal object of the present invention to provide a new low-cost composite asphalt sheet construction adaptable to roll roofing,

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shingles, and siding products, which construction overcomes the deficiencies of conventional low-cost asphaltic products by incorporating an improved dimensionally stable, fire resistant, longer life carrier base.

Another object of this invention is to provide a new low-cost moisture protection, weathering material which is much more fire safe, wind resistant, and more weather resistant than products heretofore available.

It is a further object of the invention to provide a new low-cost asphalt weathering protection sheet adapted to provide a much more fire safe surface treatment by inclusion of a catalytic composition which promotes a smothering, or in other words, a flame snuffing action, thereby minimizing the tendency for self-sustained combustion and limiting the flame spread rate of the product.

It is another object of the present invention to provide a new asphalt composite weathering sheet including high strength, temperature-resistant matter which will impart dimensional stability to the sheet to compensate for weakness and flowable nature and accordingly, low dimensional stability of asphalt in available products, especially under conditions of high temperature to which such products are subjected in the direct rays of the sun or in emergency situations such as during accidental burning of a building structure.

It is still another object of the present invention to provide an asphaltic product for moisture and weather protection which, beside being low in cost, has a fire safeness and longevity beyond that of corresponding commercially available products.

A still further object of the invention is to provide an asphaltic moisture and weather resistant product which includes a high tensile strength high modulus reinforcing material having an improved nail tear-resistance permitting its use as protection for building structures, with strength against winds and a degree of stiffness which minimizes possibilities of blow-off.

In brief, the above objectives are attained according to the present invention by providing a construction of two spaced webs of continuous glass fibers imbedded in a matrix with the core portion interposed between the webs. Mineral granules of conventional type deposited over the weathering surface of the product function as a protection against the actinic rays of the sun and provide a more rugged surface to withstand the rigors of installation and subsequent need for load bearing characteristics.

The continuous glass fibers in the present construction may be distributed in the spaced webs as individual continuous fibers or in twisted or untwisted strands to impart concentrations of strength in the product where desired. In the latter sense, improved nail-holding properties can be imparted by concentration of bundles of chopped glass fibers in the zone where nails are passed through to secure the weathering product to the surface to be protected. Concentrations of glass fibers under the nail heads improve tremendously the tensile and tear strength of the product and, accordingly, its tear-resistance and nail-holding properties.

In a broader sense, the present product can be likened to an I-beam structure with webs of glass fibers spaced apart across the thickness of the shingles, siding or roll roofing products. The glass fibers have a high tensile strength and high modulus practically independent of temperature conditions, thereby overcoming a limitation in stiffness of the asphalt itself with variations in temperature. Additionally, the spaced web construction with the glass fibers close to the outer surfaces of the product provides a retaining network for asphalt at the surface and imparts a greater dimensional stability to the surface material than is otherwise possible with the flowable surface of asphalt. The stability of the asphalt surface is increased by the presence of the fibers to an extent such that the need for the relatively expensive granules is greatly reduced thereby permitting in many instances actual elimination of such granules. This occurs particularly with the present structure since the product incorporates a weathering grade asphalt throughout, thus eliminating the need for the extra weathering barrier afforded conventional products incorporating paper felt bases by the otherwise thin layer of weathering grade asphalt. Where the usual surface granules of crushed mineral material are used, however, the close presence of the network of glass fibers provides a base or nesting zone for at least a partial nesting within the web of the topmost layer of glass fibers, thereby providing additional protection to prolong the life of the product surface.

Since the spaced mats or webs of glass fibers can be relatively thin and still provide the additional strength and dimensional stability to the asphalt matrix, the webs can be extremely porous and readily adapted to allowing saturation or passage of the asphalt therethrough. Accordingly, a higher viscosity asphalt such as a weathering grade asphalt can be utilized throughout the thickness of the product so constructed.

In addition to the above, another feature of the invention lies in the fire safeness imparted to the product by its special construction. Conventional asphalt constructions for roofing materials, upon being subjected to the heat of a flame extending over a period of a few minutes, result in a charring of the surface of the asphalt, which charred surface of itself is highly fire resistant, but due to the heating and swelling of the substrate below the charred surface, cracks usually occur in the charred surface with a consequent exposure and flow of fresh asphalt for continued spread of flame over the product surface. The present construction however, in providing an inorganic non-combustible network of glass fibers immediately under the top surface of the product, provides a base for the charred surface which during spread of the flames prevents opening of the charred matter. Accordingly, the fire resistance of the charred surface, during exposure to flame becomes progressively more non-combustible, soon results in reduction of the tendency toward sustenance of the flame. Accordingly, if the product surface is the sole base for the flame, it soon causes burn-out, in comparison to continued spread and sustenance of the flame in conventional asphalt products.

A fire safeness of the product of the invention is further enhanced by use of an asphalt having a residual catalytic reaction dormant in the mass as a result of incompletion of the catalytic reaction during processing of the raw asphalt. This dormant reaction is activated or triggered by exposure to flames which promote a gassing and crusting of the asphalt surface to result in snuffing out of the flame.

Another feature of the catalyst activated asphalt is that it does not contain as much oil and consequently does not as readily stain any mineral surface that might be present.

Fire safeness is further enhanced according to the present invention by incorporating concentrations of chopped strands or bundles of fibers of discrete length at the product edges which are critically exposed when installed on a surface to be protected. The presence of a strip or track embodying concentrations of such fibers assists in reducing flame spread characteristics by plugging up the tendency for flow of asphalt upon heating of the product. That is, when the flame reaches the edge of a conventional shingle structure, studies indicated that the tendency is for the flame to advance over the edge and then to be retarded or moved back again toward the edge. This is believed due to an initial support of combustion, but then upon buildup of crust or combustible material, the flame tends to retreat toward the edge of the shingle. Further heating of the shingle promotes flow of the asphalt and a subsequent readvancement of the flame. The readvancing flame again is retarded upon crusting and buildup of combustibles. In contrast, the presence of the chopped strands in the edge of the product of the present invention plugs up the tendency for flow of asphalt and thereby reduces or holds back the readvancement of flame caused by the flow of fresh asphalt.

As a consequence, the flame spread rate of the present product is greatly reduced by at least three principal mechanisms, namely, (1) the activation of a dormant catalytic reaction, (2) provision of a stabilized reinforced charred surface with consequent minimization of tendencies toward crackage, and (3) limiting tendencies toward flow of fresh asphalt by plugging the exposed edges of the product with chopped lengths of glass fiber strands.

Another feature of the invention lies in the adaptability of the product to construction with a degree of stiffness as desired in accordance with the use to which it is to be put. For example, if the construction is to be incorporated in a roofing shingle, a degree of stiffness is desired to assure that it lays properly on the surface to be protected without likelihood of blow-off. In this regard, it is desired that the product be sufficiently stiff that when flipped up, it will return to its natural position so that subsequent gusts will not in all cases cause it to be lifted again. Furthermore, a strength is desired in the stiffened product to the extent that constant gusting of the product, or in other words, a constant flapping of the product, will not result in its being weakened by working to an extent that it loses its practical protective value. These characteristics are presented in the present product by reason of the adaptability of the construction to being made with different degrees of stiffness, dependent upon the amount of spacing between the glass fiber webs incorporated therein. With a wide spacing of the webs, such as with the webs being at their greatest distance apart at the two major surfaces of the product, the greatest amount of stiffness is attained. This is particularly desirable in the shingle-type construction when the shingle is of thin dimension. On the other hand, when the product is a roll roofing product, a degree of flexibility is desired which will enable a roll-up for ease of shipment and ease of installation as well as ease of conformance to the surface to be protected. In such instance, the amount of spacing between the webs can be reduced to provide greater flexibility than might be desired in the shingle construction. Thus, stiffness or flexibility can be imparted to the construction, dependent upon which is desired.

Products made according to the invention also have a greatly reduced temperature susceptibility. In the usual case, when the temperature is high, the asphalt becomes less stiff and has a tendency to flow, but since the glass fibers have practically no property variation under the ordinary temperatures to which roofing and siding products might be subjected, their incorporation in the asphalt lends greatly to maintaining stiffness at high temperatures as well as providing greater dimensional stability.

The fibrous glass webs in a sense also act as retaining membranes for the asphalt in which they are incorporated. When a rise in temperature occurs, even though the matrix material might have a tendency to flow, the inert fibrous glass membranes act as extended lattice networks with interstices nesting the asphalt near the surface of the product. Accordingly, the degree of flow experienced with products of this type is reduced to the extent that it might be considered as not occurring at all. Thus, once installed, the roll roofing and shingle type constructions of this invention maintain a stable relationship with adjacent abutting and overlapping constructions of similar type and can be relied upon to have a life much greater than conventional asphaltic products.

Another and still further feature of the invention lies in the adaptability of the fibrous glass webs to being impregnated with the asphalt, and accordingly permitting selection of asphalt of a coating grade and of more fire safe character to be incorporated throughout the thickness of the product. In contrast, if the base or reinforcing material is of low porosity, then the asphalt must be selected for its capabilities to impregnate or saturate the base or reinforcing material. In the present instance, however, the fibrous glass web need only be of very thin dimensions and, accordingly, can be extremely porous and still provide the reinforcement and retaining characteristics desired, thereby enabling saturation and coating by a wide range of asphalts not necessarily selected for their saturating characteristics, but selected for their weatherability. Long weathering asphalts generally have a high viscosity and do not economically saturate conventional organic rag felt base materials. In the present construction, however, the asphalt incorporated in the product can be the same throughout, and thereby form a matrix of high grade weathering material reinforced at the surface by the glass fiber webs.

The present product construction is also inherently more adapted to receipt of granular mineral materials such as crushed rock granules by reason of the presence of the topmost web of glass fibers which functions to stabilize the exposed asphalt surface. In providing the glass fiber webs in the top surface of the product, the crushed granules can be pressed into the exposed more stable asphalt with greater assurance of retention, or can be caused to be partially nested in the glass fiber web. The glass fiber web thus is in a sense a lattice network which aids in retention of the crushed rock in position and provides an additional degree of ruggedness and stabilization not present in conventionally available products.

As pointed out above however, the fact that the glass fibers provides added surface stability reduces the need for the added protection and expense afforded by the granules and a more economical product having long life properties can be made without such granules.

A still further feature of the invention lies in the adaptability of the construction to zonal reinforcement, so that nailing zones can be provided incorporating additional reinforcing fibers to further strengthen the product against nail tear and blow-off. This is accomplished in the present invention by providing chopped lengths of glass fiber strands in the zone of the shingles where nails are conventionally inserted for securement of the shingle in place against the surface to be protected. The chopped strand lengths or bundles of glass fibers under the nail heads assure proper anchorage of the product against the surface to be protected, and an extremely limited likelihood of tear at the nail zone, in view of the extremely high tensile strength of such glass fibers.

Another feature of the invention lies in the fact that the relatively high porosity of the reinforcing mat enables use of comparatively higher viscosity mineral filled asphalt of greater fire safe character throughout the body of the product. This imparts a higher than usual weather resistance and fire safeness to the product, particularly in the critical exposed upper and edge regions of the construction. Use of such higher viscosity asphalt also permits a greater degree of freedom in design of flexibility into the product for specific temperature ranges. Additionally, since the matrix of the product is 100% weathering grade asphalt, early embrittlement and strength loss as well as skidding due to the usual low softening point of conventional saturants is eliminated.

A further feature of the invention is the particular compatibility of the product structure to combination of an asphalt harboring a latent exothermic reaction without need for increasing its viscosity by raising its temperature to a degree such that the exothermic reaction is triggered. That is, the porosity of the glass fiber web permits formation of the product with a relatively high viscosity asphalt and therefore, the temperature of the asphalt need not be raised to a degree where the danger of triggering the latent exothermic reaction exists.

The invention will be further described in connection with the drawings, in which:

FIGURE 1 is a partly broken away isometric view of an asphalt shingle reinforced with glass fibers in accordance with the concept of the present invention;

FIGURE 2 is a partly broken away enlarged elevational view of the shingle of FIGURE 1;

FIGURE 3 is an illustration of a type of mat or web of glass fibers incorporated in the construction of FIGURE 1 and illustrating in three different zones three arrangements of glass fibers adaptable to incorporation in such a mat;

FIGURE 4 is a partially broken away side elevational view in perspective of apparatus for producing the type of mat illustrated in FIGURE 3;

FIGURE 5 is a schematic isometric view of the method and apparatus by which the product of FIGURE 1 is produced;

FIGURE 6 is an enlargement of a portion of the production line of FIGURE 5 as taken on line **6—6**; and

FIGURE 7 is a skeletal version of the arrangement of glass fibers in a roofing shingle produced by the method and apparatus of FIGURES 5 and 6.

In greater detail, the shingle **10** of FIGURES 1 and 2 is made of a weathering grade asphalt material **12**, physically stabilized by having combined therewith a stabilizer such as black slate to improve weatherability and dimensional stability under erosive weathering forces. The asphalt, it has been found, if of the proper type, can contribute considerably to the fire safety of the product. In this respect, an asphalt is used in accordance with the present invention which is produced by a catalytic air blowing process and retains a residual or dormant catalytic reaction arising by reason of incompletion of the reaction during processing. In other words, the asphalt is an air blown petroleum residue to which a catalyst has been added. The catalyst is added during processing of the asphalt to increase its oxidation rate and accordingly reduce its blowing cycle period. Because of the high viscosity characteristics of asphalt, however, completion of the catalyzed reaction is ordinarily incomplete. The presence of such an asphalt in the product increases the fire safety of the product in that when it is subjected to the heat of flames, a gassing and a crusting of the asphalt surface is promoted when the dormant catalytic reaction is triggered.

An asphalt which has proven successful in providing this fire safety is one catalytically reacted with a chloride type catalyst such as ferric chloride. Phosphorus pentoxide is another example of an asphalt catalyst which provides an asphalt adapted to the principles of the present invention.

The presence of such a catalytic asphalt in the final product is believed to cause a foaming at the surface of the product upon contact by flames. The catalyzed asphalt, when contacted by flames at temperatures in the order of 475° F. and higher, produces a violent reaction which acts to halt the spread of such flames. Usually, such an asphalt is held to be undesirable in shingles of conventional construction because its excessively high viscosity at temperatures under the reaction triggering temperature, for example 425° F., prevent ready fabrication of the construction. In the present arrangement, however, such asphalts can be used in view of the porosity of the glass fiber base material which allows permeation by the higher viscosity asphalt at a lower temperature than the triggering temperature which normally would be exceeded to accomplish permeation of base materials such as rag felt.

Webs or mats **11** and **13** of glass fibers are spaced apart in parallel relation across the thickness of the construction a distance selected for the degree of stiffness desired in the product. As herein illustrated, the webs are located near the bottom-most and topmost surfaces of the product and thus produce somewhat of a sandwich construction but with the asphalt **12** enclosing both webs in the construction while granules **14** of glazed crushed stone or other suitable mineral material are set in the asphalt overlying the topmost layer or web of glass fibers.

When the overall product dimension is relatively thin, it has been found desirable that the glass fiber webs 11 and 13 be spaced as far apart as possible in order to impart the maximum stiffness possible with the given components incorporated in the shingle. The usual asphalt, of itself, lacks the dimensional stability and stiffness desired in shingles to resist the constant force of uniform winds or the erratic action of gusts of wind blowing thereagainst. Additionally by so locating the webs in the product, the top-most web immediately under the exposed surface of the product offers a more stable asphalt surface in which the granules 14 can be solidly fixed, thereby improving the capabilities of the construction to hold the granules in place under various weather conditions, as well as assuring a longer life for surface asphalt against the damaging action of the sun's rays and of water. The top-most glass fiber mat 11 furthermore acts somewhat as a retainer for the underlying asphalt and consequently is in a sense a fire barrier in cases where the product is subjected to high temperatures such as during a fire occurring in the vicinity of the surface to be protected. In this way, the uppermost web of glass fiber 11, beside acting as reinforcement and as a stabilizing means for support of the granules 14, also advantageously stabilizes the asphalt at the surface against motion during emergency conditions experienced in use. Additionally, since the matrix 12 is of weathering grade and extends throughout the thickness of the construction, life of the product against erosion is greatly increased.

The bottom-most glass fiber mat or web 13 acts in conjunction with the top-most mat 11 to impart strength to the product against its being ripped from the nails used to secure the product to the surface to be protected. The presence of two layers of glass fibers within the construction, each layer having the glass fibers as high tensile strength elements extending under the nailheads themselves, provides strength against pull of the product up and over the nailheads, thereby minimizing the possibilities of tearing of such constructions from the securing nails due to wind and the usual forces of the elements. The bottom-most web, in addition, increases the stiffness of the construction as described above and in this respect, it is preferred, especially in a relatively thin shingle construction that the web 13 be as close to the bottom surface as possible so as to assure the maximum spacing from the web 11. This increased stiffness offers resistance against flapping due to the wind. The bottom-most web 13 however, performs an additional function to be described hereinafter in relation to the process by which the product is made.

FIGURE 3 illustrates the type of mat adaptable to incorporation in the construction of FIGURE 1. The glass fiber mat 11 includes glass fibers in three different arrangements, namely, glass fibers in the form of strands or yarns aligned in relatively straight parallel relation extending along the length of the mat, as well as randomly distributed continuous strands or yarns each of a plurality of continuous glass fibers extending over the major dimension of the product. Additionally, discontinuous individual glass fibers are randomly distributed throughout the major dimension of the product. For tensile strength in the roofing construction in which the mat is incorporated, the continuous strands of glass fibers are most desirable whether randomly or parallelly oriented in the mat. In both instances, the strands are either twisted or untwisted, but include a bundle of continuous parallelly aligned glass fibers running for the full length of the strand. It is well established that individual glass fibers have shown tensile strengths up to 1,000,000 lbs. per square inch in laboratory tests and are commercially available with strengths in the order of 300,000 to 400,000 lbs. per square inch. Accordingly, bundles of these individual glass fibers in the form of strands or yarns incorporated in the mat impart a high reinforcing strength to matrices in which they are incorporated.

Section A of FIGURE 3 illustrates the appearance of a mat incorporating the parallel and random continuous glass strands, as well as the discontinuous glass fibers utilized to produce the product of FIGURE 1. Regardless of the form in which these mineral fibers are incorporated in the asphalt, they act as a filler as well as a reinforcing stabilizer against thermal and mechanical forces to which the asphalt might be subjected. Section B of FIGURE 2 illustrates the combination of continuous glass fibers in the form of strands and discontinuous glass fibers with the parallel strands omitted. Section C illustrates still another section and type of mat which can be utilized successfully in the present construction in which both the discontinuous and parallel strand fibers are omitted. All three sections of FIGURE 3 represent types of mats which can be incorporated in the roofing constructions of this invention, but as herein illustrated and as described in relation to the process by which the product is produced, the type of mat of Section A incorporating all three forms is preferred. The basic functioning elements of the mats of this invention, however, are illustrated in Section C of FIGURE 3.

FIGURE 4 illustrates the method and apparatus by which the mat of the composite type including each of the fibrous elements shown in Section A of FIGURE 3 is produced. In this arrangement, a feeder or bushing 30 is associated with a source of molten glass, such as the forehearth of a melting tank, and streams of the glass are flowed from tips 31 of the feeder whereupon the turbulent forces of a set of blowers 32 act on opposite sides of the streams to disrupt them into discontinuous fibers 22. The discontinuous fibers 22 move downwardly under the influence of gravitational forces in addition to the forces of air flowing to the lower pressure zone established below the underlying foraminous conveyor 39 on which the fibers are deposited. The fibers are guided downwardly to the conveyor within a hood 35 surrounding the zone below the blowers 32. A separating partition 33 located below the blowers 32 dissects the space under the blowers so that the fibers 22 are divided into two moving masses or groups of fibers, namely a front group and a back group, which on subsequent deposition on the conveyor 39 form the top and bottom portions respectively of the final mat product.

The separator or partition 33 is a narrow elongated tent-like construction with its apex located in the upper portion of the hood in the fiber forming zone. The separator provides a space over the conveyor from which the continuous glass strands are supplied for deposition on the conveyor between the bottom and top layer of discontinuous glass fibers. The randomly distributed continuous glass strands 20 are blown into the separator space from the creel mounted packages (not shown) disposed exteriorly of the hood and are randomly distributed therein over the underlayer of discontinuous fibers 22, whereupon the mass is moved forwardly by the conveyor 39 for receipt of the overlayer of intermingling discontinuous fibers at the forward part of the separator zone. In the underlying space within the separator the parallel strands 21 are also supplied for deposition on the conveyor 39 from tubes 36 leading from packages of the continuous strand (not shown) on a creel disposed laterally at the exterior of the hood 35. These strands are initially introduced into the mat-forming process by being blown against the conveyor 39 whereupon the blowing action is halted and continued movement is maintained due to frictional adherence of the strand to the moving conveyor which draws the strands through the tubes 36 from their source located laterally of the hood but not shown herein. Thus, the parallel strands 21 are laid on the conveyor by reason of movement of the conveyor while the randomly distributed strands 20 are blown thereon at a linear rate greater than that of the conveyor 39.

To assure that the strands 21 are properly deposited on the conveyor 39 without interentanglement in the process of transfer from their source to the conveyor, they are arranged to be supplied from side-by-side aligned tubes **36** located in a separate zone **34** in the back portion of the separator **33**. The randomly distributed strands **22**, on the other hand, are ejected from the blowing tubes **38** which effect their distribution in random arrangement within the wider space of the separator **33**. A wide distribution of the randomly distributed strands **22** is effected by locating the ejecting ends of the tubes **38** some distance above the conveyor, which for example may be in the order of 9" to 12" above the conveyor, while the parallel strands **21** which are desirably deposited in more exactingly spaced relation from each other, are supplied from the open ends of tubes **36** located within ⅛" above the conveyor **39**.

The entire mass of fibers is supplied with a binding agent from a source adjacent to the hood **35** (not shown) and is then conveyed through a curing oven (also not shown) to effect the drying and/or curing of the binding agent for full integration of the fibers into the mat. The binding agent may be any suitable material preferably a thermosetting agent, having fiber holding properties in temperature ranges above those to which the final product is likely to be subjected in use. In this respect, phenolic binders, comprising 12% to 25% of the mat, have proven successful in having a curing temperature in the range of from 300° to 400° F. and the capability of maintaining the interbonded relation for appreciable periods at temperatures in the order of 400° F. Accordingly, the integral relation of the fibers as a retaining member in asphalt or other bitumen materials of the present invention is highly effective for practically all temperatures to which the product might be subjected in normal usage. The modulus of elasticity of glass fibers is in the order of from 10 to 12 million, and accordingly, it is highly effective in increasing the overall stability of the bitumen construction which has a modulus of elasticity a considerable extent lower than the glass fibers.

By way of example rather than limitation of the invention, mats which have performed successfully for the purposes of this invention have been produced with a thickness of about 10 mils including discontinuous fibers having an average diameter of 60 hundred-thousandths inch and a length of from approximately 3 inches to a few feet, while the continuous fibers in bundles or strand-like form comprising about 30% of the mat by weight have a nominal diameter of 30 hundred-thousandths inch. One type of strand commercially available for such purposes contains 204 filaments twisted approximately one turn per inch. The strands, however, can be either twisted or untwisted, and in the case of either, a dispersion or separation between the filaments within the bundle can be provided to impart a finer texture to the mat and an intermingling interengagement to effect a bridging of the fiber gaps that might occur across the expanse of the mat. In this respect, strands such as described in the Frickert Patent 2,736,676 can be incorporated in the mat as well as that shown and described in the Frickert et al. Patent 2,875,503. The mat can be made fully of such fiber-dispersed strands without need for discontinuous fibers if desired. In referring to a strand it is to be recognized that the construction of this invention is not limited to untwisted groupings of the continuous glass fibers, but can also be twisted groupings of such fibers, as well as twisted and plied groupings or yarns. The term "strand" as utilized in describing the invention is therefore herein meant to refer to each such form of groupings of glass fibers.

FIGURE 5 shows the apparatus and process by which the roofing material of the present invention is produced. Although described in relation to production of shingles, the process and apparatus is readily adapted to production of siding and roll roofing products as well, including asphalt and other suitable thermoplastic weathering materials.

A flexible glass mat **43** of the type illustrated in FIG-

URE 3 produced by the method and apparatus of FIGURE 4 is withdrawn from a supply roll by a pair of feed rolls **50** and is then passed through a pair of coating squeeze rolls **51** and **52** which apply a coating of asphalt thereto for impregnation completely through the thickness of the web or mat. The roll **52** is of dimension such that it dips down into a pool of molten asphalt maintained at a predetermined level in a reservoir **53** disposed below the web and picks up a quantity of asphalt therefrom for application to the underside of the mat **43**. A portion of the asphalt passes through the porous mat and a nip or small globular quantity is formed on the underside of the mat at the bite between the rolls **51** and **52**, while because of the freedom of the asphalt to pass through the porous mat, a somewhat smaller nip is also formed on the upperside of the mat at the bite between the rolls **51** and **52**, whereupon continued movement of the mat between the rolls causes a squeezing and a metering of the amount applied to the mat. Although this step in the operation might be termed a mat coating operation, the asphalt is impregnated through to the upper sides from the underside of the mat. Additional asphalt can be deposited directly onto the upperside of the mat from a source **55** when desired or necessary to assist in effecting a more uniform distribution on the upperside of the mat as determined by the flow and penetrating characteristics of the asphalt used. In order to prevent excessive amounts of asphalt from being applied to the underside of the mat, however, a wiping knife or blade **54** is provided extending transversely across the width on the underside of the mat following the squeezing, coating, and impregnating operation performed by the rolls **51** and **52**. The blade **54** removes excesses of asphalt from the underside of the mat and meters the quantity applied to the underside to the degree desired. In most instances this mat is desirably provided with a minimum of asphalt on the underside but with a sufficient amount to cover the glass fibers as protection therefor. Since the catalytic reaction of the asphalt can be triggered at temperatures in the order of 425° F. and higher, it is stored in reservoir tanks at temperatures in the order of 350° F. at which the dormancy of the reaction over extended periods is assured. The asphalt, when ready for use, is then drawn from the reesrvoir tank at temperatures in the order of 400° F. and flowed to the applicator reservoir **53**. The asphalt is maintained molten and fluid in the reservoir **53** at a temperature in the order of 380° F., at which temperature it is applied to the underside of the mat **43**.

Upon advancement of the coated and impregnated mat beyond this coating zone for further processing, it is desired that the mat be cooled. It is a feature of this invention that the bottom reinforcing web or mat is cooled to a degree that molten asphalt subsequently deposited thereon will not flow through the web by melting the coating and impregnating material prior to complete assembly of the product. This cooling is accomplished by first subjecting the impregnated mat to the chilling action of a coolant such as water supplied by a set of sprays **56** spaced above and across the width of the mat from which a mist of the coolant is distributed in the zone immediately following the coating operation. The mat is then further cooled and set by air circulated between a pair of air cooling hoods **57** disposed above and below the mat in the zone immediately following the spray cooling step prior to its being supplied with additional asphalt in a subsequent core forming step. The mist from the coolant spray **56** effects an initial chill while the air cooling hoods which extend over a greater length of the path of the mat effects the major penetrating and more gradual cooling by circulating air above and below the mat.

Upon further advancement of the cooled mat, additional molten asphalt **42** is deposited thereon from a metering supply source located above the mat in which the asphalt like the asphalt in the reservoir **53**, as well as that subsequently applied, is maintained at a temperature in the order of 380° F. Before the asphalt is applied to the coated mat, however, tracks of discontinuous chopped glass strands are laid on the coated mat in the locations *45a*, *45b*, and *45c* (shown in greater detail in FIGURE 6), where the longitudinal nailing zones will lie in the final shingles. These nailing zone tracks are in the order of 2 to 3 inches wide generally near the center of the shingle width, and provide reinforcement for the asphalt in these zones to impart nail holding power to the product.

Additionally, chopped strands are provided in the locations *46a* and *46b* of the coated mat corresponding to the major exposed edge of each shingle subsequently cut from the composite web. The chopped fibers at the product edges are provided to enhance the fire safety of the shingle by plugging tendencies for flow of asphalt when subjected to the action of spreading flames.

The chopped strand tracks are made of continuous 60 end glass fiber rovings **47** withdrawn from packages **48** through guide eyelets **49** by conventional rotary type choppers **58***a, b, c, d,* and *e,* located immediately above the coated mat in the regions where the respective tracks *45a, 46a, 45b, 46b,* and *45c* are to be located. Each roving by way of example, is made up of 60 continuous glass strands of 204 continuous glass filaments each. When the roving is cut to relatively short lengths, for example, of 1" to 3", it falls into the tracks generally as randomly distributed chopped strand lengths intermingled to form a mass network.

The additional asphalt is thereupon supplied to the coated mat and over the tracks of chopped glass strands in its fluid condition from a sufficient distance above the mat that it spreads across the width of the mat and envelopes the chopped strand tracks to form a core for the product as it is advanced. A second mat of glass fibers **41** is drawn downwardly from a source by a pair of squeeze rolls **61** and is applied directly over the newly spread asphalt core by passage immediately under the uppermost squeeze roll **61**. The squeeze rolls **61** are disposed a distance apart selected for the thickness desired for the core of asphalt and are located in a position with respect to the asphalt supply **62** such that they act in conjunction with the natural spread of the asphalt to squeeze excesses to the edges of the assembled composite. Excesses squeezed from the edges are deposited in the overflow container **65** located under the squeeze rolls **61**. The coated mat or web **43** being in a relatively cool, solidified condition is able to withstand the weight of the added molten core asphalt **42** and offers a base arranged by its mass and degree of cooling such that it does not become sufficiently heated by the added molten asphalt to allow the core material to flow therethrough.

The parallel strands in the mat of the present construction improve the tensile strengths of the sheet during processing in production wherein each mat acts as a tensioning element permitting drawing of the sheet through the apparatus of the production line. The parallel strands additionally act somewhat as a base for bridging of the asphalt across the width of the sheet during the process of assembly of the product. That is, the gaps between the parallelly aligned tensioning strands are sufficiently small that the bitumen matrix deposited thereon acts in bridged or webbed relation across the gaps. The intermingled discontinuous fibers are also bridged across the gaps of the parallel strands, as well as being interbonded in integrated relation across the randomly distributed strands which extend in criss-cross relation about the extended parallel strands. By this means, gaps or voids of fibers in the mats are minimized while yet providing a porosity permitting relatively free passage of the fluid bitumen therethrough.

The mat of glass fibers **41**, in passing under the top-most squeeze roll **61** and acting in compression against the core material on the base web has an amount of the core asphalt squeezed therethrough so that upon advancement of the assembly from between the squeeze rolls **61**, a thin layer of asphalt is present over the fibers of the mat **41**. A top overlayer of asphalt is thereupon deposited over the top-most mat supplied from a source **63** located above the assembly in the manner of the supply of the core asphalt **62**. The material so supplied is spread over the width of the assembly and is passed between a pair of metering rolls **64** disposed above and below the assembly a distance just sufficient to provide the thickness desired to produce a shingle construction of predetermined thickness. Excesses of the overlayer of asphalt are squeezed from the edges of the assembly and into the oversupply container **65** for subsequent recirculation.

A wiping blade **69** is disposed on the underside of the assembly which makes contact with the underlayer of asphalt subsequent to passage through the metering rolls **64** to wipe any excesses of asphalt that might have passed to the underside. The amount of asphalt in the assembly prior to deposition of additional amounts from the sources **62** and **63** respectively, however, are such that upon cooling, the amounts added in combination with the chopped glass strand lengths are arranged to be insufficient to convey heat to the bottom web to an adequate degree to cause excessive weakening of the lowermost asphalt web reinforced by the mat **43**, and accordingly, the dripping of asphalt through the web is unlikely. The presence of the blade or wiper **69**, therefore, is precautionary for wiping of excesses squeezed from between the final metering rolls **64** in order to assure that the bottom-most mat **63** is located as close to the bottom of the assembly as possible.

The usual protective and decorative mineral granules such as crushed stone, if to be provided on the product, are thereupon deposited on the upper layer of weathering asphalt exposed after passage through the metering rolls **64**. The granules **44** are supplied from a hopper **66** and are metered over the exposed asphalt surface of the assembly by a fluted feed roll **67** disposed immediately below a granule supply hopper **66**. A multiple hopper applicator for blended colors can be used as a replacement in this stage of the process if desired. Rotation of the fluted roll **67** is matched to the forward movement of the conveyor line to assure an even supply of granules over the entire length of the assembly.

The granuled construction of asphalt and glass fibers is then advanced under and around a driven slating drum **68** which acts to partially set the granules into the asphalt of the exposed surface upon which they are deposited, while excesses of the granules which are not thereby adhesively secured to the assembly are dropped into the hopper **66** by reason of the overturned relation of the sheet after passage about the slating drum **68**. A parting agent such as mica particles **72** are deposited on the underside of the roofing sheet after passage over the slating drum **68**. The mica is supplied from a hopper **71** which feeds a quantity of particles to a vibrating inclined surface member **70**. Although mica is herein described as being used as the parting agent, it will be recognized that any number of materials can be utilized to provide the desired non-sticking character in the final product. Sand is another type of material adapted to use for this purpose.

After supply of the parting agent to the back of the sheet, the continuous composite sheet is advanced about a turnover drum **73** which more permanently fixes the parting agent to the back of the construction. Excesses of the parting agent are wiped from the drum **73** by a transverse member **74** and are redeposited on the vibrating surface member **70**. The final assembly of components for this sandwich construction is then advanced through two pairs of press rolls **76** and **77** aligned in series for final dimensioning and setting of the granules in the top-most surface of the construction. After passage through the press rolls **76**, the continuous sheet is passed over a guide roll **78** prior to being formed into loops to allow more gradual cooling of the sheet than would otherwise be possible at the speed of production of the construction.

After advancing over the guide roll **78**, the sheet or composite web of material is moved into a moving roller conveyor made up of a series of parallelly aligned slowly advancing rolls **80** extending transverse to the width of the sheet. The portion of the sheet in engagement with the second roll **80** of the conveyor is pinched between the second roll and a pair of stationarily disposed spaced wheels or tires **79** which slows the advancing movement of the pinched portion and accordingly forms a loop between the first and second rolls **80** of the conveyor. Continued advancement of the second roll under the wheels or tires **79** advances the newly formed hanging loop of the composite web past the wheels **79** placing it in series with the preceding loops on the conveyor line. In view of the web so being slowed in its linear advancement to subsequent cutting and packaging operations, it is provided an opportunity to cool slowly to a more stable condition for the further processing.

The rate of advancement of the rollers **80** relative to the rate of advancement of the sheet during its fabrication determines the length of the loops **81**, and accordingly, the time allowed for cooling of the web following fabrication.

The relative rates between fabrication and cooling of the web is regulated so that it is fully stabilized upon subsequent slitting, cutting and packaging. At the end of the line of rollers **80**, the composite web is withdrawn from the last of the series of loops **81** by a pair of pulling rolls **82** for feed thereof to a pair of slitter rolls **83**. The rate of withdrawal of the web by the pull rolls **82** can be regulated to provide a short additional loop **85** before the slitter rolls **83**, thereby reducing the requirement for an exactingly matched speed relation between the slitter rolls **83** and the pull rolls **82**. Tension problems for cutting the sheet are thereby minimized.

The slitter rolls **83** effect a severance of the web into three equal widths which are retained in side-by-side abutting relationship, in which relationship they are drawn through a pair of measuring drive rolls **84** for passage to a pair of driven cutting rolls **86** which effect a cutting of each of the parallelly moving strips of the web to form shingles of the general shape illustrated in FIGURE 1.

After being cut, the shingles are received by a pair of feed belts **87** which supply the shingles into stacked relation on a stacking plate **88** on a packaging bed **90** for strapping and final shipment.

By way of further example, successful sheets so produced have had a thickness dimension in the order of 125 mils with a spacing between 10 mil glass fiber webs in the order of 75 mils. In other words, the desired stiffness is imparted to the sheet with the spacing between webs being approximately 60% of the sheet thickness and the ratio of spacing to mat thickness being 7.5 to 1. The mats comprise approximately 2 to 4% by weight of the sheet while the core therebetween made up approximately 50% by weight of the sheet. Asphalt saturant in the lower mat comprised 4% and the top coat asphalt 10% of the product. Surface granules were about 32% and parting agent 1.5% of the product weight. The range of mat thicknesses can extend at least from 0.005″ to 0.05″ while spacing can be from 0.010″ to 0.200″. Discontinuous fiber diameters can be in the range of 0.0001″ to 0.002″ and continuous fibers from 0.0001″ to 0.001″. The weight of the two mats can range from 0.01 to 0.1 lbs. per foot and from 1 to 20% of the product weight. Asphalt incorporated therein containing 200 mesh stabilizing slate particles or similar suitable mineral material in the order of 50% by weight of the asphalt has been found to provide excellent stiffening and weathering characteristics.

Tests of asphalt shingles with and without surface granules on the exposed surface have indicated under a given set of conditions of exposure to the sun, that asphalt which reached a temperature of 125° F. with the granules present, would reach a temperature of 150° F. without the presence of surface granules. As indicated previously, however, the lack of surface granules can be tolerated in the structure of the present invention even though the asphalt might reach a higher temperature because of the stability imparted to the exposed surface due to the glass fiber network of the upper mat adjacent thereto.

Referring again to FIGURES 6 and 7 in the light of the foregoing description of the production line, the chopped strand nailing zone tracks **45***a*, **45***b*, and **45***c*, spaced across the width of the carrier web **43**, are made of 60 end rovings chopped to relatively short lengths for example, of 2 to 3 inches, and are deposited randomly in a track having a width, for example, of approximately 3 inches. The amount of chopped strands per hundred square feet of shingles can amount to 0.4 pound. The nailing track **45***c* is located a distance back from the exposed edge corresponding to the cut out portions **151** as shown in FIGURE 7. Where the shingle width is in the order of 12 inches, the nailing zone **45***c* can be 6 inches back from the exposed edge of the shingle. Thus, where 3 shingles are cut from the web produced on the production line of FIGURE 5, the web would be 36″ wide, and accordingly three separate 3″ tracks would be provided across its width.

The two additional tracks of chopped strands **46***a* and **46***b* are provided for the exposed edges of the shingles cut from the web. Only two additional tracks are required for the three shingle web, since two of the shingle strips have their exposed edges abutting each other in the arrangement of FIGURE 5. In this way, the chopped strand track **46***b* overlapping the zone where the cut is made to form the abutting exposed edges of adjacent shingle strips is 6″ wide to provide two marginal edges reinforced by chopped strands. The second track **46***a* need be only as wide as a single track in a shingle since it forms the basis for a nailing zone at the marginal edge of only the remaining shingle strip.

As pointed out in the foregoing, the chopped strands at the edge of the shingle assist in reducing flame spread or in other words, provides a flame barrier by plugging up the tendency for flow of asphalt upon heating of the shingle structure. That is, the spread of flame, in addition to being retarded by kick-off of the dormant catalytic reaction in the asphalt is further retarded by the presence of the chopped strands or bundles of glass fibers of discrete length at the shingle edge which hold the crusted or combusted materials intact after exposure to flames. The flow of fresh asphalt from the interior of the structure promoting the continuance and spread of flames is thus prevented. In still other words, the chopped strands at the shingle edge plug up the tendency for flow of hot asphalt and hold back the flow of asphalt with its consequent tendency toward continued support and advancement of flames.

As an example of improved fire safety obtainable with structure of the present invention, Underwriter's Laboratory Tests reveal that the flame spread rate of the shingle of this invention incorporating the catalytically reacted asphalt and chopped glass fibers at the exposed edge can be reduced to 3 feet or less in 10 minutes, much within the maximum of 6-foot spread in 10 minutes for class A rated roofing shingles.

Although the method and apparatus is described above in relation to the production of asphalt shingles, it will be recognized that if desired, they are also readily adapted to production of a roll roofing product of the composite web of asphalt, glass fibers and granules. In this respect, the roll roofing product is usually desired to be more flexible than shingles in that the sheet must be rollable and is desirably conformable to variations in contours of surfaces to which it is affixed. Accordingly, the stiffness of the product web is desirably modified for the less stiff condition. As indicated above, the spacing of webs across the thickness of the product, if reduced, will allow more flexing with less stiffness, but additionally, the type of asphalt incorporated in the composite web can also be modified to provide a greater or lesser degree of stiffness. Thus, both the spacing of webs and the type of asphalt are factors which will allow formation of an end product in accordance with predetermined needs.

In view of the penetrability of the coating grade asphalt in the composite structure of this invention, the asphalt can be selected for its weatherability, fire safety and stiffness, rather than being limited to its compatibility with saturant asphalts of the conventional base felt material, or to one which necessarily at least partially penetrates such base felt. In conventional manner, the asphalt of the present structure is combined with a hot slate dust prior to application and combination in the structure, but the degree of slate dust incorporated in the asphalt is not limited to conventional amounts, thereby permitting a combination which as a mixture is more stable and selectable for weatherability. As a variation of the method of producing the product of the present invention, an ordinary coating grade asphalt can have a catalytic material mixed therein such as at the time of addition of the slate in order to incorporate a dormant catalytic action in the structure. For example, ½% by weight of ferric chloride can be added to the asphalt with the slate to provide the desired dormant reaction properties.

The presence of a glass fiber mat in the weathering zone of the product causes the glass fibers to act as a reinforcement as well as a weather barrier for retention of the weathering components of the product. Studies indicate that the presence of the glass fibers reduces flowability as well as the coefficient of expansion of the asphalt and consequently increases its elastic properties in the weathering zone. Furthermore, whereas the actinic rays act to cause the surface asphalt to become more water soluble and thereby making the asphalt more subject to being washed away with rain, snow, etc.; the presence of glass in the weathering zone imparts a stability against cracks and corresponding degradation below the surface, thereby increasing the longevity of the product.

In use, the structure of the present invention improves considerably the weather resistance of asphalt shingles because the high quality asphalt is capable of being incorporated throughout its body and because of the stabilized condition imparted to the exposed surface by the network of glass fibers immediately adjacent thereto. In addition, the product lends itself to tight securement to the surface which it is to protect by reason of the increased strength of the nailing zone incorporating the high strength additional reinforcing chopped glass fiber strands.

Still further, the fire safety of the product is enhanced by incorporation of the catalytically reacted asphalt which, because of its dormant catalytic reaction, stands ready to be protectively activated upon subjection to the high temperatures of flames. The dormant catalytic reaction is in a sense a latent exothermic reaction triggered by temperatures as low as 475° F. which produces a violent reaction resulting in a snuffing action and consequent halt of flame spread. The flame activated dormant reaction is believed to snuff the flame by speeding up gassing, skinning and charring of the surface of the asphalt to entrap volatiles and also increasing the viscosity of the material toward solidification.

In addition to the high degree of retardation provided by the presence of the catalytic asphalt, additional retardation of flame spread, and a reduction of tendency toward support of combustion is provided by the glass fibers present in the chopped glass strand track at the exposed edge of the shingle which impairs flow of the asphalt and thereby simulates an increased viscosity of the asphalt at the edge of the shingle.

Whereas the structural product herein described is illustrated with two mats of glass fibers spaced from each other in the composite structure, it will be recognized that the principal improved weathering characteristics of the structure result from the presence of the topmost mat of glass fibers in the product, whereas the bottom-most web or mat of glass fibers adds stiffness and stability to the whole structure, as well as a stronger nail-holding property. The bottom-most web has a greater degree of flexibility in selection and can in some instances be other material than a glass fiber mat. In this respect, the bottom-most layer can be selected specifically as a carrier for the combination of materials deposited thereover, and accordingly may be different in construction and material from the top mat. It is preferable, however, that the bottom-most web be made of material of inert character such as glass fibers to promote the longevity thereof, since webs of organic matter usually absorb moisture which shortens the life of the product and makes it less effective as a moisture protective sheet.

Although the invention is herein described in relation to the specific forms and embodiments, it will be understood from the foregoing that modifications and variations may be effected in the method, apparatus, and product of the invention without departing from the concepts thereof, and we therefore contemplate by the appended claims to cover all such modifications as fall within the true spirit and scope of our invention.

We claim:

1. A weather resistant asphalt sheet for roofing, siding, shingles, and the like, comprising a weathering grade asphalt extending throughout the thickness of said sheet, and a coextensive integrated porous mat of mineral fibers fully impregnated by and enclosed within said asphalt, and at least one edge zone of said sheet containing mineral reinforcing fibers randomly arranged in greater concentration than the general concentration of fibers in said sheet.

2. A roofing sheet comprising a weathering grade asphalt extending throughout the thickness of said sheet, and a coextensive integrated porous mat of mineral fibers fully impregnated by and enclosed within said asphalt, said asphalt being a flame extinguishing asphalt and at least one edge zone of said sheet containing mineral reinforcing fibers randomly arranged in greater concentration than the general concentration of fibers in said sheet.

3. A roofing sheet like that of claim 2 wherein the reinforcing fibers concentrated in the edge zone of said sheet comprise discontinuous discrete bundles of glass fibers.

4. A weather resistant sheet for roofing, siding, shingles and the like comprising a weathering grade single asphalt matrix, a coextensive porous mat of mineral fibers in which the fibers are interbonded in random arrangement throughout said mat, said mat being fully impregnated and enclosed within said asphalt, said asphalt being an air blown asphalt catalytically processed having an incomplete reaction dormant at ordinary temperatures of use of said sheet but activatable at flame temperatures, said sheet having a flame barrier zone comprising a greater concentration of mineral reinforcing fibers in at least one edge of said sheet, said sheet also having a reinforced longitudinal nailing zone aligned along a portion of said sheet where nailing is effected to secure it to a surface to be protected, said nailing zone comprising a random arrangement of mineral fibers in a concentration sufficient to impart appreciable nail pull resistance to said sheet in said zone.

5. A weather resistant asphalt sheet like that of claim 4 wherein the fibers concentrated in the flame barrier and nailing zones comprise discontinuous discrete bundles of glass fibers.

6. A weather resistant sheet for roofing, siding, shingles and the like comprising a matrix of a single air blown asphalt which has been processed by a partially completed catalytic reaction to accelerate oxidation of the asphalt and in which the incomplete portion of the reaction is dormant at ordinary temperatures of use of said sheet but activatable at flame temperatures, a pair of parallelly spaced webs of glass fibers separated from each other across the thickness of said sheet, said webs being fully impregnated by and enclosed within said matrix material and being dimensionally coextensive with said sheet, and a flame barrier at least at one edge of said sheet comprising a greater concentration of glass fibers distributed between said webs along a zone immediately adjacent said edge.

7. A weather resistant sheet for roofing, siding, shingles and the like, comprising a weathering grade asphalt matrix in which the asphalt is an air blown asphalt in which oxidation has been catalytically accelerated by a catalytic reaction and in which the reaction is partially complete with the remainder being dormant at ordinary temperatures of use of said sheet but activatable at flame temperatures, a pair of individually integrated glass fiber mats, said mats being coextensive in dimension with said sheet and being parallelly oriented and fully impregnated by and enclosed within said matrix material but in spaced relation across the thickness of said sheet, each said mat comprising continuous glass fibers in the form of randomly distributed textile strands, said sheet having a band of chopped glass fiber strands concentrated in an edge zone of said sheet to reinforce said edge against flame spread.

8. A weather resistant sheet for roofing, siding, shingles and the like, comprising a weathering grade asphalt matrix in which the asphalt is an air blown asphalt in which oxidation has been catalytically accelerated by a catalytic reaction and in which the reaction is partially complete with the remainder being dormant at ordinary temperatures of use of said sheet but activatable at flame temperatures, a pair of individually integrated glass fiber mats, said mats being coextensive in dimension with said sheet and being parallelly oriented and fully impregnated by and enclosed within said matrix material but in spaced relation across the thickness of said sheet, each said mat comprising randomly arranged strands of continuous glass fibers and randomly intermingled discontinuous individual glass fibers, said fibers being interbonded in integrated relation in their respective mats by a thermosetting resinous binding agent, the upper-most of said mats

being disposed immediately adjacent the top-most surface of said matrix to reinforce said surface, and a layer of granules of mineral materials sheet in the top-most reinforced surface of said sheet, and a flame barrier zone at one edge of said sheet comprising a concentration of chopped glass fiber strands disposed immediately adjacent said edge within said matrix between said mats.

9. A weather resistant sheet for roofing, siding, shingles and the like, comprising a weathering grade asphalt matrix in which the asphalt is an air blown asphalt in which oxidation has been catalytically accelerated by a catalytic reaction and in which the reaction is partially complete with the remainder being dormant at ordinary temperatures of use of said sheet but activatable at flame temperatures, a pair of individually integrated glass fiber mats, said mats being coextensive in dimension with said sheet and being parallelly oriented and fully impregnated by and enclosed within said matrix material but in spaced relation across the thickness of said sheet, each said mat comprising randomly arranged strands of continuous glass fibers and randomly intermingled discontinuous individual glass fibers, said fibers being interbonded in integrated relation in their respective mats by a thermosetting resinous binding agent, said mats being disposed immediately adjacent the top-most and bottom-most surfaces of said mats respectively, and a nailing zone located in a portion of the sheet in which nailing is generally effected to secure the sheet to surfaces to be protected comprising chopped glass fiber strands distributed within said matrix in sufficient concentration to appreciably increase the nail pull resistance of said sheet in said zone.

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