Oct. 31, 1961 D. LABINO 3,006,797

PROCESS AND MACHINE FOR PRODUCING FIBROUS MATS

Filed March 19, 1956 2 Sheets-Sheet 1

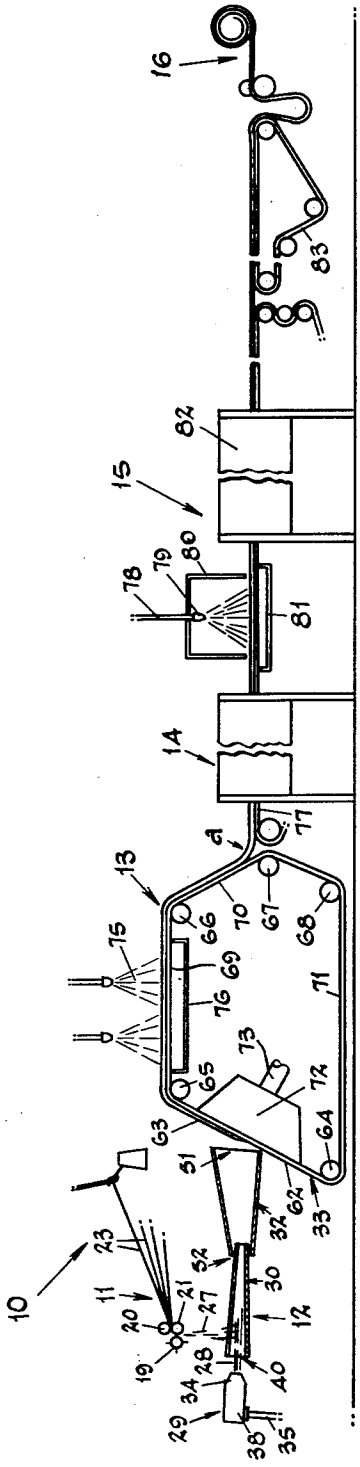


Fig. 1

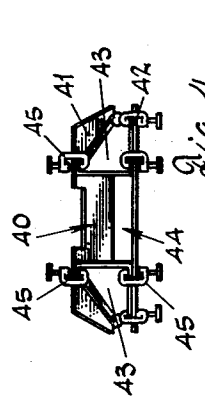


Fig. 4

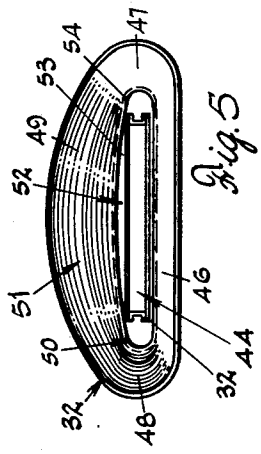


Fig. 5

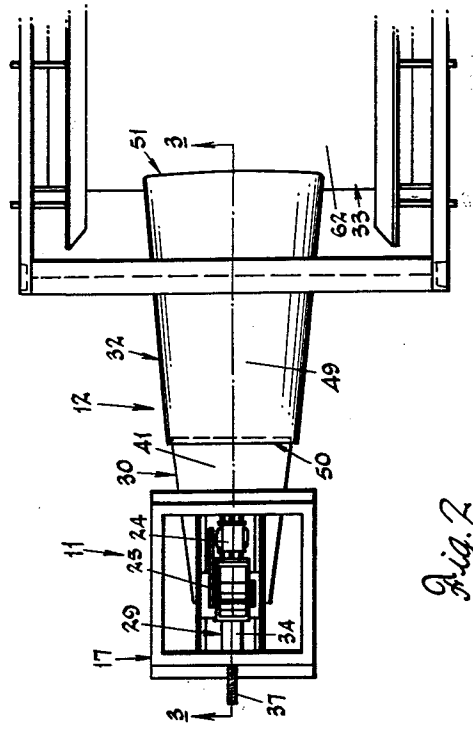


Fig. 2

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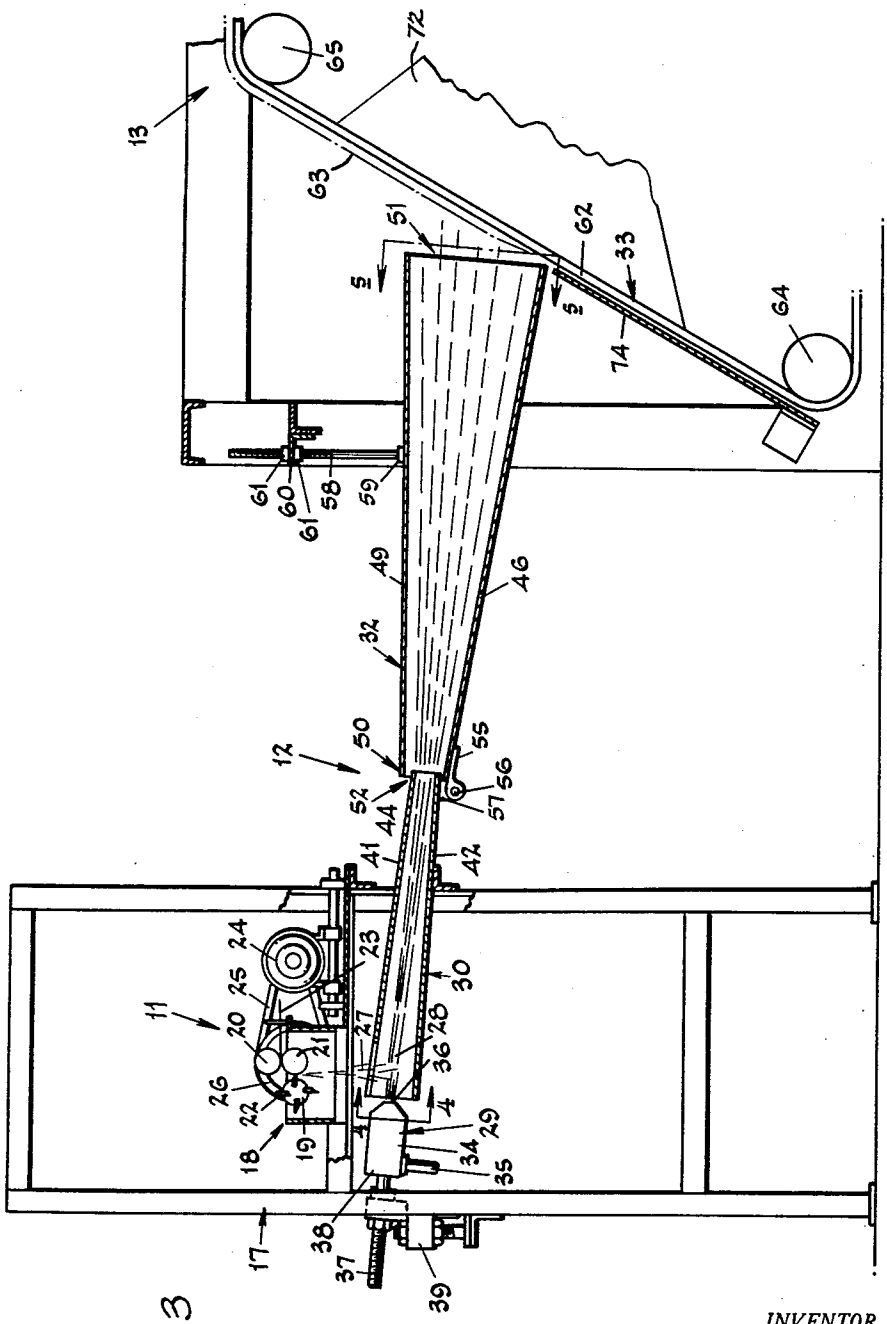


Fig. 3

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PROCESS AND MACHINE FOR PRODUCING FIBROUS MATS

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4 Claims. (Cl. 156—28)

This invention relates to asphalt bonded glass fiber roofing mats and to a process and machine for their production.

In one aspect this invention relates to a process for producing roofing mats from chopped glass fibers bonded together with asphalt.

In another aspect this invention relates to a machine for producing roofing mats from chopped glass fibers interfelted in random fashion and bonded together with cured asphalt.

Built up roofs for industrial buildings and other structures utilizing flat or substantially flat roofs are generally made from strips of asphalt impregnated kraft paper. Such roof structures are prepared by first mopping the roof boards with hot asphalt and then laying down alternate layers of asphalt paper and hot asphalt until the desired thickness of roof is built up. The durability of such roofs is limited by the life of the paper layers which are subject to deterioration when exposed to moisture, sunshine and other elements, such as when cracks develop in the structure due to expansion and contraction of heat and cold. When cracks form, water is drawn into the roof structure by the "wicking" action of the fibers of the paper, resulting in rotting and decay. Such deterioration requires periodic maintenance in the form of remopping with asphalt and eventually roof replacement is required.

Accordingly it is an important object of the present invention to provide an asphalt bonded glass fiber roofing mat.

A further object is to provide a method for producing glass fiber roofing mats from chopped glass strands wherein the chopped strands are bonded together with cured asphalt.

Another object is to provide a machine for producing roofing mats from chopped glass strands which are bonded together with asphalt.

The product prepared in accordance with the present invention is a thin, though web of porous structure composed of short lengths of chopped glass strands interfelted in random fashion, and bound together at their interstices by asphalt. This material is particularly well adapted for use in the preparation of built-up roofs as employed on buildings. Roofing mats made in accordance with the present invention, by virtue of their open porous structure are highly absorbent to asphalt mixtures of various types, and when utilized in roof making provide roof structures of improved integrity and longer life. Because of their glass content the present roofing mats have a low coefficient of expansion, which contributes to long roof life by reducing cracks and fractures.

Also since the inorganic glass fibers are not water absorbent, they display no wicking action, thus in effect inhibiting the seepage of water into the roof structure if and when cracks do form, as by oxidation of the asphalt through prolonged exposure to the elements of the atmosphere.

Other objects and advantages of the invention will become more apparent during the course of the following description when taken in connection with the accompanying drawings.

In the drawings wherein like numerals are employed to designate like parts throughout the same:

FIG. 1 is a schematic side view, partially in section, of a machine constructed in accordance with the present invention for producing asphalt bonded roofing mats;

FIG. 2 is a plan view of the fiber chopping unit employed in the machine of FIG. 1;

FIG. 3 is an enlarged section view taken along line 3—3 of FIG. 2;

FIG. 4 is a view taken along the line 4—4 of FIG. 3; and

FIG. 5 is a view taken along the line 5—5 of FIG. 3.

As shown in FIG. 1 the principal components of the machine **10** include the strand chopping unit **11**, the strand dispersing unit **12**, the mat forming and washing conveyor **13** with its associated drying oven **14**, the asphalt spraying and hardening section **15**, and the mat roll-up section **16**.

As best shown in FIG. 3 the chopping unit **11** is supported upon a steel framework **17**. The chopping unit **11** includes a housing **18** in which a cutter roll **179** and associated feed rolls **20** and **21** are journaled for rotary movement. The cutter roll **19** is provided with a plurality of elongated knives **22** having their cutting edges disposed perpendicular to the periphery of, and parallel to the axis of the cutter roll. The feed rolls **20** and **21** are disposed in peripheral contact, with their axes in horizontal, parallel relation. Feed roll **20** is disposed vertically above roll **21**. The peripheries of the feed rolls **20** and **21** are covered with rubber or other suitable friction material to grip glass strands **23** fed therebetween. A gear train (not shown) is provided in the housing **18** for rotating rolls **19**, **20** and **21** at synchronized speeds. Power is furnished by a motor **24** through belt **25** and pulley **26**, the latter being connected with the gear train for rotating the rolls.

The cutter roll **19** has its axis parallel to the axis of the lower feed roll **21** and the cutting edges of the knives **22** contact the periphery of the lower roll to cut strands **23** held thereagainst. As shown in FIG. 1, the continuous glass strands **23** are drawn from a suitable supply and passed between the feed rolls **20** and **21**, and are drawn downwardly between the cutter roll **19** and the lower feed roll **21** where they are chopped into strand unit lengths **27**.

The strand unit lengths **27** fall freely downwardly into a gaseous blast **28** of high temperature and high velocity produced by burner **29** and are thereby blown into the primary duct **30** of the fiber dispersing unit **12**. The duct **30** spreads and flattens the gaseous blast **28**, containing entrained strand unit lengths **27**, into an elongated rectangular band. From the primary duct **30** the strand unit lengths **27** are directed into a secondary duct **32** which generally enlarged and diffuses the elongated rectangular band from the primary duct for directing the strand unit lengths **27** toward a collecting chain **33**.

The burner **29** is of the internal combustion type having a refractory lined cavity (not shown) supported within a steel shell **34**. A combustible gas mixture, such as natural gas and air, is introduced into the burner **29** via pipe **35** where it is burned and the combustion products are ejected with great velocity at a high temperature as the blast **28** from a restricted orifice outlet **36** of elongated rectangular shape provided in the front of the burner. A threaded shaft **37** is secured as by welding to the rear wall **38** of the burner **29** and is supported in an adjustable hanger and alignment assembly indicated at **39**. Thus the burner **29** is adapted for horizontal and vertical alignment with the inlet opening **40** of the primary duct **30** of the fiber dispersing unit **12**.

The primary duct **30** of the fiber dispersing unit **12** is a hollow frustum-like structure of rectangular section, having open ends. The upper and lower panels **41** and **42** of the primary duct **30** are of planar, trapezoidal configuration as shown in FIGS. 2 and 4. The upper and lower panels **41** and **42** are held in forwardly converging relation by virtue of the tapered side panels **43**.

The inlet opening 40 is of substantially square section which tapers throughout the length of the primary duct 30 to an outlet opening 44 of elongated rectangular configuration. Thus strand unit lengths 27, falling freely into the inlet opening 40 of the primary duct 30 become entrained in the blast 28 from the burner 29 and are carried forwardly and formed into a flattened flow stream of elongated rectangular configuration as they emerge from the outlet opening 44 of the primary duct 30.

The manner of adjustment of the shape of the primary duct 30 is best shown in FIG. 4. The upper and lower panels 41 and 42 and the side panels 43 are secured in a desired relation by means of C-clamps 45. While the taper of the side panels 43 is constant, the distance between the front and rear ends of these panels is adjustable through the C-clamps 45 to vary the shape of the inlet opening 40 and of the outlet 44 as desired.

The secondary duct 32 of the fiber dispersing unit 12 comprises a hollow steel shell having a substantially flat bottom panel 46, FIG. 5, oval ends 47 and 48 and a top panel 49 of generally elliptical curve generation. Thus a section taken through any portion of the secondary duct 32 would provide a semi-elliptical plane section. The inlet opening 50 of the secondary duct 32 is of slightly larger inside dimension than the outside dimension of the outlet opening 44 of the primary duct 30. The secondary duct 32 tapers from the inlet opening 50 in a gradually enlarging manner up to the enlarged outlet opening 51, and appears of trapezoidal configuration when viewed in plan as per FIG. 2.

As shown in FIGS. 2 and 3 the outlet opening 44 of the primary duct 30 extends slightly into the inlet opening 50 of the secondary duct 32. Thus the primary duct 30 and the secondary duct 32 are disposed in coacting relationship. The relationship is such that a space 52 is provided between the periphery 53 of the primary duct outlet opening 44 and the inside surface 54 of the secondary duct inlet 50. This space 52 between the two elements is provided to permit the passage of aspirated air into the secondary duct 32. As mentioned above, the burner 29 produces a high velocity blast 28 of gaseous combustion products which move at a rapid rate through the primary duct 30 and out the outlet opening 44 of the primary duct. This high velocity gas stream causes appreciable amounts of air to be aspirated or drawn into the inlet opening 50 of the secondary duct 32. Thus the fiber stream emanating from the primary duct 30 is admixed with appreciable quantities of induced air in the secondary duct 32 to cause the strand unit lengths 27 to be further dispersed or fanned out and uniformly distributed across the area defined by the outlet opening 51 of the secondary duct 32.

The secondary duct 32 is provided with a bracket 55 secured as by welding to the terminal edge of the bottom panel 46 at the inlet opening 50, and is supported by means of shaft 56, the ends of which are rotatably journaled in ears 57, secured to the panel 42 of the primary duct 30. A vertically disposed rod 58 is secured at a central medial portion to the top panel 49 of the secondary duct 32 as by threading its lower end into an appropriate aperture provided in such panel and is locked in place by a bolt 59. The upper end of the rod 58 is passed then through an aperture in the frame member 60 and is secured in adjusted position by a pair of lock bolts 61. By vertically moving the rod 58 through means of the bolts 61, the outlet end of the secondary duct 32 can be adjusted to a desired vertical position.

As the strand unit lengths 27 are ejected from the outlet 51 of the secondary duct 32 they are impinged against a vertically inclined collecting flight 62 of the continuous chain 33 where they are gathered as a random mat 63.

The conveyor chain 33 is movably mounted upon a series of five parallel rolls 64, 65, 66, 67, 68, one or more of which are adapted to be power driven. The

fiber collecting flight 62 is supported in vertically inclined planar configuration by rolls 64 and 65. The mat washing flight 69 is supported by rolls 65 and 66 and the vertically downwardly inclined mat effluent flight 70 is supported by rolls 66 and 67. The return flight 71 passes from roll 67 around roll 68 and thence horizontally back to roll 64.

As shown in FIG. 3 a suction box 72 is placed behind the collecting flight 62 and is provided with an outlet 73 leading to a suitable suction device such as a fan. A portion of the fiber collection flight 62 defined by the bottom edge of the outlet opening 51 of the secondary duct 32 and roll 64 is covered with a sheet steel baffle 74 so that a reduced pressure zone produced by suction box 72 is concentrated substantially at the outlet 51 of the secondary duct 32. The gaseous constituents of the fiber stream pass through the chain 33 and are carried away by the suction box 72 and strand lengths 27 are deposited on the chain as a uniform random 63.

As shown in FIG. 1 the mat 63 is carried upwardly around the roll 65 onto the horizontally disposed washing flight 69 where a plurality of water sprays 75 are positioned to impinge upon the mat 63 and cause interfelting of the fibers of the strand unit lengths 27. The water drains through the mat 63 and the chain 33 and collects in a recovery trough 76 provided immediately beneath the chain. The mat 63 continues forwardly and downwardly on the effluent flight 70 and is transferred at point *a* onto a second horizontally disposed continuous conveyor chain 77. The mat 63 passes first through the drying oven 14 where the water from the sprays 75 is removed, and thence to the asphalt spray zone 15 where fluidized asphalt from a suitable heat exchanger is conducted by pipes 78 to the spray heads 79 and thence is ejected uniformly over the surface of the mat 63. A hood 80 is placed around the spray heads 79 to inhibit scattering of the atomized asphalt and a recovery pan 81 is placed beneath the chain 77 to collect any excess asphalt which is sprayed through the mat 63.

The asphalt coated mat 63 then passes into an oven 82 where all volatile materials are substantially completely removed and the asphalt is rendered non-tacky. The mat 63 is then transferred to a third conveyor chain 83 to expose the mat to the air so that it can cool to room temperature. When properly cooled, the mat is wound into rolls at the mat roll up section 16.

It is to be understood that the principal embodiment in the present invention is applicable to the production of bonded mats containing organic fibers or wool as well as those formed of glass materials. These include cotton, jute and other vegetable materials as well as nylon, Dacron, rayon and similar synthetic fibers. When so operating the burner may be replaced with a high pressure air jet to prevent softening or combustion of the fibrous materials which are fed into the inlet opening of the primary duct from the chopper unit.

It is also to be considered within the scope of the present invention that binders other than fluidized asphalt may be employed. For example, thermosetting synthetic resins in liquid form, such as the phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde and similar aldehydes condensation products, and the like are to be considered to fall within the purview of this invention. Also thermoplastic resins of which asphalt may be considered an analogous material, are to be included. Such thermoplastics include nylon, cellulose acetate, polystyrene, polyvinyl chloride and the like.

It is also to be considered within the scope of the present invention that powdered binders as well as fluidized binders may be employed. When so operating a duster or blower would be substituted for the spray nozzles contained within the hood. Also when so operating it may be desirable to place an exhaust conduit immediately beneath the hood to pull the powdered binder downwardly into the mat and also recover excess binder.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred embodiment of the same, but that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or scope of the subjoined claims.

I claim:

1. Apparatus for producing a bonded fibrous mat comprising, means for producing a gaseous flow stream of high velocity, means for dividing a continuous multi-fibered strand into unit lengths and directing said lengths into said flow stream, a first duct adapted to receive said flow stream and entrained strand lengths and form said flow stream into an elongated rectangular band, said first duct having a discharge opening, a second duct, said second duct having an entrance opening, said entrance opening being positioned in coacting spaced relation to said discharge opening and partially exposed to the atmosphere, said second duct being adapted to receive the flow stream from said first duct and diffuse it in enlarging array, means for collecting the fibers from said second duct as a uniform random mat, means for coating said mat with a fluidized binder, and means for hardening said binder.

2. Apparatus for producing a bonded fibrous mat comprising, means for producing a gaseous flow stream of high velocity, means for dividing a continuous multi-fibered strand into unit lengths and directing said lengths into said flow stream, a first duct adapted to receive said flow stream and entrained strand lengths, said first duct having a discharge opening, a second duct, said second duct having an entrance opening, said discharge opening of said first duct and said entrance opening of said second duct being positioned in atmospheric aspirating relation with said entrance opening of said second duct being positioned to receive the flow stream from said first duct and diffuse the same in generally enlarging array, means for collecting the fibers from said second duct as a uniform and random mat, means for coating said mat with a fluidized binder, and means for hardening said binder.

3. Apparatus for producing a bonded fibrous mat as defined in claim 2, wherein said first duct has an inlet opening positioned in atmospheric aspirating relation to the high velocity gaseous flow stream.

4. The method of producing a fibrous mat including the steps of, providing a high velocity gaseous flow stream, aspirating atmospheric gases into said flow stream in a first stage providing a plurality of unit lengths of multi-fibered strand, introducing said unit lengths into said aspirated flow stream to provide partial dispersment of the fibers of said unit lengths, aspirating atmospheric gases into said flow stream to uniformly disperse said strand lengths in a second stage, passing said flow stream through a planar foraminous member adapted to remove said strand lengths as a mat from the gaseous component of the flow stream, applying water to said mat to cause interfelting of the partially dispersed fibers of said unit lengths, subsequently removing water, applying a fluidized binder to said mat, and stabilizing said binder.

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