July 23, 1968 G. E. SMOCK ETAL 3,394,046

INTEGRATED BODY OF MULTI-FILAMENT STRANDS

Original Filed Oct. 18, 1962 4 Sheets-Sheet 1

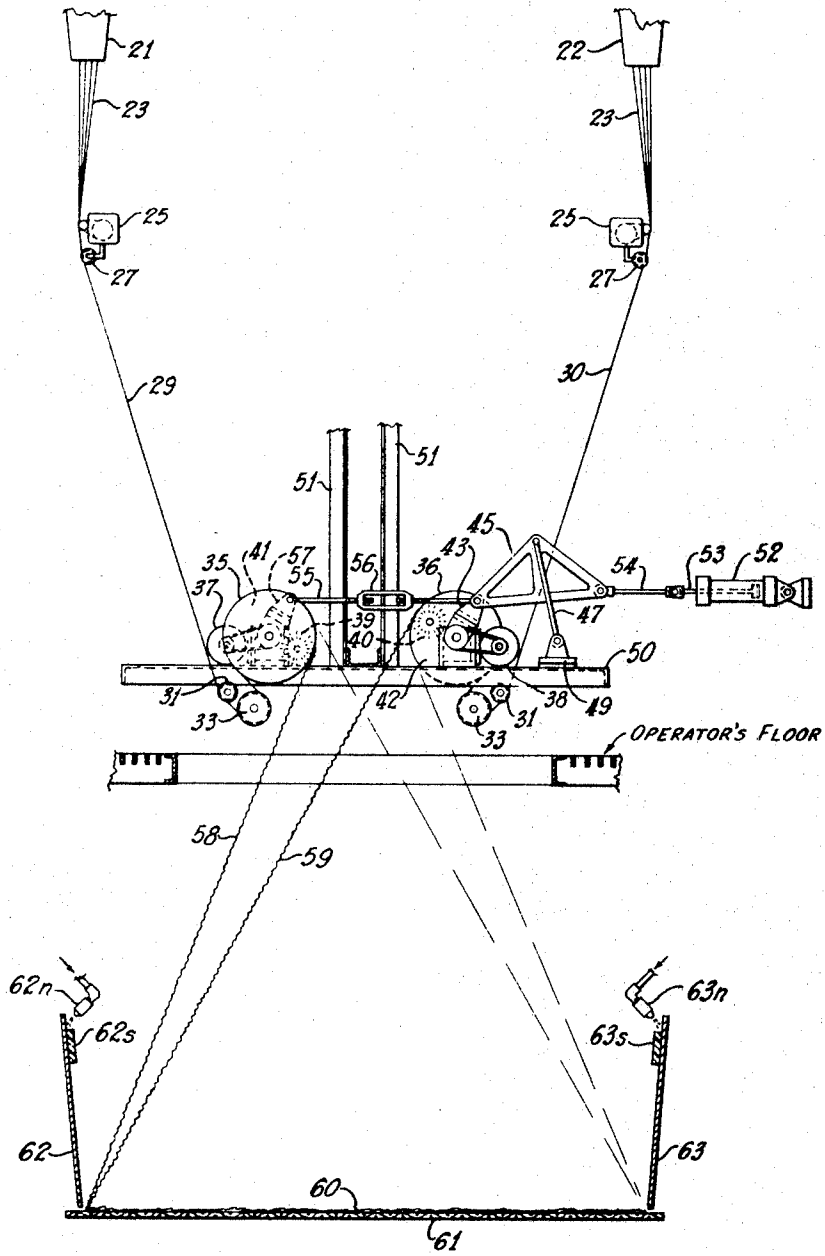


Fig. 1

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INTEGRATED BODY OF MULTI-FILAMENT STRANDS

Original Filed Oct. 18, 1962 4 Sheets-Sheet 2

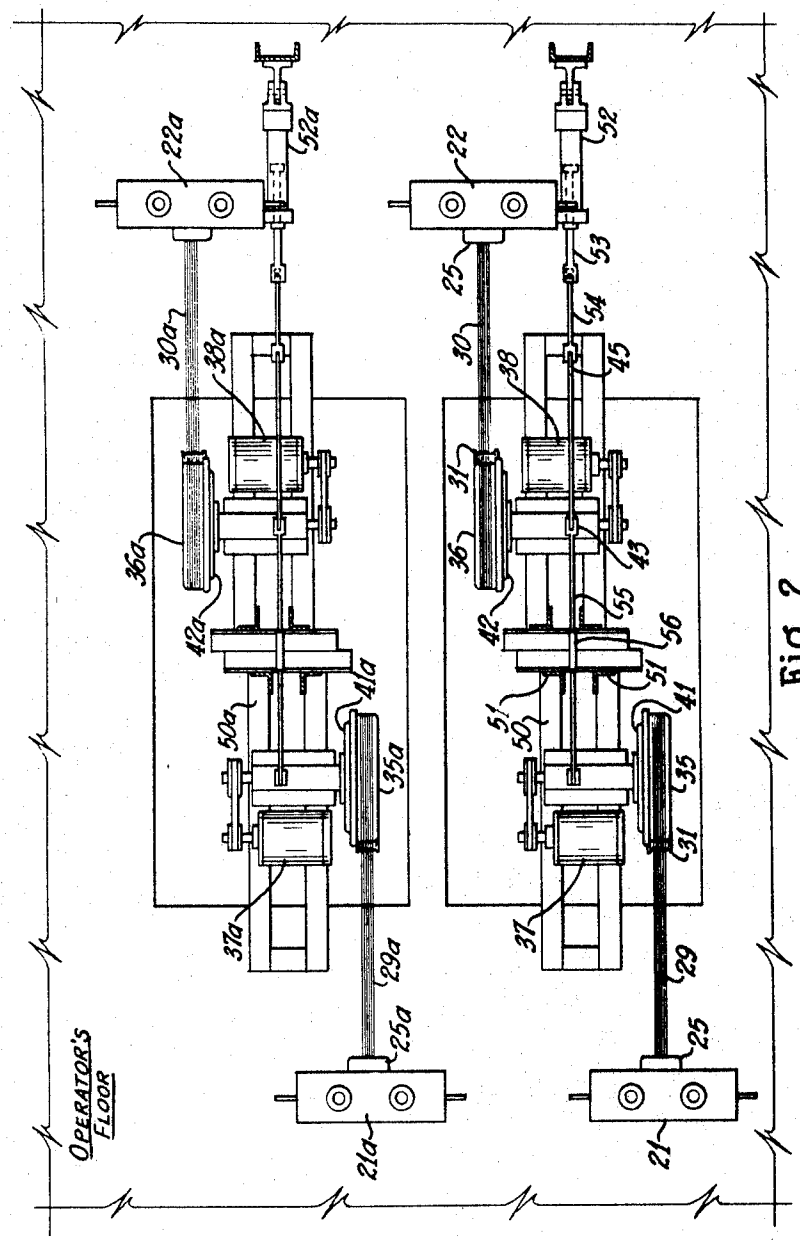


Fig. 2

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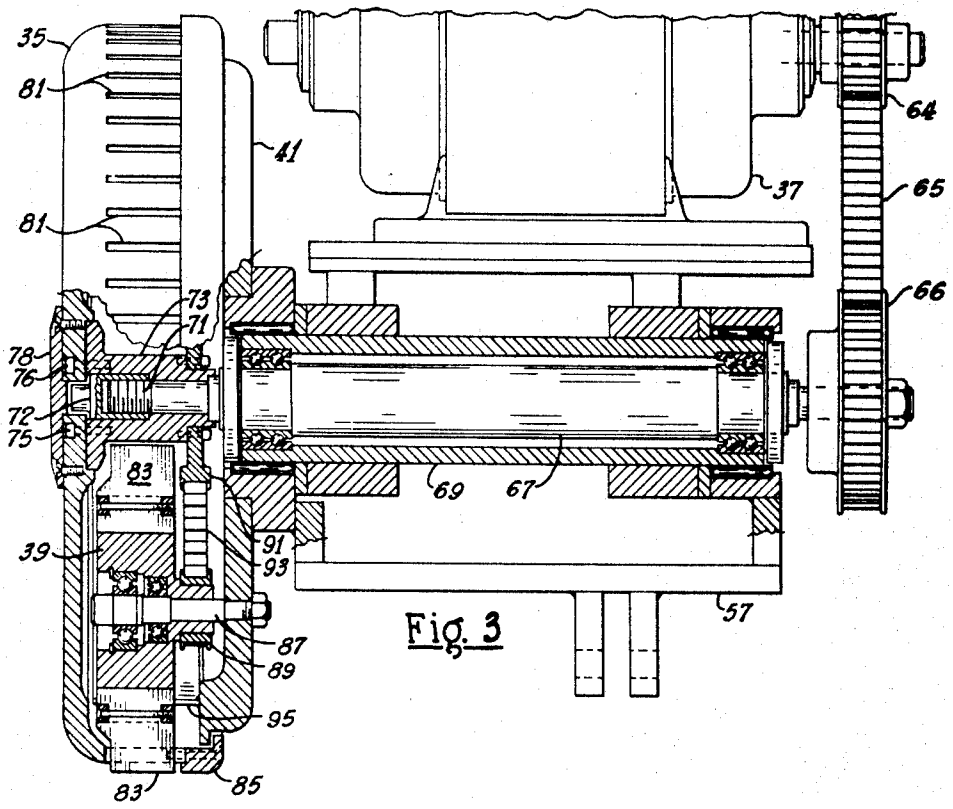


Fig. 3

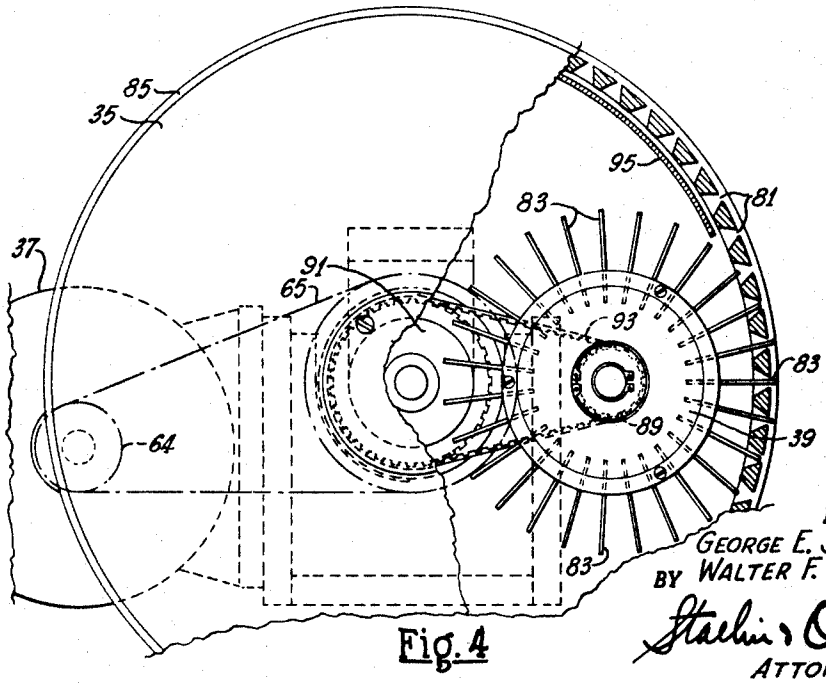


Fig. 4

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INTEGRATED BODY OF MULTI-FILAMENT STRANDS

Original Filed Oct. 18, 1962 4 Sheets-Sheet 4

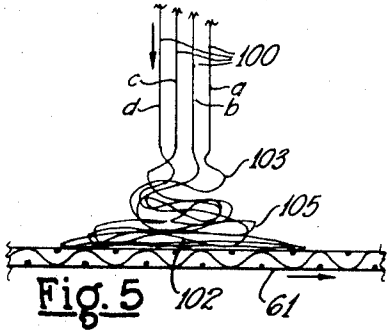


Fig. 5

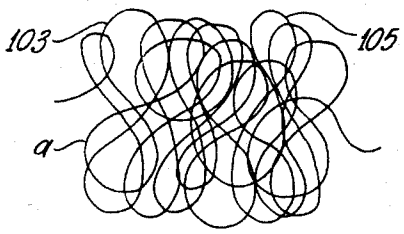


Fig. 6

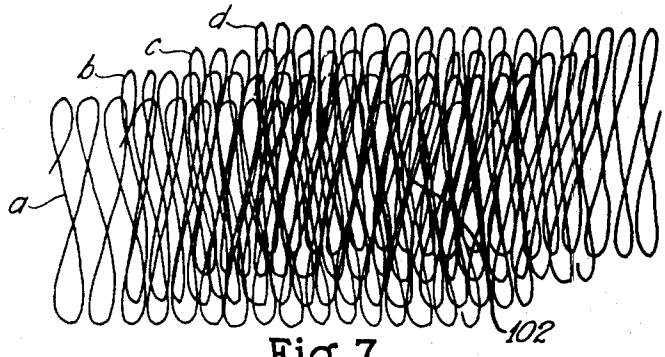


Fig. 7

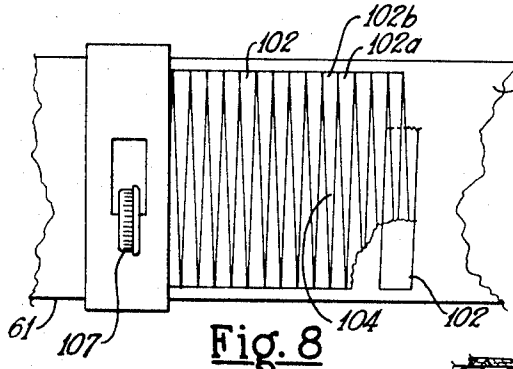


Fig. 8

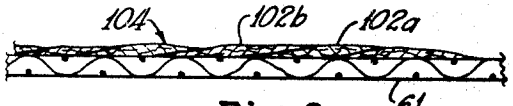


Fig. 9

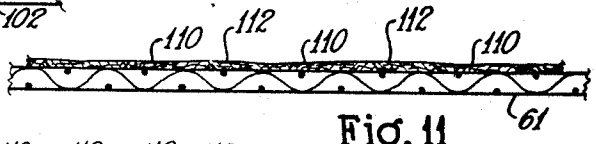


Fig. 11

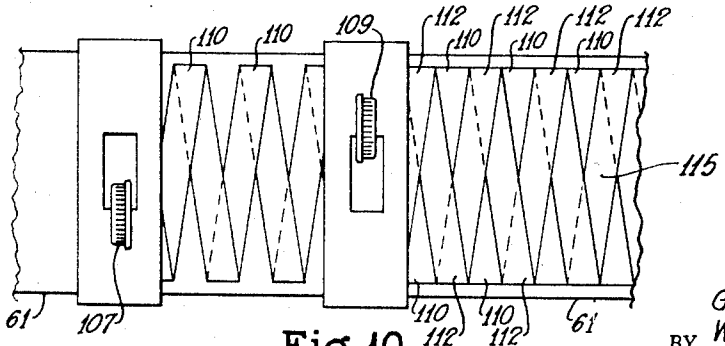


Fig. 10

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3,394,046

INTEGRATED BODY OF MULTI-FILAMENT STRANDS

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Original application Oct. 18, 1962, Ser. No. 231,362. Divided and this application Aug. 27, 1965, Ser. No. 493,957

9 Claims. (Cl. 161—170)

ABSTRACT OF THE DISCLOSURE

A fibrous body is formed of flat, narrow strips consisting of a multiplicity of fibrous glass strands. The strands of each strip extend in generally parallel courses with the loops of each strand extending laterally in interleaving relationship with the loops of other strands of the same strip.

This invention relates to mats or other bodies of multi-filament strands.

This application is a division of application Serial Number 231,362 filed in the names of the present inventors on Oct. 18, 1962, now abandoned.

Mats of fibrous glass, because of their inherent properties, especially those of strength and inertness, have many uses. They have been employed as filtering, acoustical and thermal insulating media. They also serve effectively for roofing sheets, non-woven fabrics, and for reinforcing plastic products.

In some instances the mats are composed of short fibers held together by a binder. In others the mats are bonded webs of chopped fibrous glass strands. Bundles or strands of continuous glass filaments have also been disposed in mat form. Strands of filaments have superior strength because of the continuous nature of the filaments and their concentrated linear association in strand form. Accordingly, fibrous glass strands are a most desirable mat constituent where strength is a prime consideration.

However, there have been difficulties involved in the fabrication of strand mats as well as deficiencies in such mat products. Because of the comparative greater bulk of the standard fibrous glass strands, they are not inclined to become easily entangled to form an integrated mass. They also are not disposed to lie in a flat formation. A further objection has been that the production of such mats has been costly due to requirement of special equipment and slow and involved processing.

Also, in mats of conventional types there is a lack of integrity, irregular or insufficient strength and porosity, and lack of uniform thickness.

Some of these deficiencies have been overcome by partial filamentizing of the strands by impinging them against a deflecting surface before the strands are massed in mat form. The resulting fuzziness promotes interengagement of the strands or semi-felting action which tends to integrate the mat product. However, there is an attendant bulkiness and possibly some loss of strength which are undesirable for many end uses of the mat. In addition, areas where there is a concentration of dispersed or fuzzed strands resist desired penetration by a resin to be reenforced.

In view of the above, it is an object of this invention to provide an integrated mat or other body of bonded strands in which the strands are of comparatively smaller size, and are associated in a particularly orderly and uniform manner providing a high degree of strength and porosity.

In the drawings,

FIGURE 1 is a front elevation of apparatus with which this invention may be practiced;

FIGURE 2 is an enlarged plan view of the apparatus of FIGURE 1, with an additional pair of pull wheels and associated equipment;

FIGURE 3 is a side elevation with portions in section of one of the pull wheels and the motor drive therefor incorporated in the apparatus of FIGURES 1 and 2;

FIGURE 4 is a fragmentary front view with parts broken away of the pull wheel and motor drive of FIGURE 3 with the assembly turned ninety degrees counterclockwise from the position of FIGURE 3;

FIGURE 5 is a side elevational view of a group of four strands being deposited on a conveyor;

FIGURE 6 is a plan view showing the type of loopy deposit of a single strand;

FIGURE 7 depicts, diagrammatically and in a simplified form, the interleaving of loops of four strands in a strip deposited upon a receiving surface;

FIGURE 8 is a plan view of a single pull wheel, associated conveyor and one form of mat which may be laid by a single wheel;

FIGURE 9 is a vertical section of a portion of the mat and conveyor of FIGURE 8;

FIGURE 10 is a plan view of two pull wheels, an associated conveyor, and a pattern of mat which may be laid by two pull wheels; and

FIGURE 11 is a vertical section of a portion of the mat and conveyor of FIGURE 10.

Referring to the drawings in more detail the apparatus of FIGURES 1 and 2 includes molten glass feeding bushings **21** and **22** depending from conventional glass melting tanks which are not illustrated. A second paired set of bushings **21***a* and **22***a* is depicted in FIGURE 2. The additional equipment of FIGURE 2 duplicates that of FIGURE 1 and will not be described separately. The main components carry the same identifying numbers as the like parts of the apparatus of FIGURE 1 but with the letter *a* following each number.

Continuous filaments **23** are drawn from the minute streams of molten glass issuing from orifices of the bushings. It will be considered that a bushing with 352 orifices is here utilized and the filaments are drawn to an average diameter of fifty hundred-thousandths of an inch.

Size is applied to the filaments as the latter pass over the traveling belts or aprons of the conventional size applicators **25**. The size may merely be water to reduce friction between filaments as they are subsequently joined together in strand form. A more complex size is however desired to promote coherence of the filaments when combined as strands, and adherence of the strands of filaments to the surfaces of the pulling wheels. Where the mat produced is to be ultimately combined with a plastic resin, it is also desirable to include a coupling agent in the size which facilitates wetting of the mat by the resin.

Instead of a size, and preferable thereto, is a binder which retains sufficient cohesive properties when cured to contribute to the bonding of the strands in the mat or other form in which they are collected on the conveyor or the receiving surface. Such a binder has the unique dual purpose of holding the filaments together as strands, and bonding the strands into an integrated body.

Since the mats are produced immediately below the glass filament forming stations without the strands being subjected to intermediate handling, a commonly used lubricant component of the size may be omitted. The inclusion of such a lubricating material has been found necessary for improving the handleability of the strands in those cases where the strands are required to go

through subsequent operations such as plying and twisting.

However, such a lubricant is not otherwise necessary, and in fact interferes with effective wetting of the strands where they are to be subsequently combined with a resinous material such as in a laminate.

The filaments from each bushing, after sizing, are grouped together to form a set of six strands individually segregated as they travel within six grooves over the respective gathering shoe **27**. Each strand contains about sixty filaments. The division of the filaments into strands is here accomplished manually at the start of operations.

The sets of strands **29** and **30** pass under the aligning shoes **31** which are grooved in the same manner as the gathering shoes **27**.

To help keep the pull wheels clean of size and to distribute the wearing action of the strands on the pull wheel the aligning shoes may be given a slight traversing action. This slowly shifts the strand position on the pulling wheel, moving back and forth about once in three minutes.

From shoes **31** the two sets of spaced strands **29** and **30** are led around the two idler wheels **33** and respectively travel around the pull wheels **35** and **36**. These wheels are similarly constructed but are relatively reversed in position.

Motors **37** and **38** respectively drive pull wheels **35** and **36**. The strands carried by pull wheel **35** are released therefrom by the successive projection of fingers of oscillating spoke wheel **39** through slots in the peripheral surface of the pull wheel **35**, while the fingers of spoke wheel **40** serve this purpose in connection with pull wheel **36**. The strands are kinetically projected in tangential paths from the pull wheels.

The rear side of each pull wheel is covered by an independently mounted, oscillatable back plate on which the associated spoke wheel is carried. Back plate **42** of the assembly including pull wheel **36** is arcuately oscillated through arm **43**. The latter is driven by functioning of the fluid cylinder **52** which sets through the triangular link **45**, which pivots upon bar **47** on the base **49**. The piston rod **53** extending from the cylinder is joined to the triangular link **45** by linking rod **54**. The base **49** is positioned on the platform **50** which also supports the pull wheels **35** and **36** and the equipment associated therewith. Platform **50** is suspended by angle iron hangers **51**.

Through the connecting assembly **55**, including the turnbuckle **56**, the transverse movement of the triangular link **45** is transmitted to arm **57** to arcuately oscillate the spoke wheel **39** within the pull wheel **35**. This oscillation is preferably in an arc of approximately fifty-seven degrees. With the single means effecting the oscillation of both spoke wheels their action may be closely synchronized.

The group of strands **58** thrown down by the pull wheel **35** and the group of strands **59** thrown down by the pull wheel **36**, and the strands from any other pull wheels preceding this pair are accumulated in mat form **60** upon traveling conveyor **61**, which is preferably of carbon steel chain construction. Side shields **62** and **63** define the edges of the mat **60** and prevent undesirable lateral overreaching of the strands. A two foot height for these shields is generally sufficient.

To prevent adherence of the strands to the side shields **62** and **63**, strips **61***s* and **63***s* of open-cell foam or of other porous material, about one half inch thick are attached along the shields near the top edges thereof. Plain cotton rag material has been found to be satisfactory. Water nozzles **62***n* and **63***n* are arranged to feed water to the upper surface of the foam strips. The water seeps through the strips and is distributed uniformly to form a water film flowing down the surfaces of the shields. Tubing with a series of holes may be used instead of the nozzles **62***n* and **63***n* to deliver the water and may be employed for directly forming the water films.

The width of the conveyor covered by the mat in this case is four and one half feet, but this may be varied through a wide range by changing the oscillating arc length of the spoke wheels and the distance of the pull wheels above the conveyor. The side shields **62** and **63** are mounted to adjust their spacing to match the width of the deposited material. Ordinarily the width utilized would be between extreme limits of two and nine feet.

The pull wheel **35** and the drive therefor are shown in more detail in FIGURES 3 and 4. On the shaft of motor **37** is a toothed pulley **64** which has driving connection through the segmented timing belt **65** with toothed pulley **66**. The latter is mounted on the outer end of shaft **67**, on the other end of which is carried the pull wheel **35**.

The shaft **67** is journaled in the stationary casing **69** upon which the motor **37** is supported. The pull wheel is held upon the threaded stud **71** of the shaft **67** by the barrel nut **72**. The hub **73** of the pull wheel has a bored section fitting over the smooth portion of the stud **71** and held against a shoulder terminating the smooth portion by the barrel nut **72**. The main body of the pull wheel is fastened to the hub **73** by machine screws **75** and **76**. A cap **78** covers the outer end of the bore through the hub.

By way of example, dimensions of embodiment of the pull wheel **35** may be twelve inches in diameter and have a series of peripheral cross slots **81**, approximately one and one-eighth inches long, three-sixteenths of an inch wide and spaced five-sixteenths of an inch apart. To reduce the wear the strand receiving surface of the pull wheel is given a hard surface such as an electrolytic deposit of aluminum oxide or a coating of nickel phosphate.

The fingers **83** of the spoke wheel **39** within the pull wheel **35** are dimensioned and motivated to successively project through the slots **81**. The spoke wheel is mounted on shaft **87** projecting from the back plate **41** and carries the toothed pulley **89** on a rearward extension of the wheel hub **73**.

The main body of the spoke wheel **39** is in this instance about three and three-quarter inches in diameter with the fingers **83**, twenty-seven in number, radially extending slightly more than thirteen-sixteenths of an inch from the periphery of the main body. The exterior portions of the fingers are generally of rectangular blade form one inch wide with a thickness of .024 of an inch. About one eighth of an inch of the outer end of the fingers extend out of the pull wheel slots at the point of their greatest projection.

The movement of the fingers **83** into the slots **81** and their momentary projection through the slots to release the strands is synchronized through the timing drive between the pull wheel and the spoke wheel. This includes the toothed pulley **91** fixed upon the hub **73** of the pull wheel, the cog timing belt **93** running over pulley **91**, and the pulley **89** on the shaft **87** upon which the spoke wheel is journaled.

The back plate **41**, oscillatable through yoke **57** to which it is attached, is mounted through bearings on the stationary casing **69**. Yoke **57** and therethrough back plate **41** and the spoke wheel **39** are oscillated in an arc of approximately 57° by functioning of fluid cylinder **51**.

Air movement into the interior of the pull wheel **35** is curtailed by the shroud ring **85** held to the inner edge of the wheel periphery by a series of machine screws. A baffle **95** interruptedly cylindrical in form, is carried by the oscillating back plate **41** and lies under the slots **81** except for an open section of the baffle in the region of the spoke wheel. This prevents air movement outwardly through the slots which is apt to irregularly release strands from the pull wheel. As the baffle oscillates with the spoke wheel, the open portion of the baffle is always

in the area where the fingers **83** enter the slots **81** of the pull wheel.

With the high peripheral speed of the pull wheel, the strands are forcefully projected in straight tangential lines from the oscillating point of disengagement effected by the fingers of the spoke wheel. The kinetic energy the strands thus acquire carries them in relatively straight courses to the region of the conveyor surface. Here they are self-positioning in lazy whirl formation with each strand assuming an individualistic pattern but disposed in interengaging and interleaving relation with the other five strands of the set.

The distance of the pull wheels above the conveyor, and the rotational speed of the wheels are so selected, in relation to the specifications of the plurality of strands being deposited, that the strands are projected with sufficient kinetic energy to carry them as a band of generally constant form and in substantially regular paths to the surface of the conveyor or other collection surface.

The group of strands is thus deposited in a reciprocating strip disposed in a constant repeating pattern and with substantially stable dimensions.

Consequently, full control may be exercised to obtain a desired relationship between adjacent courses of the strip deposited from a single wheel and to complement or match the resulting pattern with that developed by the deposit of strips from associated pull wheels. The mat produced may thus be assured of having a thickness with a high degree of uniformity, or a definite repeated pattern of varying thicknesses, if such is required.

Variations in patterns can be imparted to the product by oscillating adjacent wheels in the system at different rates, or at different angles with respect to the line of travel of the conveyor. Also, the speed of the conveyor may be varied to alter the degree of pitch of the zig-zag strips being deposited.

A large range of relationships can be established between the strips laid by various pull wheels in the system, but any one product may be reproduced uniformly by locking the system into the dynamic relationship which has been found to produce the particular mat structure desired.

The control of various factors in the operation of the apparatus is important for the successful attainment of the feature of the invention comprising the creation of a mat or other body of fibrous strands having a high number of thin laminations or leaves of stable dimensions, which are superimposed in a controlled and regular manner. A uniformity of properties is thus obtained that has not otherwise been available.

While a balance of the various factors involved is required to establish the proper kinetic energy for carrying the strands in a dependable, regular fashion to the conveyor surface, the projection of the strands in close array helps prolong the integrity of the band formation. Evidently each strand aspirates air during its high speed descent and this tends to pull or hold adjacent strands together. The group of strands will travel further than a single strand before losing momentum and directional regularity because the retarding effect of the thin wall of air separating strands is reduced by the joint pull of such strands upon the air.

The total resistance opposing the group is thus materially less than the total resistance that would be encountered by the same number of strands projected individually.

When the strands reach the proximity of the conveyor surface, their kinetic energy has been quite completely dissipated through air drag and possibly by a braking effect transmitted upwardly by the immediately preceding deposited strand portions. Since the length of the strands thus deposited greatly exceed the length of the course upon which they are laid, the strands assume a looped formation. This looping is initiated above the surface of the conveyor and is generally characterized by irregularly shaped, figure eights with loops extending laterally as much as an inch or more from the preceding, comparatively straight path of each strand. The loops of adjacent strands and possibly of all the strands of a strip are variously interleaved to integrate the deposited strip.

The profile of the usual strip of looped strands thus deposited on the conveyors is flat at the bottom and slightly but symmetrically curved across the top; the greatest elevation, actually of a low value, being at the center of the strip with a gradual diminution of the elevational dimension toward the edges of the strip. Thus, when such strips are overlapped by an amount generally in the order of one-half the width of the strips, the thickness dimension and the unit weight distribution across the width of the mat layer thus formed is substantially uniform.

If the zig-zag sweep of the strips across the width of the collection zone from a single pull wheel is so arranged that the pitch or distance between adjacent parallel strips is greater than one-half the width of the strip, overlying layers must be supplied to fill in this gap and the overlap between different strips can be set to provide the desired uniformity in thickness and unit weight distribution of the mat. In this regard, the strips are overlapped in definite patterned relation to obtain the final flat mat of uniform thickness or weight.

When adjusting reciprocation and conveyor speeds to establish less overlapping or greater spacing between successive strips or passes of a band, it is recommended that one half the width of the strip and an integer be taken as factors in determining the new strip advancing measurement.

By way of further developing the example set forth above, the six strands of each set led over the pulling wheel, as previously stated, are composed of an average of sixty filaments with each filament having a nominal diameter of fifty hundred-thousandths of an inch. The individual strands are roughly six-thousandths of an inch in diameter and are delivered to the surface of the pull wheel closely arrayed in parallel relation and in a planar band. The strands may be uniformly spaced apart about one-eighth of an inch. A strip of the peripheral surface of the pulling wheel no more than one-half of an inch wide is then occupied by the set of six strands.

If it is desired to include a greater number of strands in a set drawn over the pull wheel they may be positioned more closely together. While probably twelve strands is about the maximum practical number, as many as thirty may be thrown down from a single wheel of the particular embodiment herein described. Under such conditions, the strands could be spaced only one thirty-second of an inch apart. The number and spacing of the grooves on the stationary gathering shoes **27**, and on the guiding shoes **31** are arranged to space and guide the particular number of strands utilized.

The traction between the strands and the surface of the pull wheel is ample to furnish the pulling force required to attenuate the glass filaments formed from the minute molten glass streams issuing from the orifices of the furnace bushing. This adherence of the strands to the pull wheel although not fully understood is felt possibly due to the cohesive effect of the size carried by the strands and to other air and surface forces of attraction.

The pull wheel is driven at a speed of about two thousand revolutions per minute to deliver the strands at a rate of six thousand feet per minute. This rate may feasibly range from two to twelve thousand feet per minute.

The fluid cylinder **51** in the example set forth is actuated sixty times a minute to cause the spoke wheels to oscillate at the same rate and to thus direct the strands released from the pull wheels back and forth across the conveyor sixty times per minute. Because of the high rate of deposit, even with sixty reciprocations of the strands across the conveyor per minute, ten inches of strand is delivered to the conveyor for every inch of the strand travel across the conveyor. This explains why the strand repeatedly loops upon itself and upon the strands with

which it is associated as it reaches the surface of the conveyor. Higher rates of reciprocation are feasible but, if raised substantially, should be coupled with higher feeding rates, if the same degree of looping of the strands and degree of coherence of the deposited strips is desired.

With a conveyor speed of seven feet per minute and sixty strand reciprocations per minute there are one hundred and twenty overlapped cross strips of strand for every seven foot length of the deposited mat, with an average overlap of about two-thirds of an inch between the composite strips laid down from each pull wheel.

A succession of twelve pull wheels arranged in six pairs and handling strands assembled from filaments from twelve bushings is considered a desirable production system. This number is, of course, variable to meet any production requirements that may arise, and for lighter mats all of the pull wheels need not be utilized.

With twelve pull wheels and with the parallel strip portions laid from each wheel overlapping each other one-half of the width of a strip to effect a unitary layer of uniform thickness, the final mat will have twenty-four laminations. While each lamination is thin, the strips thereof are concisely and regularly interleaved to form the lamination as an integral elemental part of the mat. Under such conditions, the effect of a slight variation in any one lamination is negligible in the overall mat, as each lamination is only a small part of the whole and any variation is apt to be balanced by a compensating variation in an adjacent lamination; consequently the final product has outstanding uniformity.

In analyzing and determining the pattern to be formed, it is necessary to consider the parallel strip portions produced by bands moving across the conveyor in one direction only. These strip portions are generally parallel and it is the amount of their overlapping or spacing which govern the matching pattern to be deposited by subsequent pull wheels, which may be necessary to form a complete lamination of uniform thickness.

The parallel cross strip portions which are angled to the first described parallel strip portions produced by bands moving across the conveyor from the opposite side, have the same overlapping or spacing relation as the first described strip portions, and together with any required matching strips form a separate, duplicate lamination.

These laminations are units on a somewhat theoretical basis since the angled strips repeatedly cross each other. However, because of the thinness of the strips and their regular width dimensions, they form a continuous layer which from a practical standpoint can be considered as an elemental portion or building unit of the product.

As heretofore set forth, the method and product of this invention involve the linear projection of a closely arrayed group of comparatively light strands, the looped deposition and interleaving of the strands into integrated, dimensionally stable flat strips, and the mat or other body structure formed by the reciprocation deposit of the thin strips in overlapped patterned relation in a multiplicity of stacked laminations.

Characteristics of the invention may be better understood by reference to the illustrations in FIGURES 5 through 11. For simplification, strands **100** are shown in a projected band of four only, which are individually identified with the letters *a*, *b*, *c* and *d*. This projected band of closely arrayed strands has followed a relatively straight, though reciprocating course until losing kinetic energy shortly before reaching the conveyor **61**. At **103** the looping of the individual strands is initiated, with enlarging and interleaving of the loops at **105** as the strands are about to settle on the conveyor and together form the flat, thin integrated strip **102**.

A typical looped pattern is shown in FIGURE 6 of the single strand *a* incorporating the particular loops **103** and **105** identified in FIGURE 5. While the loops and swirls are irregularly arranged, the width and mass, longitudinally, of the single strand deposit are basically constant and contribute to the uniformity of the strip **102**, in which the four strands *a*, *b*, *c* and *d* are laid in intermingled and slightly offset relation, as indicated by the extremely diagrammatic showing of FIGURE 7. With all the coils and loops and other intermingled relationships of the strands, the overall courses of the strands of each strip are generally straight and arranged in slightly spaced parallel relation.

For some cause, which may be an induction effect attending the strand projection, or the barrier of adjacent strands to lateral looping, there is a greater thickness build-up along the center portion of a strip than indicated by FIGURE 7, particularly with a larger number of strands in a band. This is responsible for the usual, slightly curved upper outline of a cross section of a strip.

With a strip of such a form, overlapping one-half the width of an adjacent parallel strip portion builds a lamination of uniform weight or thickness. Such an arrangement is illustrated in FIGURE 8, wherein a pull wheel **107** is shown projecting a continuous strip **102** back and forth across the conveyor **61**. The full width of the strip **102** is shown in the broken away section of the lamination or mat **104**. Because of the repeated overlapping, half of each strip cross portion is always covered by an adjacent parallel cross portion and the true strip width is not discernible.

While two laminations are actually created by such an operation, with the two sets of parallel cross strips angled to each other, one only is illustrated in FIGURE 9.

As there portrayed the cross strip **102***a* is half covered by the following parallel cross strip **102***b*, with all strips of the parallel set of the lamination **104** in like superimposed relation.

While this showing is theoretical to the extent that it omits the cross strips of the set angled to and which pass over and under the cross strips illustrated as previously explained, from a structural standpoint, a distinct lamination is still present. A second lamination of the same nature is formed by the angled set of cross strips. The two laminations are integrated into a composite layer by the resulting rough weaving effect of the angled strips passing over and under each other.

Should the effective width of a strip be approximately the same as the actual width, practically no overlapping of parallel cross strip portions would be necessary. They could then be laid in edge abutting relation. Such a situation might arise where there is a particularly high strand projection rate to build a thicker strip, and uniformity of thickness or uniformity of weight distribution is not essential in the final product.

Apparatus arranged to project strips in this manner is schematically shown in FIGURE 10. The first pull wheel **107** deposits a reciprocating strip with parallel cross strip portions **110** on the conveyor **61**. These cross strips are spaced the strip width apart.

The operation of the following pull wheel **109** is synchronized to lay a strip with parallel cross portions **112** disposed between the cross strip portions **110**. A filled in mat **115** is thus created.

The relative positioning of the cross strips **110** and **112** on the conveyor **61** is illustrated in the sectional view of FIGURE 11. A slight edge overlapping of the last laid strips **112** is indicated.

As in all other cases, there would in the present instance be a duplicate lamination composed of the cross strips angled to those here specifically identified and an integration of the two laminations by the slight interweaving between the angled strips.

In general practice, the thin mat **115** would only be an incremental part of a mat or other body built up by strands projected from a series of probably eight or more pull wheels. In spite of the multiplicity of layers, the final product can be made to have a thickness of less than one eighth of an inch. Because of the natural flat lay of the thin strips, ironing or compression of the mat to produce

a smooth compacted product is limited. This contrasts with the severe, fiber crushing, repeated compressions usually necessary where fibers or fibrous strands are laid in bulky masses to create a mat.

In view of the foregoing description of various aspects of the invention, it will be understood that modifications and variations may be effected in the product of the present invention without departing from the scope and spirit thereof.

We claim:

1. A fibrous body including a multiplicity of strands in which the strands are disposed in a plurality of consistently dimensioned, flat, narrow strips with the strips in planarly parallel relation and extending in straight angled paths in overlapping relation back and forth across the fibrous body, each of said strips comprising a plurality of fibrous glass strands, the strands of each strip disposed in generally parallel and closely positioned courses with loops of each strand extending laterally across a substantial portion of the strip in interleaving relation with the loops of other strands of the same strip, and a binder material interbonding portions of the strands of the fibrous body to impart integrity to said body.

2. A fibrous body according to claim 1 in which loops of each strand of a strip are in interleaving relation with loops of all other strands of the strip.

3. A fibrous body according to claim 1 in which the loops of each strand are of irregular figure "8" form.

4. A fibrous body according to claim 1 in which the strands are composed of continuous filaments and the average strand has no more than sixty continuous filaments.

5. A fibrous body according to claim 1 in which the courses of the strands of each strip are spaced no more than a fraction of an inch apart.

6. A fibrous body according to claim 5, in which the courses of the strands of each strip are less than one quarter of an inch apart.

7. A fibrous body according to claim 1 in which the strands are untwisted.

8. A fibrous body according to claim 1 in which there are at least six strands in each strip.

9. A fibrous body according to claim 1 in which the fibrous body is in the form of an elongated planar mat.

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