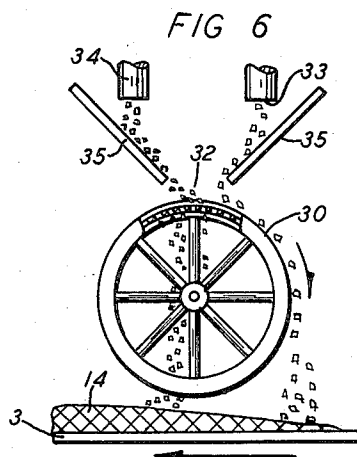
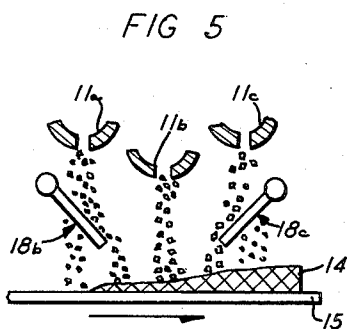
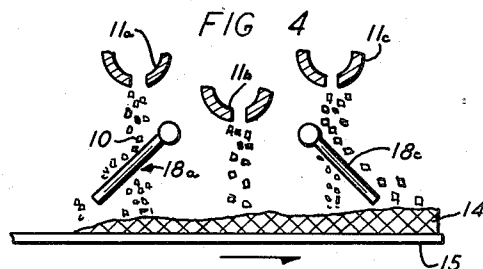
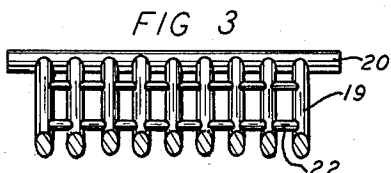
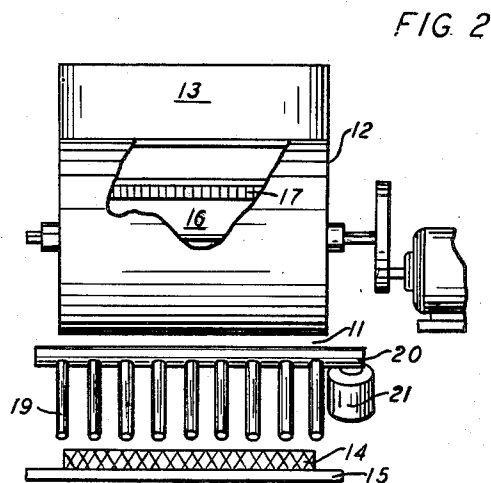
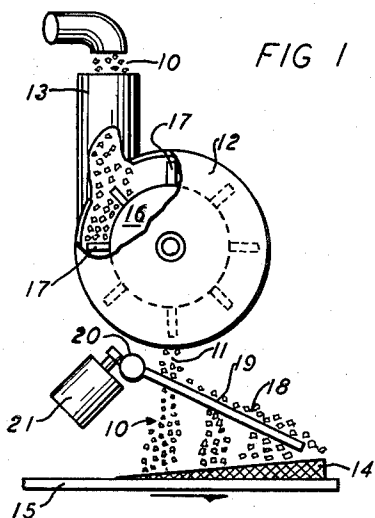


July 1, 1958

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2,840,865
METHOD AND APPARATUS FOR DEPOSITING FIBROUS ELEMENTS
IN THE MANUFACTURE OF FIBROUS STRUCTURES
 Filed Oct. 22, 1954



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METHOD AND APPARATUS FOR DEPOSITING FIBROUS ELEMENTS IN THE MANUFACTURE OF FIBROUS STRUCTURES

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Application October 22, 1954, Serial No. 464,039

12 Claims. (Cl. 19—155)

This invention relates to the manufacture of consolidated structures of fibrous elements such as wafers, chips, slivers and the like, and it relates more particularly to the deposition of fibrous elements to form endless mats which may be divided into sections for consolidation under heat and pressure into hard board panels and the like. As used herein, the term "fibrous elements" is meant to include fibers, wafers and chips produced of woody material and the like. These elements may be present in various shapes such as discs, ovoids, squares, rectangular members, fibrous and other simple shapes and they may be present in various dimensions ranging from individual fibers on up to wafers of substantial dimension, but it is preferred to make use of fibrous elements having less than 5 inches in any length or width to enable use in automatic systems for depositing the fibrous elements as employed in the practice of this invention. The term may include fibrous elements which are severed from wood by cutting parallel to and along the grain and the invention has particular application to the processing of thin flat wafers of the type described in copending applications Ser. Nos. 344,088, now abandoned, 344,089 and 375,152, and now U. S. Patents Nos. 2,773,789 and 2,776,685 respectively, in which wafers of less than 5 inches in length and varying in thickness from 0.002 to 0.065 inch are cut parallel to and across the grain of the wood.

In the manufacture of boards and similar molded structures by a process in which the fibrous elements are felted, either wet or dry, to form a mat, the fibrous elements are usually coated with a suitable binder, preferably in dry powder or particulate form. The fibrous elements are deposited automatically by gravitational means onto a collecting surface moving endlessly in one direction to form a continuous mat, for example as upon caul plates aligned in end to end relation for movement as an endless belt through the fiber depositing zone. In general, the fibrous elements are supplied for issuance in a uniform concentration from orifices situated uniformly across the collecting surface, such as for example by the means described in copending applications Ser. No. 381,448, filed September 21, 1953, and entitled "Method and Apparatus for Deposition of Fibrous Elements in the Manufacture of Fibrous Structures," and Ser. No. 371,055, filed July 29, 1953, now U. S. Patent No. 2,770,844 and entitled "Method and Means for Felting Fibrous Elements." The thickness of the mat of the fibrous elements which is formed upon the surfaces of the caul plates may be varied depending upon the feed rate of the fibrous elements and the linear speed of the collecting surface during passage through the fiber depositing zone.

In the manufacture of laminar structures wherein the character of the fibrous elements may be varied from the outer lamina to the inner cores, manufacture by processes heretofore described can conveniently and efficiently be carried out with a number of such fiber depositing systems arranged in sequence to deposit successive layers of the

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fibrous elements one upon the other to produce the mat for consolidation by molding under heat and pressure. The first and last fiber depositing heads will provide the top and bottom lamina of the structure formed. Unless the structure is to be formed with a face veneer or with a veneer or cover sheet laminated thereto, it is desirable to control the fibrous elements deposited in forming the outer lamina to avoid large variations in the types, in the kind, and in the dimensions of the fibrous elements deposited. In general, it is most desirable, especially from the standpoint of appearance, to form the surface lamina of fibrous elements of large thin wafers having substantially uniform dimension.

When the material forming the surfaces of the composite structures constitutes fibrous elements which are widely varying in dimension, such as in their lengths and widths, many difficulties arise in the steps of processing and such variation in particle size detracts materially from the appearance of the structure. The desire for uniformity in the dimension of the fibrous elements coupled with the desire to make use of thin wafers of substantial dimension has been in conflict with the continuous processes for mass production heretofore employed for handling the fibrous elements in deposition to form mats. Such large thin fibrous wafers are readily split lengthwise along the grain into separate entities of smaller dimension during handling in such continuous operations. Screening to separate the wafers for size during an intermediate stage of the process has been found to be impractical because fractures continue to occur in screening and in the subsequent handling of the fibrous elements. In addition, the separation of the fine or smaller elements from the remainder presents a problem because disposal of the elements would be uneconomical and use therefor requires an increase in the number of fiber depositing heads and in the space required therefor.

In the attempt to minimize breakage or splitting of the fibrous elements, use has been made of fibrous elements cut to thicknesses greater than desired for use in producing smooth flat surfaces on the molded structure. Even then, breakage and splitting occurs so that it has been impractical from a commercial standpoint to deposit fibrous elements to form surface lamina which are substantially free of separated narrow splittings or small particles torn or rubbed from the fibrous elements. Such smaller particles formed of wafers of greater thickness provide surface blemishes especially on the surfaces of the product which are adjacent to the caul plates in molding.

It is an object of this invention to provide a method for handling fibrous elements to effect an efficient separation for size during travel of the fibrous elements immediately in advance of deposition onto the collecting surface to form the mat thereby to eliminate the possibilities of further splittings subsequent to separation.

Another object is to provide apparatus and a method for receiving the fibrous elements in uniform distribution across the width of the surface for forming the mat and for laying the larger or intact fibrous elements in one position and the smaller or separated fibrous elements in another position longitudinally along the collecting surface during its travel thereby to form separated lamina of the large and small elements from the fiber stream.

More specifically, another object is to provide a method for separating a stream of discrete fibrous elements of mixed dimensions into two or more streams containing the elements according to their size and to deposit them in separate lamina to form a mat without recourse to the use of additional fiber depositing heads or apparatus.

A still further object is to produce apparatus and to provide a method for depositing fibrous elements in a continuous, mass production operation to form mats in which the fibrous elements constituting the portion of

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the mat making up the outer surfaces are formed of substantially intact, thin and fragile wafers of substantial dimension.

These and other objects and advantages of this invention will hereinafter appear and for purposes of illustration, but not of limitation, embodiments of the invention are shown in the accompanying drawing in which—

Figure 1 is a schematic elevational view illustrating the arrangement of parts in apparatus embodying the features of this invention;

Figure 2 is an end elevational view of the apparatus shown in Figure 1;

Figure 3 is an elevational view of a modification in one of the elements shown in Figures 1 and 2, embodying features of this invention;

Figure 4 is a diagrammatic elevational view illustrating the arrangement of parts in the manufacture of a mat of fibrous elements in accordance with the practice of this invention;

Figure 5 is an elevational view similar to that of Figure 4 with the elements positioned for modification of the mat that is formed, and

Figure 6 is a schematic elevational view similar to that of Figure 1 showing a modification in the fiber depositing head and the means associated therewith embodying features of this invention for manufacturing a mat.

As previously pointed out, the practice of this invention is applicable chiefly to processes wherein deposition of fibrous elements to form the mat occurs principally by utilization of forces of gravity, such as with a felter head of the type described in copending application Ser. No. 381,448, filed September 21, 1953, and illustrated generally in Figure 1. In the alternative, use may be made of a fiber depositing system of the type described in copending application Ser. No. 371,055, filed July 29, 1953, now U. S. Patent No. 2,770,844, illustrated in part only in Figure 6 of the drawing.

In the fiber depositing head of Figure 1, fibrous elements 10 are introduced at a substantially continuous and uniform rate into the feed inlet 13 of a spherical cylindrical housing 12 having outlet openings 11 forming orifices across the underside thereof from which separated fibrous elements 10 issue in uniform distribution across the cylinder for deposition to form a mat 14 upon a collecting surface in the form of caul plates 15 moving continuously in one direction and in end to end relation through the fiber depositing zone. In the apparatus illustrated schematically in Figure 1, a drum 16 having scrubber blades 17 extending outwardly from the periphery thereof is rotated at a sufficiently high velocity to achieve uniform distribution of the fibers and passage of the fibrous elements in uniform distribution from the openings 11.

In accordance with the practice of this invention, the fibrous elements 10 issuing from the orifices 11 are processed without interference with the flow or distribution thereof for separation of the fibrous elements which are intact or of the desired larger dimension from the smaller elements and concurrently to deposit the separated fibrous elements to form adjacent lamina of the structure that is formed. Such separation at a point which avoids splitting of the fibrous elements subsequent to separation is achieved by means of a rake 18 having a plurality of laterally spaced and elongate prongs 19 extending from a supporting cross arm 20 at an angle with the vertical which is sufficiently great to intercept the stream of fibrous elements prior to their being deposited onto the collecting surface so as to enable deflection of some of the fibrous elements from their normal path of travel but at an angle which is not so great as to interfere with their continuous movement or flow by gravitational force so that some of the fibrous elements may become hung upon the rake.

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The prongs 19 are preferably formed of rods or bars of rigid material having a smooth surface and the prongs are adapted to be spaced one from another by a distance calculated to permit splits and other fibrous elements of smaller dimension to pass freely therethrough whereas elements of larger dimension including intact wafers are intercepted by the prongs for passage downwardly over the inclined surfaces thereof for deposition onto the collecting wall across a portion in longitudinally spaced relation from the area of deposit of the elements which are able to pass through the rake between the prongs 19. It will be apparent that substantially all of the fibrous elements below a certain dimension will find their way through the prongs for deposition onto the collecting wall within an area beneath the rake. It will be apparent also that a substantial portion of the larger and intact wafers which might have been incapable of passage through the prongs if engaged while flat will be able to pass through between the prongs when otherwise arranged so that the first of the plural zones of deposition governed by the rake will contain some of the large as well as most of all the small fibrous elements but that the zone aligned with the ends of the prongs will contain uniform wafers of substantial dimension and that wafers of some small but mostly of large dimension will fall into indefinite zones in between. Instead of relying exclusively on gravitational force to effect the desired separation and movement of fibrous elements over and through the prongs, use may be made of vibrational forces such as by means of a vibrator 21 fixed to the connecting bar 20 or the like out of the path of the prongs or other suitable arrangements as employed in a vibrational conveyor to prevent the fibrous elements from being hung on the rake and to accelerate movement. The vibrational systems may be employed in addition to or in partial substitution for gravitational force and such vibrational means are preferred to be employed in such modifications in the construction of a rake member as illustrated in Figure 3 wherein cross brace members 22 are employed rigidly to engage the prongs 19 in longitudinally spaced apart relation and on the underside thereof for rigidity and support.

As indicated above, the character of the fibrous elements in the surface portion of the mat may selectively be arranged to be formed of the larger or the smaller fibrous elements from the stream of fibers being deposited merely by arranging the angular relationship of the rake to displace the larger elements for deposition in advance of or behind the smaller. When, for example, it is desired to concentrate the smaller or the finer of the fibrous elements to form the face of the mat, the rake member is positioned, as illustrated in Figure 1 of the drawing, to incline the prongs in the direction of movement of the caul plate, as indicated by the arrow. These smaller or finer fibrous elements which are able to filter through between the prongs of the rake deposit on the surfaces of the caul plate while the larger of the fibrous elements separated out onto the surfaces of the prongs of the rake are displaced forwardly for deposition onto the layer of finer elements previously deposited from the stream of material.

When, as illustrated in Figure 4, it is desired to incorporate the larger or intact fibrous elements of larger dimension in the outer faces of the mat adjacent the caul plate, the rake 18^a which intercepts the stream of fibrous elements 10 issuing from the first orifice 11^a may be mounted in the path of the fibrous elements with the prongs extending at a rearward incline. This will displace the larger and intact fibrous elements rearwardly for deposition first onto the surface of the caul plates in advance of the deposition of any of the other fibrous elements thereby to form the outer lamina. The smaller fibrous elements which are able to pass through between the prongs will be deposited onto the lamina of the previously deposited fibrous elements of larger dimension origi-

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nally forming a part of the same fibrous stream. As illustrated in Figures 4 and 5, one or more additional fiber depositing heads 11^b may be subsequently employed to form additional layers of fibrous elements on the previously deposited lamina. Since the fibrous elements forming the intermediate layer or core of the mat are concealed from the surface, separation for dimension is unimportant and such core sections may be formed of rough cut fibers of greater dimension or greater variable in dimension or of different materials such as low cost fibrous elements or elements adapted to introduce specific properties such as lower gravity, softness, insulation characteristics or the like.

In a multiple system of the type described, the top surface of the mat may be formed to embody characteristics similar to that of the bottom by the use of a rake 18^c positioned in the path of the stream issuing from the last of the fiber depositing heads 11^c with the prongs of the rake positioned at a forward incline to permit the smaller of the fibrous elements to fall through between the prongs for deposition onto the previously deposited layers while the larger or intact fibrous elements are displaced forwardly over the prongs for deposition to produce the upper surface lamina of the mat.

In Figure 5, illustration is made of a similar system wherein the outer laminae of the mat are adapted to constitute the fibrous elements of smaller dimension with the larger intact fibrous elements in the adjacent areas in the interior thereof. For this purpose, the rake 18^b below the first orifice 11^a is positioned with the prongs extending in the direction of movement of the collecting surface or caul plates while the rake 18^c lying in the path of the stream of fibrous elements issuing from the last orifice 11^c is positioned with the prongs extending in the reverse direction which is opposite to the direction of movement of the caul plates. Fibrous elements issuing from the orifices 11^b in between may be allowed to fall gravitationally for deposition in uniform distribution to form the core of the mat.

By way of modification, the desired separation for deposition of the intact fibrous elements to form laminae substantially independent of the smaller and broken fibrous elements issuing from the same stream may be achieved also by the use of a foraminous drum 30 positioned between the caul plates 15 and the stream of fibrous elements 11 issuing from orifices in uniform distribution for deposition onto the caul plates. The drum 30 is perforated in its peripheral surface which enables the smaller fibrous elements to fall through the drum onto the caul plates 15 by gravitational force. The larger or intact wafers will be separated out onto the periphery of the drum which carries the fibrous elements forwardly or rearwardly for deposition onto the caul plates in advance of or behind the smaller elements, depending upon the direction of rotation of the drum. When, as illustrated in Figure 6, the drum is rotated slowly in a clockwise direction over a collecting surface traveling continuously in the direction to the left, the larger or intact fibrous elements will be displaced by the drum for deposition onto the collecting surface in advance of the smaller fibrous elements, which fall through the drum, so that the larger or intact fibrous elements will be contained in the surface laminae adjacent the caul plates. If, on the other hand, the drum 30 is rotated in the opposite direction, the smaller fibrous elements falling through the drum will deposit first upon the caul plates in advance of the larger or intact elements displaced from the stream in the direction of movement of the collecting surface.

In Figure 6, illustration is made of the use of a separating drum 30 in communication with a series of orifices 33 at the end of down pipes 34 employed in a fiber depositing system described in copending application Ser. No. 371,055 and now U. S. Patent No. 2,770,844. The plates 35 represent splash plates in communication with the outlet ends of the orifices and which function to

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spread each individual stream of fibrous elements laterally upon emission and thereby to achieve uniform distribution of fibrous elements for deposition on the collecting surface, eliminating grooves or zones of depletion.

It will be understood that the drum system may be used with equal effectiveness in the streams of fibrous elements formed by the apparatus illustrated in Figures 1 to 5 or with any other fibrous stream capable of being intercepted by the drum and that the rakes may similarly be interchanged for the drum in the fiber depositing system shown in Figure 6 or for use with other streams of fibrous elements.

It will be apparent from the foregoing that I have provided a simple and expedient means for processing fibrous elements in a stream for separation of the elements to displace the larger or intact members from the broken down or smaller members for deposition onto a collecting surface and that such means for separation may be achieved without interference with the flow or distribution of the fibers and at a stage in the operation which minimizes the possibility of subsequent breakdown of fibrous elements and without causing excessive breakage thereby to enable the formation of laminae of selected materials. It will be evident further that the concepts embodying features of this invention may be adapted for the continuous operation in mass production of mats of fibrous elements, with or without binder previously applied to the surfaces thereof, for use in the manufacture of consolidated structures in the form of boards and panels and in which the surface lamina of the consolidated members may be selectively formed of thin wafers of substantial dimension to improve the appearance thereof.

It will be understood that various changes may be made in the construction, arrangement and operation without departing from the spirit of the invention, especially as defined in the following claims.

I claim:

1. Apparatus for the deposition of fibrous elements varying in dimension to form a mat in which the fibrous elements of larger dimension are deposited in a layer substantially separated from the layer of fibrous elements of smaller dimension, comprising a collecting surface moving endlessly in a longitudinal direction, means for issuing the fibrous elements in an endless stream in uniform distribution crosswise from an outlet in spaced relation over the collecting surface, and a member extending crosswise of the collecting surface and intercepting the stream of fibrous elements having foramens dimensioned to permit passage therethrough of fibrous elements of smaller dimension for deposition onto the collecting surface while the fibrous elements of larger dimension are displaced longitudinally by the foraminous member for deposition onto the collecting surface longitudinally of the fibrous elements of smaller dimension.

2. Apparatus for the deposition of fibrous elements varying in dimension to form a mat in which the fibrous elements of larger dimension are deposited in a layer substantially separated from the layer of fibrous elements of smaller dimension, comprising a collecting surface moving continuously in a longitudinal direction, means for issuing the fibrous elements in an endless stream in uniform distribution crosswise from an outlet spaced over the collecting surface, and a member extending crosswise of the collecting surface and longitudinally at a downward incline across the path of the stream of fibrous elements having foramens dimensioned to permit passage therethrough of fibrous elements of smaller dimension for deposition onto the collecting surface while fibrous elements of larger dimension are displaced from the stream of fibrous elements over the surface thereof for deposition longitudinally of the fibrous elements of smaller dimension onto the collecting surface.

3. Apparatus for the deposition of fibrous elements in forming a mat as claimed in claim 2 in which the

foraminous member is inclined in the direction opposite the direction of movement of the collecting surface for deposition of the fibrous elements of larger dimension onto the collecting surface to form a layer in advance of the deposition of fibrous elements of smaller dimension passing through the foraminous member.

4. Apparatus for the deposition of fibrous elements in forming a mat as claimed in claim 2 in which the foraminous member is inclined in the direction of movement of the collecting surface for deposition of the fibrous elements of larger dimension to form a layer over the layer of fibrous elements of smaller dimension passing through the foraminous member for deposition in advance on the collecting surface.

5. Apparatus for the deposition of fibrous elements in forming a mat as claimed in claim 2 in which the foraminous member comprises a plurality of interconnected elongate rods extending in closely spaced apart parallel relation through the stream of fibrous elements issuing from the outlet.

6. Apparatus for the deposition of fibrous elements varying in dimension to form a mat in which the fibrous elements of larger dimension are in a layer substantially separated from the layer of fibrous elements of smaller dimension, comprising a collecting surface moving continuously in a longitudinal direction, means for issuing the fibrous elements in an endless stream in uniform distribution crosswise of the collecting surface and from an outlet spaced upwardly therefrom, and a foraminous drum rotatably mounted for movement through the path of the stream of fibrous elements about an axis crosswise of the collecting surface having forams dimensioned to permit passage of fibrous elements of smaller dimension therethrough for deposition onto the collecting surface while fibrous elements of larger dimension are retained on the surface of the drum for displacement longitudinally from the stream for deposition onto the collecting surface.

7. Apparatus for the deposition of fibrous elements in forming a mat as claimed in claim 6 in which the foraminous drum is rotated in a direction whereby the peripheral portion engaged by the stream moves in a direction opposite the direction of movement of the collecting surface to displace the fibrous elements of larger dimension rearwardly to form a layer in advance of the deposition of fibrous elements of smaller dimension passing through the foraminous drum.

8. Apparatus for the deposition of fibrous elements in forming a mat as claimed in claim 6 in which the foraminous drum is rotated in a direction whereby the peripheral portion engaged by the oncoming stream of fibrous elements moves in the direction corresponding to that of the collecting surface whereby the fibrous elements of larger dimension are displaced forwardly from the stream for deposition onto the collecting surface subsequent to the deposition of the fibrous elements of smaller dimension passing through the drum.

9. In the method of forming a felted mat of fibrous elements of variable dimension in which the fibrous elements of smaller dimension form a layer substantially separated from the fibrous elements of larger dimension, the steps of advancing a collecting surface continuously in a longitudinal direction, issuing the fibrous elements in an endless stream from an outlet spaced above the

collecting surface and with the fibrous elements in uniform distribution across the collecting surface; and gravitationally displacing the fibrous elements of larger dimension from the stream in a longitudinal direction thereby to enable deposition of the fibrous elements of larger dimension onto the collecting surface in longitudinally spaced apart relation from the fibrous elements of smaller dimension originally present in the same stream.

10. In the method of forming a felted mat of fibrous elements, the steps of advancing a collecting surface continuously in a longitudinal direction, issuing the fibrous elements in an endless stream from an outlet spaced above the collecting surface and with the fibrous elements in uniform distribution across the collecting surface, intercepting the stream of fibrous elements between the outlet and the collecting surface with a foraminous member having forams dimensioned to permit passage of fibrous elements of smaller dimension therethrough for continued travel by gravitational force to the collecting surface, and displacing the fibrous elements unable to pass through the foraminous member in a longitudinal direction for deposition onto a longitudinally spaced portion of the collecting surface in spaced apart relation to the fibrous elements of smaller dimension passing through the foraminous member.

11. In the gravity deposition of mixed fibrous elements in forming a mat, the steps of issuing the fibrous elements in a continuous stream in uniform distribution across a collecting surface from an outlet spaced above the collecting surface, separating the larger fibrous elements by screening from the smaller in the descending stream to permit the smaller elements in the stream to proceed downwardly for deposition onto the collecting surface, and displacing the larger elements in a longitudinal direction for deposition onto the collecting surface along a zone longitudinally adjacent to that where the smaller elements are deposited whereby the larger and smaller elements are incorporated into the structure as separate laminae.

12. In the manufacture of structures from mixed fibrous material, the steps of sprinkling discrete elements of the material of large and small dimension in admixture from an orifice towards a collecting surface on which a matrix of the structure is to be formed, moving the collecting surface continuously in a longitudinal direction intercepting the larger elements during their passage to the surface, moving them longitudinally from their passage, and simultaneously depositing them with the smaller elements on the collecting surface whereby the larger elements are deposited longitudinally of the simultaneously deposited smaller elements and are therefore concentrated in a separate lamina from that formed by the smaller elements.

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