

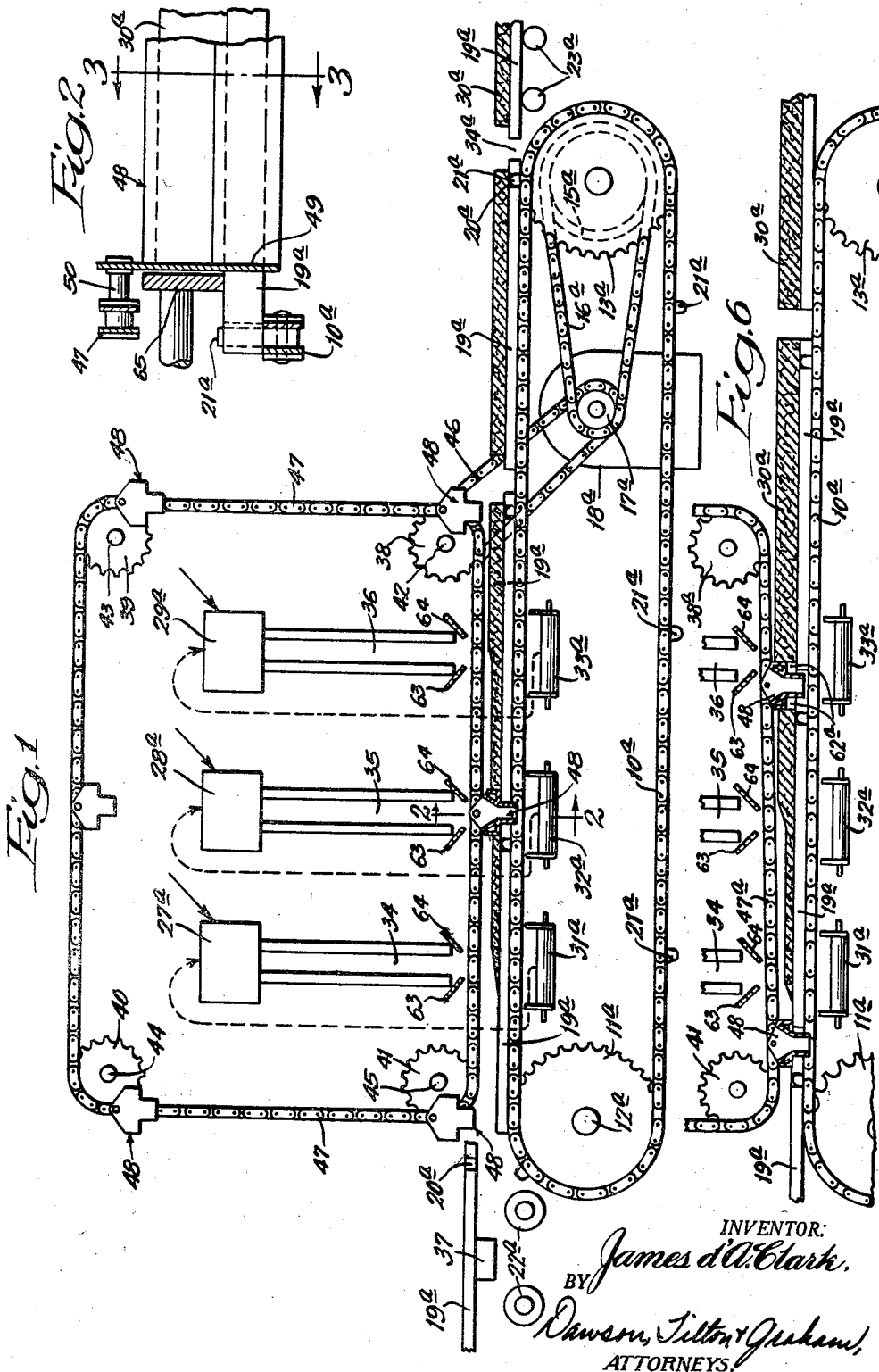
Aug. 5, 1958

J. D'A. CLARK  
METHOD AND APPARATUS FOR DEPOSITING LOOSE  
MATERIALS ON SUPPORT SURFACES

2,845,662

Filed June 13, 1956

2 Sheets-Sheet 1



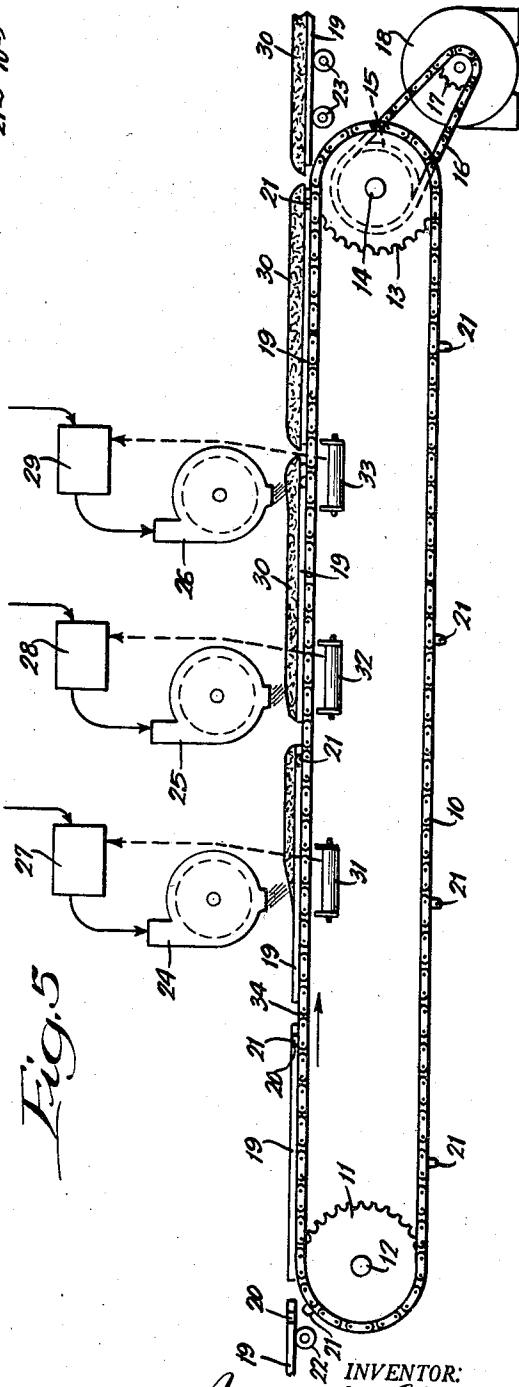
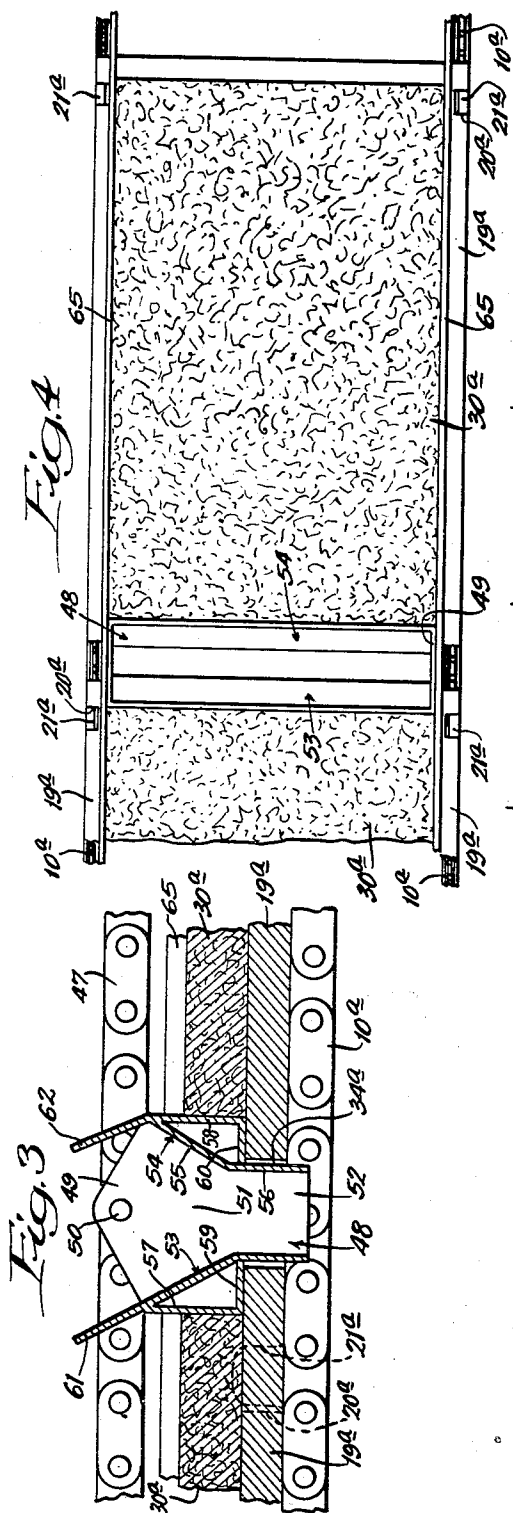
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1

2,845,662

**METHOD AND APPARATUS FOR DEPOSITING  
LOOSE MATERIALS ON SUPPORT SURFACES**

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Application June 13, 1956, Serial No. 591,036

15 Claims. (Cl. 19—155)

This invention relates to a method and apparatus for depositing loose materials on support surfaces, and more especially to a method and means for the preparation of fibrous structures for processing in a system wherein individual fibrous elements are deposited in a continuous fashion upon collecting walls moving with respect thereto. The invention is particularly suited for controlling the location and area of the deposited structures on each of the collecting walls in preparation for subsequent operations, and the invention has utility, for example, in depositing fibrous matrices on caul plates in preparation to having those matrices consolidated into boards in subsequent pressing operations.

This application is a continuation-in-part of my co-pending application, Serial No. 394,022, filed November 24, 1953, which discloses a method and means particularly adapted for use in conjunction with a continuous foraminous collecting wall for receiving elements from pneumatically or gravitationally operated depositing apparatus referred to hereinafter as a "head" or "deposition head." When dealing with the deposition of elements from a gravitational head—that is, without the use of air and thus without the need of a foraminous collecting wall—upon individual receiving surfaces or caul plates, it has been found that certain modifications and improvements in the means disclosed in the aforesaid application are possible, and such modifications and improvements form the subject matter of this invention.

An object of the invention is to provide a simple method and apparatus for producing separated structures, such as mats or preforms of fibrous elements from quantities of fibrous elements which are being continuously deposited upon moving surfaces, with a minimum waste of the fibrous elements from spillage, etc. Another object is to provide a simple method and means for moving a series of caul plates successively beneath one or more depositing heads, and for simultaneously therewith interposing a series of spacing devices between successive caul plates, whereby the ends of fibrous mats deposited by the head onto the caul plates are located in a desired position relative to the ends of the caul plates supporting the fibrous mats thereon.

Another object is that of providing both a method and means of the character described wherein when different materials are deposited from a plurality of separate heads onto caul plates passing successively therebeneath, separation means are interposed between successive caul plates and are operative in association with complementary apparatus to separately collect the different materials and return them to the various heads from which they issued without admixture with elements from the other heads. Yet a further object is to provide a method and apparatus adapted for use in the production of consolidated matrices from loose fibrous matrices in molding operations that are subsequent to the deposition of the loose fibrous matrices on supporting caul plates, and wherein there is no appreciable differential between the thickness and density of the loose

2

fibrous matrices and matrices consolidated therefrom with respect to the end portions of those matrices and the inner areas thereof, whereby after consolidation of the matrices have a predetermined rectangular contour of relatively uniform thickness throughout so that the ends may be trimmed with but a minimum wastage of material.

Yet a further object is in the provision of apparatus generally as described wherein a plurality of spaced apart caul plates are advanced one by one in succession beneath deposition heads wherein loose fibrous materials are deposited thereon, and whereby masking funnels are interposed between adjacent caul plates as they are advanced beneath the deposition heads, and are effective to provide matrices of uniform thickness and density along the end portions of the caul plates, and are also effective to collect the excess material that would spill over from the caul plates, and in connection with return apparatus, deliver such material to the deposition heads for redistribution. Additional objects and advantages will become apparent as the specification develops.

Embodiments of the invention are illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal sectional view taken through the apparatus; Figure 2 is a vertical sectional view taken along the line 2—2 of Figure 1; Figure 3 is a longitudinal sectional view taken along the line 3—3 of Figure 2 but with sides adapted to receive elements from the felting heads shown in Figure 5; Figure 4 is a top plan view of the apparatus; Figure 5 is a longitudinal sectional view of a modified form of the apparatus; and Figure 6 is a broken longitudinal sectional view similar to Figure 1, but showing a slight modification.

In describing the apparatus, reference will first be made to Figure 5 which shows one feature of the invention in its simplest form. Referring then to that figure, it is seen that a pair of endless conveyor chains 10 is entrained at one end about idler sprockets 11 supported for rotation on a shaft 12, and at their other ends are entrained about drive sprockets 13 rotatably supported on a shaft 14. The drive sprockets 13 are equipped with a sprocket wheel 15 having a drive chain 16 entrained thereabout, and which at its opposite end is entrained about a drive sprocket wheel 17 mounted on the end of the shaft of a motor 18. When the motor is energized, the conveyor chain 10 moves from the left to right along the top thereof, as viewed in Figure 5.

Advanced in succession by the chain 10 are collecting walls, receiving surfaces or caul plates 19 which are generally rectangular and are dimensioned so as to be supported adequately by the chain. The caul plates 19 are provided along each side thereof adjacent the forward edge with slots or recesses 20 adapted to receive therein fingers or dogs 21 carried by the conveyor chain 10 along each side thereof and in spaced apart relation. These fingers advance into the slots 20, and upon insertion thereinto pull the caul plates forwardly. As is noted at the left-hand side of Figure 5, caul plates 19 advancing toward the conveyor 10 may be supported on rollers 22. At the discharged end of the conveyor 10, the cauls 19 may be received on support rollers 23.

As the caul plates are advanced by the conveyor chain 10, they pass beneath a plurality of deposition heads 24, 25 and 26 which are supplied, respectively, from supply bins 27 through 29. The heads are adapted to discharge loose materials downwardly and onto the caul plates 19 to form fibrous matrices 30 thereon. The heads 24 through 26 have discharge outlets that extend transversely across the caul plates 19 from edge to edge thereof, and are adapted to deposit fibrous materials downwardly and onto the caul plates, the materials deposited by each head being different or alike, as desired. A more elaborate description of the deposition heads may be obtained

by referring to my copending patent applications, Serial No. 286,716, filed May 8, 1952, now Patent No. 2,748,429, and Serial No. 381,448, filed September 21, 1953.

Beneath the respective heads 24 through 26 and in substantial alignment with the discharge nozzles thereof are collectors or collector conveyors 31 through 33, respectively, which are operative to receive thereon fibrous material that spills over from the caul plates 19, and those collector conveyors are arranged to return such spillage to the storage bins 27 through 29, respectively.

In operation of this apparatus, energization of the motor drives the endless drive chain 16 and the sprocket 13, and therefore the endless conveyor chain 10 entrained thereabout. As the conveyor rotates, the spaced fingers 21 thereof enter the slots 20 of a caul plate 19 positioned adjacent the infeed end of the conveyor, as shown at the left of Figure 5. The fingers then advance such caul plates one-by-one beneath the deposition heads 24 through 26. The spacing between adjacent fingers 21 is slightly greater than the length of the caul plates 19—the lengths thereof being identical—whereby the caul plates are spaced apart as they are advanced beneath the deposition heads, as shown in Figure 5, the spacing between adjacent caul plates being designated by the numeral 34. As the plates are advanced beneath the successive heads, fibrous elements are deposited thereon to build up the loose fibrous matrices 30, and the caul plates with the matrices 30 thereon are discharged from the conveyor 10 and onto the discharge rollers 23.

Since the caul plates are spaced apart, and since the deposition heads 24 through 26 continuously discharge fibrous elements downwardly toward the caul plates and endless conveyor 10, such fibrous elements will move downwardly between adjacent caul plates through the spaces 34 and onto the collector conveyors 31 through 33 positioned therebelow. Those return conveyors or collector conveyors (through means not shown) will return the overflow or spillage to the bins, or perhaps directly to the deposition heads.

In this apparatus, the deposited material or matrices 30 will cover the entire length of the caul plates 19 and ordinarily will drape over the ends thereof. However, if the matrices 30 are relatively thin, the effect of this overhang on the subsequent operations may be negligible, but for best results it is desired to eliminate such overhang and to locate the ends of the matrices 30 inwardly from the ends of the caul plates. Also, in the case of thick matrices 30, as are provided in the formation of consolidated boards, it is desirable to have firm, square ends so that the fibrous elements will not be shaken therefrom during subsequent handling, and so that after a consolidating operation in a molding press, the ends of the consolidated boards formed from the matrices will require but a minimum width of strip to be trimmed therefrom.

In its essentials, the apparatus illustrated in Figures 1 through 4, inclusive, embodies substantially all of the features thus far described, except that the deposition heads 24 through 26 are replaced by heads of the type described in copending application, Serial No. 371,055, filed July 29, 1953, now Patent No. 2,770,844. These heads are designated for identification with the numerals 34, 35 and 36. The other apparatus which has been described hereinbefore will be designated with the same numerals as in the illustration of Figure 5, except that the letter "a" will be added thereto.

The infeed end of the conveyor 10a has a vertically movable arm 37 mounted adjacent thereto which is operative to lift at least the forward end portion of a caul plate 19a upwardly from the rolls 22a to a point wherein the slot 20a of the plate is spaced from the fingers 21 of the conveyor. Thus, so long as the support arm 37 is in elevated position, caul plates supported thereon cannot be advanced by the conveyor. The arm 37 then

provides a means achieving controlled feeding of caul plates to the conveyor 10a. Any suitable means may be provided by raising and lowering the support arm 37 either by manual control or automatically at preselected times.

Disposed above the conveyor 10a are sprockets 38 through 41 rotatably supported, respectively, on shafts 42 through 45. The sprocket 38 is driven by link chain 46 in operative engagement therewith, which at one end is entrained about the sprocket 17a driven by motor 18a. The sprockets 39, 40 and 41 are idlers, and together with driven sprocket 38 are disposed so as to define the corners of a rectangle although that configuration is not essential; and entrained about all of these sprockets are a pair of carrier chains 47 which are spaced apart, one chain being disposed generally along each side of the conveyor 10a, as is seen best perhaps in Figures 2 and 4.

The carrier chains 47 are equipped with masking funnel boxes 48 which are disposed so as to be interposed in the space 34a between adjacent caul plates as those plates are advanced by the conveyor 10a. That is to say, the carrier chains 47 are synchronized with the conveyor chains 10a, since both are driven by the motor 18a through the chain and sprocket drive arrangement described, and the masking funnel boxes 48 are oriented with respect to the lugs or fingers 21a so that the funnel boxes align with and enter the spaces 34a provided between adjacent caul plates because of the spacing between the fingers 21a that, as has been described before, exceeds slightly the length of the caul plates.

The funnel boxes 48, as is seen most clearly in Figures 3 and 4, are provided with end walls 49, and each end wall is secured by pin 50 to one of the respective carrier chains 47. The end walls 49 have a central body portion 51 provided with downwardly converging edges that merge with a restricted neck portion 52 dimensioned so as to be received within the space 34a between caul plates. Extending between the end walls 49 are side walls 53 and 54, respectively, that are designed to conform to the configuration of the end walls 49—therefore, each having a downwardly and inwardly inclined wall portion 55 and a vertical wall portion 56 that provide therebetween a restricted neck. The walls 53 and 54 may be secured to the end walls 49 by any suitable means, such as welding.

The funnel boxes 48 also serve the function of masking the end portions of the caul plates 19a, as is best seen in Figure 3, so that the matrices 30a deposited on the caul plates have a uniform thickness from end to end thereof. To accomplish this function, each of the boxes 48 is provided with generally vertical masking walls 57 and 58 connected, respectively, at their upper ends to the inclined wall portions 55 of the side walls 53 and 54, and with generally horizontal wall portions 59 and 60 which are secured, respectively, to the bottom ends of the vertical masking walls 57 and 58 and to the neck portions 56 of the side walls 53 and 54. The masking walls 57, 58, 59 and 60 are dimensioned so as to be disposed above and along the ends of the caul plates 19a. That is, the horizontal walls 59 and 60 seat on the upper surfaces of successive caul plates 19a, while the vertical masking walls 57 and 58 extend vertically upwardly therefrom to provide an abutment wall for supporting fibrous materials deposited on the caul plates in forming the matrices 30a.

Desirably, the masking walls 57 and 58 or the side walls 53 and 54 are equipped with upwardly oriented extensions 61 and 62 which are effective, if the fibrous elements from the felting heads do not descend substantially vertically, to keep the height and density of the fibrous elements deposited on the caul plates 19a in forming the matrices 30a the same adjacent the ends thereof as in the central areas. Ordinarily, the speed of advancement of the caul plates 19a along the con-

veyor 10a is very low in comparison with the speed of the fibrous elements descending from the deposition heads 34 through 36 so as to assure a uniform deposition of the fibrous material from end to end of the caul plates, the angular extensions 61 and 62 may be parallel to each other and substantially parallel to the direction of the stream of elements issuing from the felting or deposition heads.

If the matrix to be formed has a very substantial thickness, it is generally desirable to elevate the sprocket 38 farther above the surface of the caul plate. Such an arrangement is shown in Figure 6, and it will there be seen that the chain 47a is inclined upwardly between the sprocket 41 and sprocket 38a, whereby the funnels 48 are gradually or progressively withdrawn upwardly from the caul plates and thereby provide the incrementally increasing space 62a. This arrangement, of course, permits the build-up of a very thick matrix without increasing the size of the funnel boxes 48.

Referring now to Figure 1, it is seen that each of the heads 34 through 36, respectively, is provided with a pair of splash plates or guides 63 and 64 which serve to spread and to direct the fibrous elements issuing from the deposition heads in a linear zone across the width of the caul plates. The splash plates or guides 63 and 64 are a part of the deposition heads, and are stationary with respect to the conveyor 10a, carrier chains 47 and collector conveyors 31a through 33a. If reference is made to Figures 2 and 3, it will be noted that deckle boards 65 are provided, one along each side of the conveyor 10a and, more specifically, adjacent the end walls 49 of the funnel boxes 48. The deckle boards or longitudinal guides 65 are stationary and are supported on the framework of the apparatus, and bear lightly upon the upper surfaces of the caul plates 19a to support the fibrous materials deposited thereon so as to assure sharp, uniform longitudinal edges for the matrices 30a. For purposes of simplifying the drawing, the deckle boards or longitudinal guides 65 are not illustrated in Figures 1 and 5.

It is believed that the operation of the apparatus shown in Figures 1 through 4 will be apparent from the description already set forth. The operation may be summarized briefly, however, as follows: Energization of the motor 18a drives the conveyor 10a and support chains 47 in synchronism. The lugs or fingers 21a on the conveyor are spaced apart so as to separate the caul plates 19a that are advanced by the conveyor. When the feed control 37 is lowered to permit the fingers 21a to enter the slots 20a of an awaiting caul plate, the caul plates are advanced by the conveyor successively beneath the felting or deposition heads 34, 35 and 36, each of which continuously discharges fibrous materials downwardly and onto the caul plates passing therebeneath. The felting heads provide a continuous issuance of fibrous materials extending transversely across the caul plates, and that issue of fibrous elements is preferably guided by the splash plates 63 and 64 so as to better define a linear discharge from edge to edge of the caul plates.

The masking funnel boxes 48 are disposed along the carrier chains 47 so as to be positioned in the spaces 34a between adjacent caul plates as the caul plates are moved beneath the deposition heads. Generally, the members 48 define a funnel-shaped channel between the caul plates so that fibrous materials deposited by the deposition heads toward the funnel boxes when those boxes are passed therebeneath, are confined and are guided toward the collector conveyors 31a through 33a which then carry those fibrous elements to the feed bins 27a through 29a. The masking walls of the boxes cause the fibrous elements discharged from the deposition heads to be collected at a uniform thickness on the caul plates adjacent the masking walls, whereby the fibrous matrices 30a have a uniform thickness from end to end thereof. Thus, when those matrices are consolidated into boards in subsequent press-

ing operations, the consolidated boards have a uniform thickness, and only a minimum trimming of the edges is required to provide a finished board product. Therefore, there is but a minimum wastage of material in such trimming operations. Further, little of the fibrous elements are lost through spillage, etc. because all overflow is collected on the transversely extending collector members (conveyors, in the specific illustration) and is returned to the feed bins.

It will be apparent that the apparatus and the method inherent in the operation thereof, both of which have been described, are susceptible to modification and variation within the limits of the inventive concepts set forth. For example, where very thick matrices are consolidated, the felting or fibrous deposition operation may be quite slow, and in such cases there is ample time available for an operator to position the masking funnel boxes by hand between adjacent caul plates. Also, in the event that the space above the felting heads is not sufficiently large to permit the horizontal overhead return passage of the funnel boxes 48, as shown in Figure 1, the return sprockets 39 and 40 may be located laterally of the conveyor 10a instead of directly over it, and the carrier chains 47 curved upwards so as to pass over the laterally disposed return sprockets. This construction is permitted because of the relatively light-weight construction of the boxes 48. It may also be noted that the method and means described may be adapted to the production of fibrous structures having ends that are not straight by shaping the sides and outer walls of the funnel boxes to conform with the end contours desired.

While in the foregoing specification embodiments of the invention, both as to the apparatus and method, have been described in considerable detail for purposes of amply describing the same, it will be apparent that numerous changes may be made in those details without departing from the spirit and principles of the invention.

I claim:

1. In the manufacture of separated laminar matrices upon individual caul plates from fibrous elements deposited thereon from a plurality of depositing heads in sequence, the steps of advancing a series of said caul plates in succession beneath the depositing heads, maintaining a gap of predetermined width between adjacent successive plates, issuing fibrous elements from said depositing heads for collection on said caul plates and recovering those elements that pass through each of said gaps as those gaps move beneath the heads, and returning the elements so recovered to the respective heads from which they issued.

2. In the manufacture of separated laminar matrices upon individual caul plates by consolidation of fibrous elements deposited on the caul plates from a plurality of depositing heads in succession, the steps of advancing a series of caul plates into position with respect to the depositing heads for receiving fibrous elements therefrom, spacing the plates apart to provide a gap therebetween of predetermined width and maintaining such gaps between adjacent plates, defining areas on said caul plates along the gaps therebetween for protection against the deposition of fibrous elements thereon, issuing fibrous elements from said depositing heads and directing those elements falling along the gaps between caul plates into such gaps, collecting the elements that are directed through the gaps, and subsequently returning those collected elements to the depositing heads.

3. The method of depositing relatively dry fibrous elements to make separated preforms of uniform thickness with the fibers in interfelted relationship, which comprises the steps of issuing fibrous elements in a continuous downwardly directed stream, advancing a series of plates through the path of said stream so as to receive and collect fibrous elements thereon, maintaining the series of plates in end-to-end alignment with gaps of predetermined width interposed between adjacent plates, funnel-

ing the elements directed toward said gaps and the end portions of the plates adjacent thereto through the respective gaps between the plates, collecting the elements funneled therethrough, and returning the collected elements to the issuing stream thereof.

4. The method of depositing relatively dry fibrous elements to make separated preforms of uniform thickness with the fibers in interfelted relationship, which comprises the steps of advancing a plurality of caul plates in succession into position for receiving fibrous elements thereon while maintaining successive plates in spaced apart relation to define a gap of predetermined width therebetween, issuing fibrous elements in a continuous stream toward said plates to effectuate a collection of such elements thereon, masking a portion of the upper surfaces of the caul plates adjacent each of said gaps to prevent the deposition of fibrous elements thereon, funneling the fibrous elements directed toward the masked areas into said gaps, collecting the fibrous elements so funneled through said gaps, and unmasking the aforesaid areas after fibrous elements have been deposited on the plates, whereby cleanly-defined end portions of the preforms are provided along the areas so masked.

5. In a method of forming matrices of uniform thickness on caul plates in preparation for consolidation of such matrices in subsequent pressing operations, the steps of advancing a plurality of caul plates in succession into a position for receipt of fibrous elements thereon while maintaining a gap of predetermined width between successive caul plates, issuing a continuous stream of fibrous elements extending across the caul plates for collection on the caul plates and as those caul plates are advanced, masking the end portions of adjacent caul plates along the gaps therebetween to prevent the deposition of fibrous elements thereon, funneling elements directed toward the end portions of adjacent caul plates into the gap therebetween, and collecting those elements for reuse.

6. In apparatus for the deposition of fibrous elements in the forming of separated preforms upon individual caul plates, a felting head, means for advancing a plurality of caul plates in end-to-end relation in succession beneath said felting head and with gaps of predetermined width between adjacent plates, a masking funnel box adapted to be received within the gaps between adjacent caul plates, means for positioning said box within a gap between the plates prior to the advancement of it and of adjacent caul plates beneath said felting head, said box being carried in masking relation with respect to the edge portions of the caul plates bordering the gap and having openings therethrough for funneling fibrous elements through the gap between adjacent plates.

7. The apparatus of claim 6, in which said means for positioning said box within a gap includes support means for the box operative to gradually withdraw the box upwardly from the caul plates as those plates and box are advanced beneath said felting head.

8. The apparatus of claim 6 in which said caul plates are each provided with a notch in a longitudinal edge adjacent the forward end thereof, and in which said means for moving said caul plates comprise a conveyor equipped with spaced apart fingers adapted to enter said notches for pulling the plates forwardly, said fingers being uniformly spaced apart along said conveyor by a distance exceeding the length of the caul plates whereby those plates are spaced apart when advanced by said conveyor.

9. In apparatus of the character described, at least one deposition head adapted to issue fibrous elements in a continuous stream, conveyor means for advancing a plurality of caul plates in succession and in spaced apart relation beneath said deposition head whereby fibrous elements are deposited thereon, means aligned with said deposition head for recovering fibrous elements passing between adjacent caul plates as they are advanced beneath said deposition head, a plurality of masking funnels each dimensioned to be received within the gaps between ad-

jacent successive caul plates while masking the edge portions of the caul plates, bordering such gaps, said masking funnels being operative to prevent the deposition of fibrous elements on the caul plate areas masked thereby and being operative also to funnel fibrous elements directed on those areas through the gaps between the plates, and means for positioning the funnels within said gaps prior to the movement thereof beneath said deposition head and for removing the funnels after passage of the gaps from beneath the deposition head.

10. The apparatus of claim 9 in which the means for advancing the caul plates comprises a conveyor, and in which the means for positioning and removing said funnels comprises carrier chains secured to said funnels and moved in synchronism with the movement of said conveyor.

11. The apparatus of claim 10 in which said conveyor is equipped with spaced apart fingers, and in which each of said caul plates is provided along opposite edges thereof adjacent the forward ends with slots for receiving said fingers therein, said fingers being operative to pull said caul plates beneath said deposition head and the spacing between adjacent fingers being greater than the lengths of said caul plates whereby the caul plates are spaced apart automatically by a gap of predetermined width by the spacing of said fingers.

12. The structure of claim 9 in which said funnels comprise end walls and inclined side walls extending therebetween for funneling fibrous elements between adjacent plates, and masking end walls exterior of the inclined side walls for location along the upper surfaces of caul plates to sharply define the line of element deposition therealong.

13. In masking funnel apparatus adapted for use in systems wherein fibrous elements are deposited in a continuous stream on caul plates to form matrices of uniform thickness thereon, a pair of end walls adapted to be secured to carrier chains and being oriented in spaced apart alignment, corresponding inwardly and downwardly inclined longitudinal wall portions secured to said end walls and extending therebetween, depending longitudinal wall portions secured to said end walls and to said inclined longitudinal wall portions along the lower edge thereof whereby the longitudinal wall portions define funnels, and generally vertical masking wall portions exterior of said inclined wall portions, said masking wall portions being adapted to extend along the upper surfaces of adjacent, spaced apart caul plates to mask the areas enclosed thereby and thus prevent the deposition of fibrous elements thereon.

14. In deposition apparatus of the character described, means for advancing caul plates in succession with each such plate spaced from those adjacent thereto, a plurality of deposition heads spaced apart along the path of movement of said plates for depositing successive layers of material onto the plates as they are advanced therebeneath, carrier chain means extending along the path of movement of said plates, means for supporting said carrier chain means in inclined relation with respect to the path of movement of said plates and diverging therefrom along the line of their advance, and at least one funnel box supported by said carrier chain means and being adapted to be received between adjacent plates as the plates are advanced beneath said deposition heads, said inclined carrier chain means being operative to progressively withdraw said funnel box upwardly from said plates whereby a relatively short funnel box may be used in masking the plates during the deposition of thick matrices thereon.

15. In the manufacture of separated laminar matrices upon individual caul plates from fibrous elements deposited thereon from a depositing head, the steps of advancing series of said caul plates in succession beneath the depositing head, maintaining a gap of predetermined

width between adjacent successive plates, issuing fibrous elements from said depositing head for collection on said caul plates and recovering those elements that pass through each of said gaps as those gaps move beneath the head, and returning the elements so recovered to the depositing head. 5

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