Dec. 17, 1940. M. SKOLNIK 2,225,134

METHOD OF MAKING FIBROUS SHEET MATERIAL

Filed June 19, 1937 2 Sheets-Sheet 1

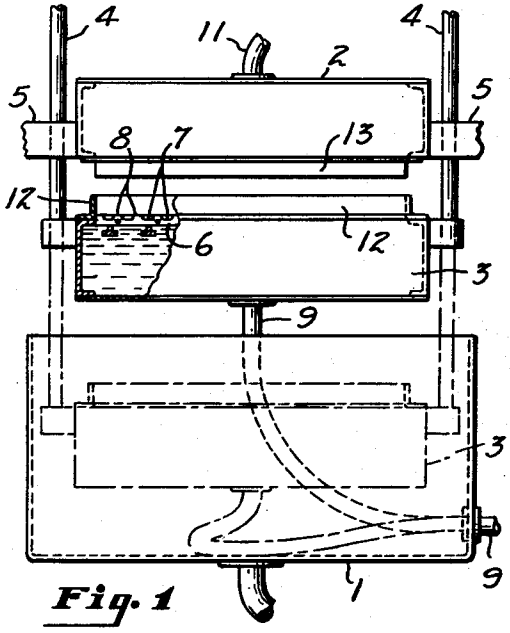


Fig. 1

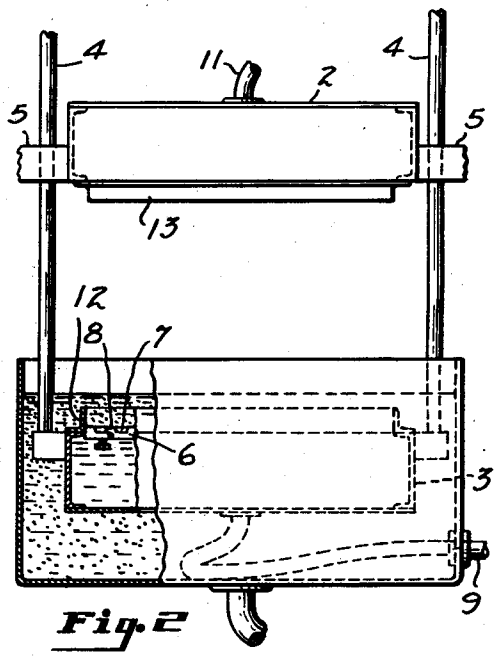


Fig. 2

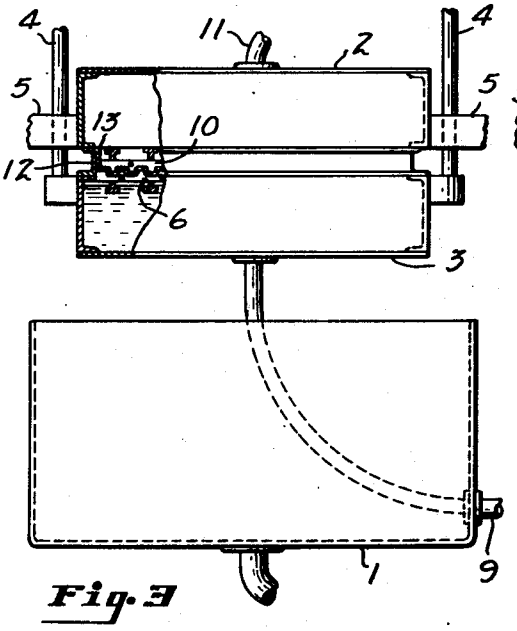


Fig. 3

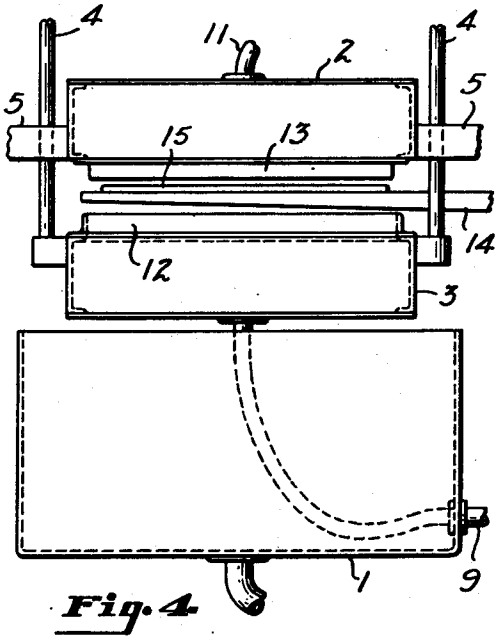


Fig. 4

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METHOD OF MAKING FIBROUS SHEET MATERIAL

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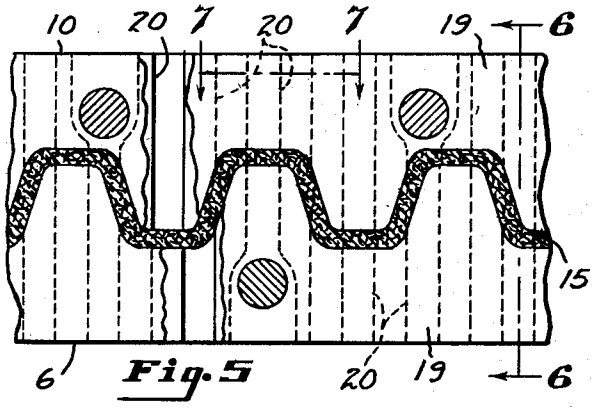


Fig. 5

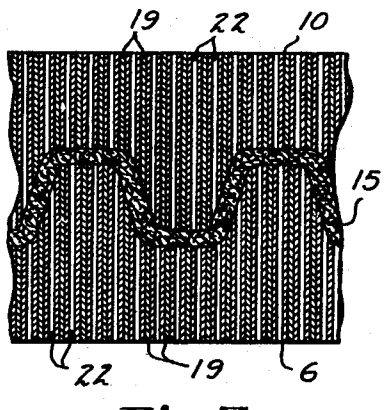


Fig. 6

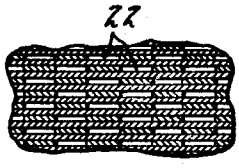


Fig. 7

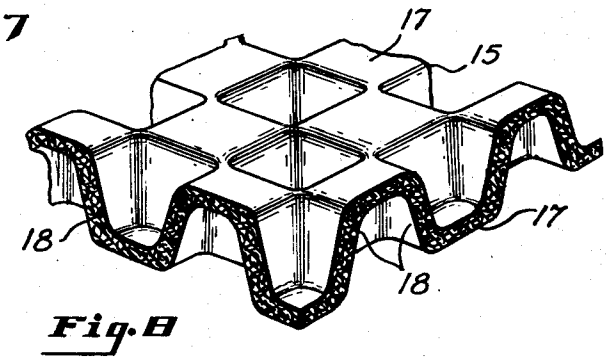


Fig. 8

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METHOD OF MAKING FIBROUS SHEET MATERIAL

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Application June 19, 1937, Serial No. 149,064

9 Claims. (Cl. 92—56)

This invention relates to the manufacture of fibrous sheet material and particularly to the manufacture of molded insulation board from paper pulp.

The method of the present invention is particularly applicable to the manufacture of felted and molded insulation board of the type disclosed in my co-pending application Serial No. 133,227 filed March 26, 1937.

The present invention has for its object to provide a method of making molded fibrous sheet material of the desired configuration which is of substantially uniform thickness and density throughout the entire sheet.

A further object is to provide an improved method of depositing a layer of fibrous material such as paper pulp upon a rigid molding die.

Further objects are to provide a method of forming sheets in which a layer of fibrous material is deposited upon a screen die from a body of liquid containing fibrous material in suspension and in which liquid is expelled from the layer of fibrous material and the material is uniformly compacted by pressure between the screen die upon which the material is deposited and a complemental screen die.

A further object of the invention is to provide a method in which liquid is expelled from the fibrous material during the molding operation in such manner that a uniform, densely compacted sheet of material is formed.

With the above and other objects in view, the invention may be said to comprise the method as illustrated in the accompanying drawings hereinafter described and particularly set forth in the appended claims, together with such variations and modifications thereof as will be apparent to one skilled in the art to which the invention appertains.

Reference should be had to the accompanying drawings forming a part of this specification, in which:

Figure 1 shows a pulp tank, and upper and lower molding dies in the positions which they occupy at the beginning of the sheet forming operation;

Fig. 2 shows the bottom die submerged in the liquid in the pulp tank;

Fig. 3 shows the bottom die in engagement with the upper fixed die;

Fig. 4 shows the dies separated with a transfer member between them upon which is a molded sheet which has been ejected from the upper die;

Fig. 5 is a transverse section through one of the dies;

Fig. 6 is a section taken on the line indicated at 6—6 in Fig. 5;

Fig. 7 is a section taken on the line indicated at 7—7 in Fig. 5;

Fig. 8 is a fragmentary perspective view of the molded sheet material.

The method of the present invention consists first in collecting the fibrous material by trapping a substantially predetermined volume of fibrous material in suspension in a quiescent body of liquid above a screen die and drawing the liquid downwardly through the screen die without creating turbulence in the liquid so as to deposit the fibrous material in a uniform layer upon the upper surface of the screen die, then compressing the layer of wet fibrous material so deposited between the die upon which the layer rests, and the complemental screen die in such manner that liquid is expelled from the fibrous material and the material is uniformly compacted to the configuration of the dies, and then freeing the molded sheet from the dies. The dies are so operated as to separate the molded sheet first from one of the dies and then the other without marring or otherwise injuring the freshly molded sheet.

In the accompanying drawings apparatus is shown which is suitable for practicing the process. Figs. 1 to 4 illustrate successive operations which are performed in practicing the process. As shown in the drawings, a suitable open-top tank 1 is provided which contains a suspension of fibrous material such as paper pulp of a known concentration. The liquid suspension may be supplied to the tank 1 from time to time from a suitable mixing device, not shown, in which the suspension of water and fibrous material of the desired concentration is prepared. The manner in which the suspension is formed is unimportant, in so far as the present invention is concerned, it being understood that a body of liquid is provided in the tank 1 which carries in suspension a predetermined amount of fibrous material per unit volume. Above the tank 1 a molding device is mounted which consists of upper and lower die boxes 2 and 3. The upper die box is stationary and the lower die box is mounted for vertical movement down into the tank and up into engagement with the upper die box. The lower die box may be carried by vertical suspension rods 4 attached to the ends thereof and sliding in suitable guide 5 at the ends of the upper die box 2.

The lower die box 3 has imperforate side and bottom walls and, a short distance below the open top thereof, there is a screen die 6 which is of rigid construction, mounted in fixed position in the box and forming a partition intermediate the top and bottom of the box. The upper surface of the screen is provided with depressions 7 of frusto pyramidal form, which are rectangular in horizontal section and disposed corner to corner in a checkered arrangement to provide a corresponding checkered arrangement of projections 8. A flexible hose 9 is connected to the bottom portion of the die box 3 for draining liquid from the bottom of the box. The upper die box 2 is provided with a rigid screen die 10, the lower face of which has a configuration complemental to that of the lower screen die 6, so that material may be molded between the two dies into the form of a sheet which has a configuration corresponding to that of the dies.

Pipe 11 is connected to the upper die box 2 through which air may be drawn from the upper die box by suction or air under pressure may be admitted to the upper die box. The lower die box 3 has an upper rim portion 12 above the screen die 6 and the upper die box has a rim portion 13 which fits over the rim portion 12 when the lower box is moved up into engagement with the upper die box.

In making the sheet material by the method of the present invention the lower die box 3 is filled with water to substantially the level of the bottom of the screen 6 as shown in Fig. 1. The die box 3 is then lowered into the tank 1 as shown in Fig. 2 until the box is submerged in the liquid in the tank 1 and the portion of the die box 3 above the screen 6 is filled with a suspension of fibrous material. The die box is then raised out of the tank 1 dipping from the tank a predetermined volume of the suspension of fibrous material. As the box 3 is being raised toward the box 2 water is drained from the bottom of the box 3, preferably by applying suction to the hose 9. The withdrawal of liquid from the bottom of the box 3 causes a uniform downward flow of the liquid in the box above the screen, causing the fibrous material to be deposited on the upper surface of the screen die 6. Since a predetermined volume of fibrous material is contained in the liquid dipped from the tank, and since the downward flow of liquid is uniform and without turbulence, the fibrous material is deposited in a uniform layer on the upper surface of the die 6. As the die box 3 comes into engagement with the upper die box 2, the rims 12 and 13 come into telescopic engagement and continued movement causes pressure to be applied to the fibrous material lying upon the die 6. This layer of fibrous material contains considerable water and the layer of fibrous material is sufficiently fluent to be uniformly distributed in the space between the two dies during the molding operation. Suction is maintained on the hose 9 and also on the upper die box through the pipe 11 during the molding operation. When the rim portions 12 and 13 of the die boxes come into telescopic engagement the suction through the screen dies 6 and 10 causes a uniform layer of fibrous material to be drawn up against the surface of the die 10 and a similar layer to be held against the die 6. Upon application of pressure, water is expelled from the layer of fibrous material and the material is formed into a sheet of substantially uniform thickness and density. The suction on the lower box is then released and the die box 3 is lowered to the position shown in Fig. 1. By reason of suction on the upper die the molded sheet sticks to the upper die and is freed from the lower die. A suitable transfer device 14 is then introduced between the upper and lower die and air under pressure is admitted to the upper die box 2 to apply a uniform downward pressure to the molded sheet through the apertures of the upper die, forcing the sheet off the upper die onto the transfer device 14 which is then moved away and carries the sheet 15 with it.

After molding, the sheet 15 may be dried in an oven or by other suitable means and is ready for use as an insulating construction material. The sheet has opposite flat faces each formed by the checkered arrangement of flat rectangular areas 17 which alternate with the depressions. The side walls 18 of the depressions provide closely spaced connecting webs giving the sheet great compressive strength and substantially uniform flexibility along lines extending in any direction. The closely spaced depressions in both sides of the sheet provide air cells uniformly distributed throughout the sheet which greatly increase the effectiveness of the material for insulating purposes.

It is necessary that the screen be constructed with sufficient rigidity to withstand the heavy pressure during the molding operation, and it is desirable that the passages through the die through which the liquid flows be such as to provide uniformity of flow and unidirectional flow so that no turbulence is set up in the liquid above the screen during the draining operation.

As shown in Figs. 5, 6, and 7, the screen may be constructed of parallel sheet metal strips 19 set on edge, extending the full length of the die and spaced apart narrow vertical sheet metal strips 20 of substantially the same thickness as the strips 19. The upper edges of the strips are notched to provide the desired configuration of the upper surface of the die and the strips are held together by bolts passing transversely through the strips 19. Vertical passages 22 are provided throughout the extent of the die between the vertical strips 20 which space the parallel longitudinal strips 19.

It will be apparent that the present invention provides a method of making sheet material of uniform thickness and density by depositing fibrous material in a uniform layer on a die and molding the layer of fibrous material while still containing considerable quantity of water, and that the method provides a means for producing, economically, molded fibrous sheet material of high quality.

Furthermore, it is to be understood that the particular form of product shown and described, and the particular procedure set forth, are presented for purposes of explanation and illustration and that various modifications of said product and procedure can be made without departing from my invention as defined in the appended claims.

What I claim is:

1. The herein described method of making fibrous sheet material which comprises filling a die box which has an open top and a horizontally disposed screen die forming a partition between the top and bottom thereof and having closely spaced depressions with steeply inclined sides with liquid substantially to the underside of the screen die, submerging the die box in a tank

containing a liquid suspension of fibrous material, lifting the box vertically out of the tank while maintaining the same in substantially horizontal position to dip from the tank a substantially predetermined volume of the liquid suspension, imparting a non-turbulent downward flow to the liquid above the screen die in the die box by draining liquid from the portion of the die box below the screen die to cause the fibrous material to settle in a substantially uniform layer upon the screen die, and applying pressure with a complemental die to the layer of fibrous material so formed to expel liquid therefrom and form a molded sheet.

2. The herein described method of making fibrous sheet material which comprises filling a die box which has an open top and a horizontally disposed screen die forming a partition between the top and bottom thereof and having closely spaced depressions with steeply inclined sides with liquid substantially to the underside of the screen die, submerging the die box in a tank containing a liquid suspension of fibrous material, lifting the box vertically out of the tank while maintaining the same in substantially horizontal position to dip from the tank a substantially predetermined volume of the liquid suspension, imparting a non-turbulent downward flow to the liquid above the screen die in the die box by draining liquid from the portion of the die box below the screen die to cause the fibrous material to settle in a substantially uniform layer upon the screen die, applying pressure to the layer of fibrous material on said screen die with an upper screen die, applying suction to said complemental die, and lifting the complemental die while maintaining suction thereon to free the molded sheet from the lower die.

3. The herein described method of making fibrous sheet material which comprises filling a die box which has an open top and a horizontally disposed screen die forming a partition between the top and bottom thereof and having closely spaced depressions with steeply inclined sides with liquid substantially to the underside of the screen die, submerging the die box in a tank containing a liquid suspension of fibrous material, lifting the box vertically out of the tank while maintaining the same in substantially horizontal position to dip from the tank a substantially predetermined volume of the liquid suspension, imparting a non-turbulent downward flow to the liquid above the screen die in the die box by draining liquid from the portion of the die box below the screen die to cause the fibrous material to settle in a substantially uniform layer upon the screen die, applying pressure to the layer of fibrous material on said screen die with an upper screen die, applying suction to both dies immediately prior to and during the initial application of pressure, releasing the suction on the lower die, and lifting the upper die while maintaining suction thereon to free the molded sheet from the lower die.

4. The herein described method of making fibrous sheet material which comprises supplying liquid to a die box which has an open top and a horizontal screen die which forms a partition below the open top of the box to fill said box substantially to the level of said screen die, introducing a substantially predetermined volume of a liquid suspension of fibrous material into the portion of the die box above the screen die, imparting a non-turbulent downward flow to the body of liquid above the screen die by draining liquid from the portion of the die box below the screen die to cause the fibrous material to settle in a substantially uniform layer upon said screen die, and applying pressure to the layer of fibrous material so formed with a complemental screen die to expel liquid therefrom and form a molded sheet.

5. The herein described method of making fibrous sheet material which comprises supplying liquid to a die box which has an open top and a horizontal screen die which forms a partition below the open top of the box to fill said box substantially to the level of said screen die, introducing a substantially predetermined volume of a liquid suspension of fibrous material into the portion of the die box above the screen die, imparting a non-turbulent downward flow to the body of liquid above the screen die by draining liquid from the portion of the die box below the screen die to cause the fibrous material to settle in a substantially uniform layer upon said screen die, applying pressure to the layer of fibrous material so formed with a complemental screen die to expel liquid therefrom and form a molded sheet, applying suction to both dies as the dies approach the pressing position, increasing the air pressure on one of the dies and then separating the dies to free the molded sheet from one of the dies.

6. The herein described method of making fibrous sheet material which comprises supplying liquid to a die box which has an open top and a horizontal screen die forming a partition in the box below the open top thereof to fill the box with liquid substantially to the bottom of the screen die, submerging the box in a tank containing a liquid having fibrous material in suspension therein, moving the die box upwardly out of the liquid in the tank while maintaining the box in horizontal position to dip from the tank a substantially predetermined volume of the fibre containing liquid, imparting a non-turbulent downward flow to the liquid above the screen die in the die box by draining liquid from the portion of the die box below the screen die to cause the fibrous material to settle in a substantially uniform layer upon the screen die, and applying pressure to the layer of fibrous material on the screen die with a complemental screen die to expel liquid therefrom and form a molded sheet.

7. The herein described method of making fibrous sheet material which comprises supplying liquid to a die box which has an open top and a horizontal screen die forming a partition in the box below the open top thereof to fill the box with liquid substantially to the bottom of the screen die, submerging the box in a tank containing a liquid having fibrous material in suspension therein, moving the die box upwardly out of the liquid in the tank while maintaining the box in horizontal position to dip from the tank a substantially predetermined volume of the fibre containing liquid, imparting a non-turbulent downward flow to the liquid above the screen die in the die box by draining liquid from the portion of the die box below the screen die to cause the fibrous material to settle in a substantially uniform layer upon the screen die, applying pressure to the layer of fibrous material on the screen die with a complemental screen die to expel liquid therefrom and form a molded sheet, and applying suction to both dies during the molding operation.

8. The herein described method of making fibrous sheet material which comprises supplying liquid to a die box which has an open top and a horizontal screen die forming a partition in the box below the open top thereof to fill the box with liquid substantially to the bottom of the screen die, submerging the box in a tank containing a liquid having fibrous material in suspension therein, moving the die box upwardly out of the liquid in the tank while maintaining the box in horizontal position to dip from the tank a substantially predetermined volume of the fibre containing liquid, imparting a non-turbulent downward flow to the liquid above the screen die in the die box by draining liquid from the portion of the die box below the screen die to cause the fibrous material to settle in a substantially uniform layer upon the screen die, applying pressure to the layer of fibrous material on the screen die with a complemental screen die to expel liquid therefrom and form a molded sheet, applying suction to both dies during the molding operation, and separating the dies with suction applied to one of the dies only to free the molded sheet from one of the dies.

9. The herein described method of making fibrous sheet material which comprises supplying liquid to a die box which has an open top and a horizontal screen die forming a partition in the box below the open top thereof to fill the box with liquid substantially to the bottom of the screen die, submerging the box in a tank containing a liquid having fibrous material in suspension therein, moving the die box upwardly out of the liquid in the tank while maintaining the box in horizontal position to dip from the tank a substantially predetermined volume of the fibre containing liquid, imparting a non-turbulent downward flow to the liquid above the screen die in the die box by draining liquid from the portion of the die box below the screen die to cause the fibrous material to settle in a substantially uniform layer upon the screen die, applying pressure to the layer of fibrous material on the screen die with a complemental screen die to expel liquid therefrom and form a molded sheet, applying suction to both dies during the molding operation, separating the dies with suction applied to one of the dies only to free the molded sheet from one of the dies, and applying air under pressure to the die in which the sheet is retained to discharge the sheet therefrom.

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