Feb. 13, 1968 G. E. DE LONG 3,368,936

METHOD AND APPARATUS FOR INTRODUCING A FLOCCULATING AGENT TO AN ASBESTOS-CEMENT SLURRY TO CONTROL THE THICKNESS OF THE SHEET USED IN WINDING TO FORM A PIPE

Original Filed April 16, 1964 3 Sheets-Sheet 1

Fig. 1.

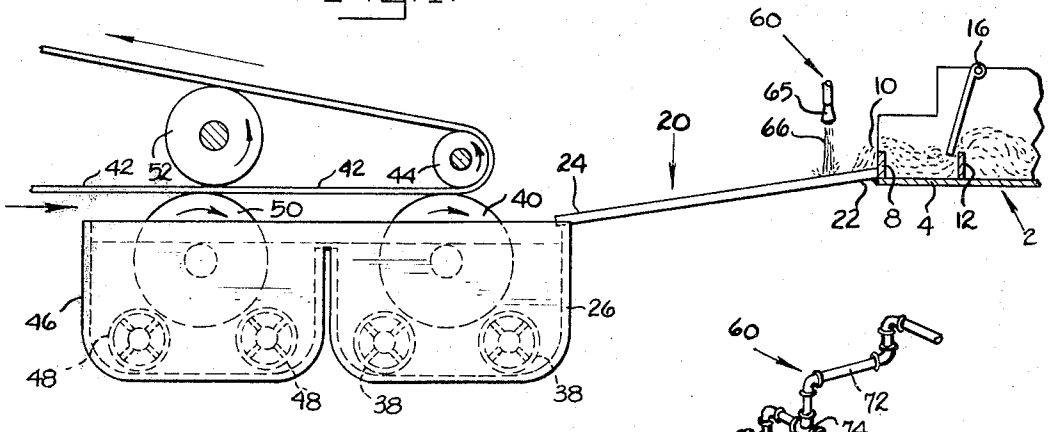
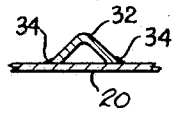


Fig. 3.



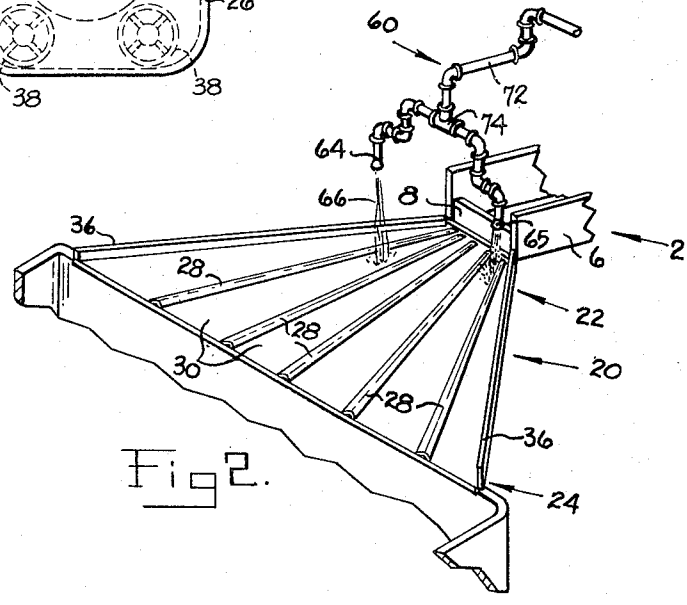


Fig 2.

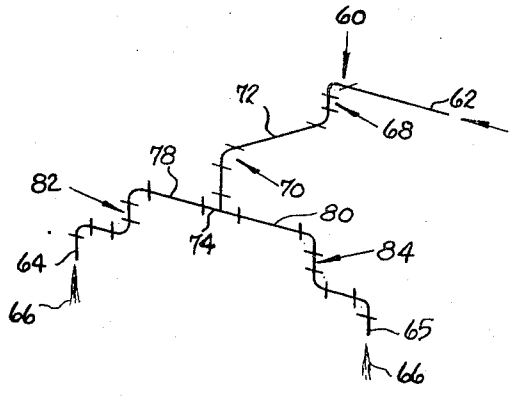


Fig. 4.

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Feb. 13, 1968 G. E. DE LONG 3,368,936

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Original Filed April 16, 1964 3 Sheets-Sheet 2

Fig. 5.

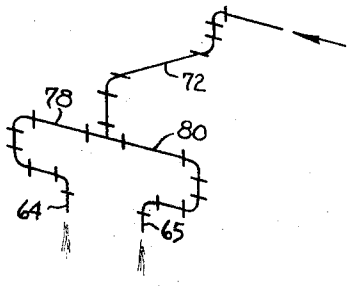


Fig. 6.

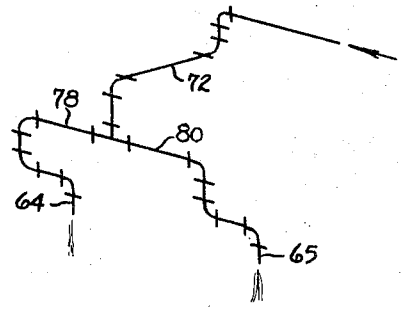


Fig. 7.

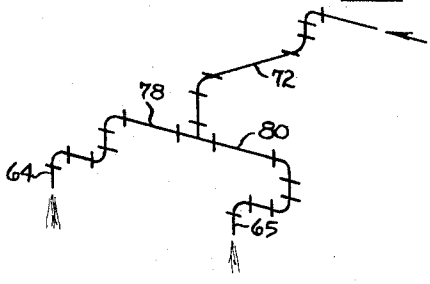


Fig. 8.

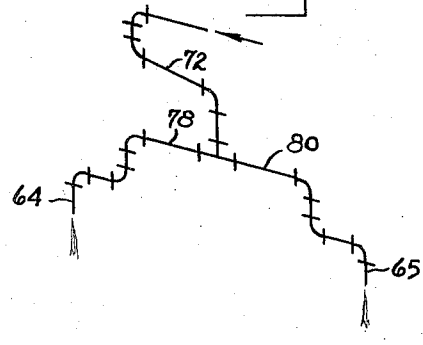
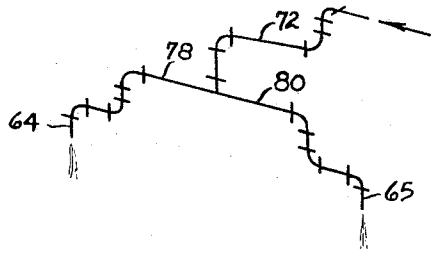


Fig. 9.



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Feb. 13, 1968 G. E. DE LONG 3,368,936

METHOD AND APPARATUS FOR INTRODUCING A FLOCCULATING AGENT TO AN ASBESTOS-CEMENT SLURRY TO CONTROL THE THICKNESS OF THE SHEET USED IN WINDING TO FORM A PIPE

Original Filed April 16, 1964 3 Sheets-Sheet 3

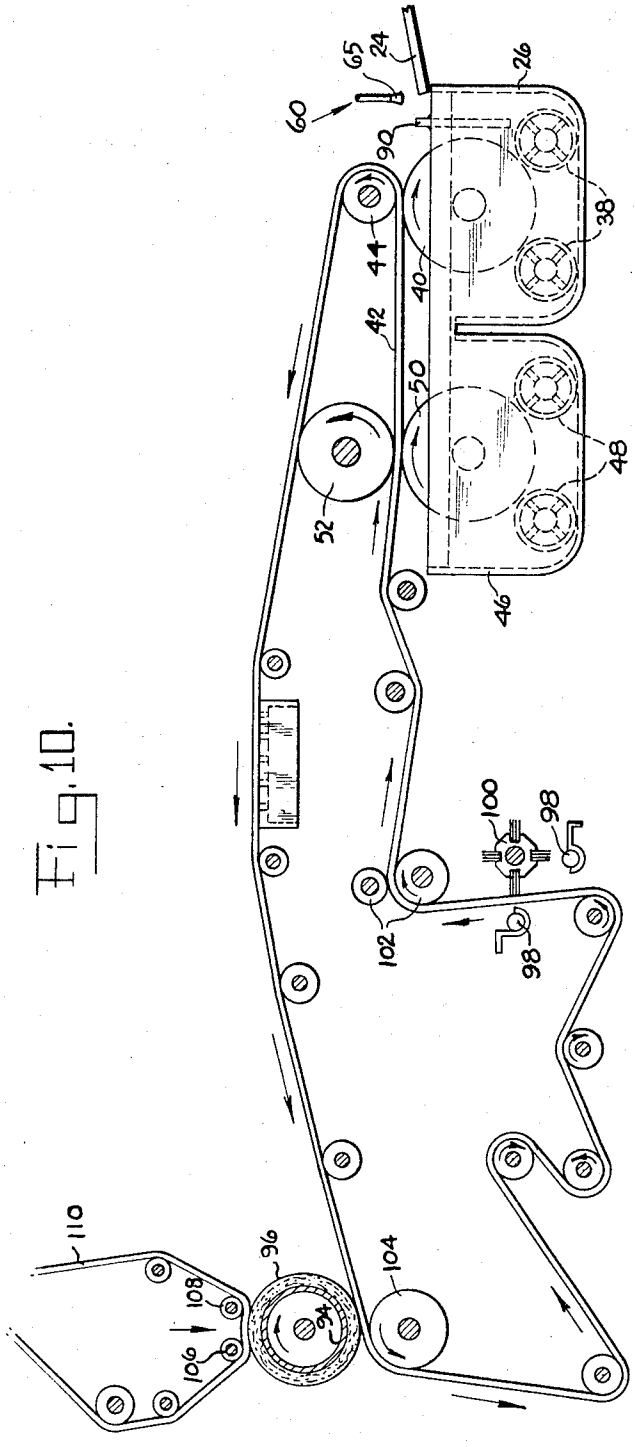


Fig. 10.

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METHOD AND APPARATUS FOR INTRODUCING A FLOCCULATING AGENT TO AN ASBESTOS-CEMENT SLURRY TO CONTROL THE THICKNESS OF THE SHEET USED IN WINDING TO FORM A PIPE

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Continuation of application Ser. No. 360,265, Apr. 16, 1964. This application Mar. 17, 1967, Ser. No. 624,683

8 Claims. (Cl. 162—118)

This application is a continuation of Ser. No. 360,265, filed Apr. 16, 1964, now abandoned.

This invention relates to the manufacture of products from a sheet of particulate material which is formed by the deposition of particulate material from a slurry onto a conveyor and more specifically to the introduction of a flocculating agent into the slurry for controlling the deposition of such particulate material onto the conveyor. In particular, the invention relates to the introduction of a flocculating agent into an asbestos-cement slurry from which asbestos-cement pipe is formed.

In the formation of asbestos-cement products, especially asbestos-cement pipe wherein a sheet of asbestos-cement stock carried by an endless conveyor is wrapped around a mandrel, there are many problems associated with maintaining the desired thickness of stock across the width of the conveyor so that asbestos-cement pipe of desired wall thicknesses and profile will be formed. If it is desired to build a laminate of substantially even thickness throughout its axial length on the mandrel, it might happen that for some reason or other associated with the manufacturing process more asbestos-cement stock is being consistently deposited on one side of the endless conveyor so as to build up one side of the laminate on the mandrel to a thickness greater than the thickness of the laminate on the other side of the mandrel. Also in some instances, such as where better flex strength is desired, it is desirable to form a laminate on the mandrel wherein a thicker portion of the laminate occurs at approximately the middle section of the mandrel. Many attempts have been made in the past to control the thickness of the laminate during its formation on the mandrel by regulating the flow of slurry over the flow pan prior to its entry into the mixing vat. Such devices as movable dams, separate feedings of the slurry, oscillating fans, all function to produce some control of the formation of the laminate on the mandrel. However, past experience has proven that even with such devices, the constant formation of the desired wall thickness on the mandrel was extremely difficult or not at all possible to attain.

It is an object of the instant invention to provide method and apparatus for controlling the deposition of particulate material from a slurry onto a conveyor so that the sheet of such deposited particulate material on the conveyor will be of the desired thickness across the width thereof.

It is a further object of the instant invention to provide method and apparatus for the dispersing of a flocculating agent into an asbestos-cement slurry so as to control the deposition of asbestos-cement stock from such slurry on a conveyor so that the lamination of such asbestos-cement stock on a mandrel will be of the desired thickness from one end to the other end thereof.

The foregoing objects are accomplished in accordance with the instant invention by method and apparatus wherein a flocculating agent is dispersed or deposited into a slurry prior to the deposition of particulate material from such slurry onto a conveyor. In the preferred embodiment of the invention, the flocculating agent is introduced into an asbestos-cement slurry as it is flowing over the

flow pan to be deposited into the mixing vat of a conventional asbestos-cement pipe forming machine. In the preferred embodiment of the invention, the flow pan is provided with a plurality of baffles so as to provide the surface of the flow pan with a plurality of channels which diverge from the mouth portion of the flow pan which is adjacent the trough to the exit portion of the flow pan adjacent the mixing vat. Apparatus, which in the preferred embodiment of the invention comprises a plurality of swivelly mounted nozzles, is utilized to disperse a flocculating agent, such as one of the types described in Sfiscko et al., U.S. Patent No. 3,095,346, into the asbestos-cement slurry as it passes over the flow pan. The flocculating agent is dispersed into the flow pan so that a major portion of the flocculating agent is deposited into that section of the mixing vat where the increase in thickness of the laminate on the conveyor is most desired. Thus, if it is desired to have the thickness of the middle section of the laminate on the conveyor increased, the apparatus would be positioned so that the major portion of the flocculating agent is dispersed into those channels adjacent the central portion of the flow pan.

The invention will be more fully understood and further objects and advantages thereof will become apparent when reference is made to the following detail description of a preferred embodiment of the invention and the accompanying drawings in which:

FIG. 1 is a side elevation of apparatus, schematically illustrated, made in accordance with the instant invention;

FIG. 2 is a pictorial representation of a flow pan and dispersing system as illustrated in FIG. 1;

FIG. 3 is an end view of part of the flow pan; and

FIGS. 4 through 9 are pictorial representations of the flocculating agent dispersing system in various positions; and

FIG. 10 is a schematic illustration of another form of the invention.

Referring to the drawings and in particular to FIG. 1, there is illustrated a portion of the apparatus used to manufacture asbestos-cement pipe for laminating a plurality of layers of asbestos-cement stock on a mandrel. The general system for this type of asbestos-cement manufacture is described in U.S. Patent No. 2,182,353 to Rembert. In FIG. 1, there is illustrated that portion of the Rembert pipe machine comprising a trough **2** having the base **4** and a pair of side walls **6**. At one end the trough **2** is provided with a baffle **8** which extends across the trough **2** and over which an aqueous slurry **10** flows. In the preferred embodiment of the invention the aqueous slurry **10** comprises asbestos, cement and appropriate filler material such as silica mixed with a sufficient quantity of water to form a slurry of predetermined viscosity. Spaced a short distance from the baffle **8** but extending generally parallel thereto and across the full width of trough **2** between the walls **6** is a gate valve comprising a lower element **12** above which the gate **14** is positioned. The gate **14** is pivotally mounted at **16** and may be secured at desired locations so as to vary the opening **18** between the top of the element **12** and the bottom of the gate **14** so as to control the amount of slurry flowing through the trough **2** and over the baffle **8**.

A flow pan **20** has one end **22** thereof in contact with the bottom of baffle **8** and the other end **24** thereof positioned over the back vat **26**. The flow pan **20** diverges in a direction from the end **22** to the end **24** and is positioned so that end **22** is higher than the end **24** to provide a gravity feed. In the preferred embodiment of the invention, the angle of divergence is such that the width of the end **24** in a direction perpendicular to the flow of material over the flow pan **20** is about seven times greater than the corresponding width of the end **22**. The upper surface of the flow pan **20** is provided with a plurality of baffles

28 which form channels 30 which diverge in proportions corresponding to the divergence of the flow pan 20. In the preferred embodiment of the invention, as illustrated in FIG. 3, each baffle 28 comprises an inverted angle section 32 secured by the welds 34 to the flow pan 20. The flow pan 20 is also provided with edges 36 which extend upwardly from the flow pan a distance greater than a height of the angle sections 32 and which cooperate to hold the slurry in proper position as it flows over the flow pan 20.

The slurry 10 flows over the end 24 of the flow pan 20 into the back vat 26. In the bottom of the vat 26, there are agitators 38 for maintaining the solid particles in suspension. A cylinder mold 40 is mounted for rotation in the back vat 26 and the aqueous slurry passing through a facing wire on the cylinder mold deposits a thin sheet of solid material, which as stated above in the preferred embodiment of the invention comprises asbestos and cement, on the surface of the wire. This thin sheet is continuously transferred from the cylinder mold to an endless belt 42 which contacts the cylinder mold 40 as it passes between the cylinder mold and couch roll 44. Adjacent to the back vat 26 is the front vat 46 having two agitators 48 therein for maintaining the solid particles in suspension. A cylinder mold 50 is mounted for rotation in the front vat 46 and the aqueous slurry passing through a facing wire on the cylinder mold 50 deposits a thin sheet of solid material on the surface of the wire. This thin sheet is continuously transferred from the cylinder mold to the endless belt 42 which contacts the cylinder mold 50 as it passes between the cylinder mold and couch roll 52. As is readily apparent from FIG. 1, the sheet of asbestos-cement stock which is carried by the endless belt 42 and from which the asbestos-cement product is formed comprises the composite laminate formed by the thin sheets of asbestos-cement deposited on the belt 42 by the cylinder molds 50 and 40.

The mechanism which disperses the flocculating agent, as illustrated in the drawing, comprises a piping system 60 which is connected at one end 62 with a pump (not shown) which feeds the flocculating agent to the piping system and at its other end with a plurality of nozzles 64 and 65 through which the flocculating agent 66 flows to be deposited in the asbestos-cement slurry as it flows over the surface of the flow pan 20. The first section of the piping system 60 comprises a pair of swivel joints 68 and 70 joined by a pipe 72 which is generally maintained substantially parallel to the upper surface of the flow pan 20. The swivel joints 68 and 70 are of a nature that they may be turned through 180° for a purpose to be described. After the swivel joint 70, the piping system 60 is provided with a T 74 which divides the flow of the flocculating agent through the first section of the pipe system into two parts so that one part flows through the pipe 78 and the other part flows through the pipe 80. Between the pipe 78 and the nozzle 64, there is provided a swivel joint 82 and between the pipe 80 and the nozzle 65 there is provided a swivel joint 84. The pipes 78 and 80 are generally maintained substantially parallel to the surface of the flow pan 20 and substantially perpendicular to the direction of the flow of the slurry over the flow pan 20. The swivel joints 82 and 84 are of a nature that they may be rotated through 360° for a purpose to be described.

As illustrated in FIG. 1, the piping system 60 is positioned so that the nozzles 64 and 65 will disperse the flocculating agent onto the flow pan 20 at the location near the baffle 8. This section is sometimes referred to as the mouth of the flow pan. In forming asbestos-cement products utilizing the apparatus illustrated in the drawings, an aqueous slurry comprising asbestos, cement, and suitable fillers including silica is formed in the trough 2 in such a manner that the slurry flows over the element 12 through gate valve 14 formed by the gate 14 and the element 12 in an amount governed by the position of the gate 14. The slurry then flows over the baffle 8 and onto the end 22 of the flow pan 20. The amount of the slurry provided to the baffle 8 is sufficient to insure that a substantially even flow of the slurry across the width of the baffle 8 is obtained. As the slurry is deposited onto the flow pan 20, it is divided into predetermined portions by the baffles 28 so as to flow over the flow pan 20 in the channels 30 and into the back vat 26.

In the manufacture of asbestos-cement pipe, a considerable decrease in formation time can be obtained by including in the slurry flocculating agents such as those described and illustrated in Sfiscko et al., supra. In the commercial utilization of the process described in Sfiscko et al., it has been a general practice to include the flocculating agent by adding it to the water immediately prior to the introduction of the dry mixed materials such as asbestos, cement and fillers. In accordance with the discovery of the instant invention, significant results in controlling the wall thickness of asbestos-cement pipe made by a pipe forming process such as illustrated in Rembert, supra, may be obtained by the addition of the flocculating agent at predetermined positions on the surface of the flow pan and then controlling the movement of the slurry prior to its deposition into the mixing vat. In accordance with the invention, the system for introducing the flocculating agent in amounts as set forth in Sfiscko et al., comprises the piping system 60 through which the flocculating agent flows so as to be deposited into the slurry on the surface of the flow pan 20 by the nozzles 64 and 65. The exact position where the flocculating agent is dispersed into the slurry on the surface of the flow pan 20 is governed by suitably manipulating the pipes 72, 78, and 80 and the nozzles 64 and 65 through the swivel joints 68, 70, 82, and 84. Various locations of these elements are illustrated in FIGS. 4–9, inclusive, of the drawings. It is noted that the swivel joints 68 and 72 function so that pipes 78 and 80 may be moved from one side of the flow pan 20 to the other side thereof and still remain substantially perpendicular to the direction of the flow of the slurry over the flow pan 20. The swivels 82 and 84 allow the nozzles 64 and 65 to be rotated as desired so that they may be properly positioned at desired locations over the flow pan.

By diverting or adjusting the point of introduction of the flocculating agent into the slurry, it is possible to correct any undesirable characteristics in the wall thickness of the pipe as it is being formed on the mandrel from the asbestos-cement stock carried by the endless belt in the pipe forming process. In addition to being able to correct for the variations in wall thickness during the formation of asbestos-cement pipe due to the peculiar characteristics of the pipe forming process itself, the instant invention makes it possible to provide a predetermined control for governing the formation of a desired wall thickness in particular sections of the laminate on the mandrel. Thus, in the manufacture of small diameter pipe where it is generally desirable to increase the flex strength of the pipe, the flocculating agent dispersing system is adjusted so that the flocculating agent is deposited adjacent the central portion of the flow pan, such as illustrated in FIG. 5, so as to manufacture pipe having a greater thickness in the center thereof as compared to the ends thereof. This provides the pipe with greater flex strength without completely jeopardizing its hydro strength. On a large diameter pipe where hydro strength is a more essential factor in the control and acceptance of the pipe, the piping system 60 is adjusted to provide for maximum hydro strength. This is achieved by an almost perfect lamination, in so far as thickness is concerned, from end to end of the pipe. This uniformity of thickness is generally obtained by adjusting the nozzles 64 and 65 so that they disperse the flocculating agent onto the surface of the flow pan 20 at distances equally spaced from the sides 36 of the flow pan 20, as illustrated in FIGS. 2 and 4. However, if for some unknown reason the pipe is formed with

a greater thickness near one end thereof, this may be corrected by moving the piping system to one side or the other such as illustrated in FIGS. 8 and 9. In other instances control of the wall thickness of the pipe may be obtained by movement of the nozzles **64** and **65** through the swivel joints **82** and **84** as illustrated in FIGS. 6 and 7.

In the form of the invention illustrated in FIG. 10, the flocculating agent is introduced into the mixing vat **26** at the approximate location where the slurry flows into the vat **26** from the flow pan **20**. As noted in FIG. 10, the flocculating agent dispersing system **60** is located directly above the section of the mixing vat **26** adjacent the end of the flow pan **20**. It is understood that other flocculating agent dispersing systems, such as a plurality of individually controlled nozzles located across the full width of the mixing vat, adjacent the section where the slurry enters the vat, could be substituted for the flocculating agent dispersing system **60**. The apparatus illustrated in FIG. 10 is generally similar to that apparatus illustrated in FIG. 1 and corresponding parts have been similarly numbered. Also, the remaining portions of the pipe forming machine as disclosed in Rembert, supra, have been illustrated in FIG. 10.

The mixing vat **26** in FIG. 10 has been provided with a baffle **90** so that the slurry as it is deposited into the vat **26** must move downwardly and be acted on by the agitator **38** prior to its entering the main body of the vat **26** where the asbestos-cement material in the slurry is deposited on the cylinder mold **40**. The dispersing system **60** is positioned so that it may disperse the flocculating agent into that portion of the vat **26** between the baffle **90** and the wall of the vat **26** in contact with the end 24 of the flow pan **20**. It is understood that the operation of the dispersing system **60** is similar to the operation described relative to FIG. 1. It is also to be noted that the flocculating agent dispersing system **60** of FIG. 10 may be moved to positions over the vat **26**, similar to the positions illustrated in FIGS. 4–9, inclusive, to control by the dispersion of the flocculating agent at selected locations the deposition of the particulate asbestos-cement material in the slurry in the vat onto the cylinder molds **40** and **50** and the conveyor belt **42**.

As illustrated in FIG. 10, the sheet of particulate asbestos-cement material on the belt **42** passes continuously over a suction box **92** through which a large portion of the water in the sheet is removed and then moves to the press section of the machine. Here the sheet is transferred from the belt **42** to the forming mandrel **94**. The sheet from the belt is spirally wrapped and composited under pressure to form the tube **96**. The belt after transferring the sheet to the mandrel **94** returns to the cylinder molds **40** and **50** after passing under the several tension and guide rollers and through the washers **98** and beater **100** and between the wringer rolls **102** where the belt again picks up a thin sheet of asbestos-cement material.

The press section of the machine includes a heavy bottom anvil roll **104** on which the forming mandrel rests during the formation of the tube **96**. Acting upon the tube are two smaller press rolls **106** and **108** which are rotatably mounted on a frame (not shown) that is forced downwardly by hydraulic pressure. These rolls are permitted to rise as the thickness of the tube increases, the pressure of the rolls being controlled by means of an automatic relief valve on the hydraulic medium. An endless belt **110** travels around the two press rolls **106–108** and loops over a sufficient number of guide and tension rolls to permit satisfactory manipulating and intermittent cleaning thereof.

The foregoing explanation of the preferred embodiment of the invention has been directed primarily to the manufacture of asbestos-cement pipe. However, it is to be understood that the inventive concepts of the instant application are equally applicable to systems for the manufacture of other asbestos-cement products such as sheets and board. Also, it is to be understood that the inventive concepts are readily applicable to any type of manufacture where a flocculating agent is utilized to aid in the deposition of particulate material from a slurry onto a conveyor such as in the manufacture of asbestos or cellulosic paper. Also, although reference has been made to the particular flocculating agent disclosed in Sfiscko et al., supra, because of the unique properties associated with these flocculating agents and asbestos-cement, it is to be understood that the inventive concepts of the instant application are equally applicable with any type of flocculating agent.

While the invention has been described in rather full detail, it will be understood that these details need not be strictly adhered to and that various changes and modifications may suggest themselves to one skilled in the art, all falling within the scope of the invention as defined by the subjoined claims.

What I claim is:

1. The method of controlling the thickness of a sheet of particulate material on a conveyor across the width of said conveyor comprising:

(a) containing a slurry of particulate material in a vat,

(b) depositing portions of said particulate material from said slurry and forming on a conveyor a sheet of said particulate material across the width of said conveyor wherein said conveyor has a width extending in the same direction as the width of said vat,

(c) introducing an agent into said slurry at spaced locations across the width of said vat to control the rate of deposition of said particulate material from said vat onto said conveyor, and

(d) adjusting the space between said spaced locations where said agent is being introduced to control the rate of deposition of said particulate material from said slurry across the width of said vat and the thickness of said sheet across the width of said conveyor.

2. The method of controlling the thickness of a sheet of particulate material on a conveyor across the width of said conveyor comprising:

(a) containing a slurry of particulate material in a vat,

(b) depositing portions of said particulate material from said slurry and forming on a conveyor a sheet of said particulate material across the width of said conveyor wherein said conveyor has a width extending in the same direction as the width of said vat,

(c) maintaining the level of said slurry in said vat by flowing streams of slurry into said vat at spaced locations across the width of said vat, and

(d) introducing an agent into some of said streams of slurry to control the rate of deposition of said particulate material from said slurry across the width of said vat and the thickness of said sheet across the width of said conveyor.

3. The method as defined in claim **2** wherein said agent comprises:

(a) a flocculating agent.

4. In a method of producing asbestos-cement pipe having good strength properties by:

(a) feeding a slurry comprising water and particulate material comprising asbestos and cement into a vat containing a rotary cylinder mold, said rotary cylinder mold having a width extending in the same direction as the width of said vat,

(b) depositing portions of said particulate material from said slurry onto said rotary cylinder mold and transferring said deposited particulate material onto a conveyor to form a continuous sheet of asbestos-cement thereon,

(c) introducing an agent into said slurry to control the rate of deposition of said particulate material onto said rotary cylinder mold across the width of said cylinder mold,

(d) winding said continuous sheet around a mandrel to form a plurality of superposed layers of said sheet on said mandrel and applying compressive force to said superposed layers to consolidate them into a handleable and principally uncured tubular asbestos-cement article,

(e) removing said tubular asbestos-cement article from said mandrel, and

(f) curing said tubular asbestos-cement article to form a cured asbestos-cement pipe having good strength properties, the improvement comprising:

(g) introducing said agent of step (c) into said slurry at spaced locations across the width of said vat, and

(h) adjusting the space between said spaced locations where said agent is being introduced to control the rate of deposition of said particulate material from said slurry across the width of said cylinder mold and the thickness of said sheet across the width of said cylinder mold.

5. Apparatus for controlling the thickness of a sheet of particulate material across the width thereof wherein said sheet is formed on a conveyor from a slurry of said particulate material comprising:

(a) a vat containing a slurry of particulate material,

(b) means for depositing portions of said particulate material from said slurry and forming on a conveyor a sheet of said particulate material across the width of said conveyor,

(c) said conveyor having a width extending in the same directions as the width of said vat,

(d) means for controlling the rate of deposition of said particulate material from said slurry including the addition of an agent to said slurry at spaced locations across the width of said vat, and

(e) means for adjusting the space between said spaced locations where said agent is being introduced to control the rate of deposition of said particulate material from said slurry across the width of said vat and the thickness of said sheet across the width of said conveyor.

6. Apparatus for controlling the thickness of a sheet of particulate material across the width thereof wherein said sheet is formed from a slurry of said particulate material comprising:

(a) a vat containing a slurry of particulate material,

(b) means for depositing portions of said particulate material across the width of said conveyor,

(c) said conveyor having a width extending in the same direction as the width of said vat,

(d) means for feeding a plurality of separate streams of slurry into said vat at spaced locations across the width of said vat to maintain the level of said slurry in said vat,

(e) means for introducing an agent into some of said streams of slurry to control the rate of deposition of said particulate material onto said conveyor, and

(f) means for adjusting the means in subparagraph (e) to select the streams into which said agent is introduced to control the rate of deposition of said particulate material from said slurry across the width of said vat and the thickness of said sheet across the width of said conveyor.

7. Apparatus as defined in claim **6** wherein said means for feeding a plurality of streams of slurry into said vat comprises:

(a) a flow pan having a length and width and a surface over which said slurry may flow,

(b) means for dividing said surface of said flow pan into a plurality of separate channels,

(c) means for depositing said slurry onto the surface of said flow pan so that said slurry is divided into portions with each portion moving as a stream through one of said channels, and

(d) means mounting said flow pan adjacent said vat so that said streams of slurry flow into said vat across the width of said vat.

8. Apparatus as defined in claim **5**, in which the means defined in sub-section (b) comprise:

(a) rotatable cylinder mold in said vat for collecting portions of said particulate material from said slurry,

(b) said cylinder mold having a width extending in the same direction as the width of said vat, and

(c) means for transferring said deposited particulate material from said cylinder mold onto said conveyor to form a sheet of said particulate material on said conveyor.

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