

PATENT SPECIFICATION

DRAWINGS ATTACHED

871,361



Date of Application and filing Complete Specification:
June 23, 1959.

No. 21458/59.

Application made in Belgium on June 27, 1958.

Complete Specification Published June 28, 1961.

Index at Acceptance: Classes 96, A7AX, A7B(4:6:8:14:15:26), B(2A:11A:131X); and 99(2), P1A11 P2(B2:C5:C12).

International Classification: D21f,h. F06l.

Manufacturing sheets and tubes from pulp.

COMPLETE SPECIFICATION



We, JOHNS-MANVILLE CORPORATION, a corporation organized under the laws of the State of New York, United States of America, of 22 East 40th Street, New York, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The instant invention relates to a method and apparatus for the manufacturing of sheets and tubes from a pulp comprising fibres suspended in a liquid medium and is particularly directed to a method and apparatus for the manufacture of sheets and tubes from a pulp comprising asbestos fibers suspended in a cement slurry.

In a conventional machine for forming sheets and tubes from a pulp, it is common practice to deposit a layer of the pulp on a continuously moving belt and to transfer the continuous layer of pulp onto a rotating mandrel until a desired thickness of the pulp is formed on the mandrel. In these machines, the layer of pulp is placed on a continuously moving belt either by (1) direct deposit; (2) transfer from a rotating screen in a vat; or, (3) by suction exerted on one surface of the belt while the other is in contact with the rotating screen or the horizontal surface of the pulp contained in a vat. The above types of machines require vats having a large surface area and which at the same time must be sufficiently deep to house the necessary agitators. This large volume makes it difficult to maintain uniformity of the pulp slurry and wastes large quantities of pulp whenever it is necessary to empty the vats. In many instances, in the methods described above, the layer of pulp is poorly fixed to the continuously moving belt to result in irregularities in the finished product.

In the conventional machines, as described above, it is necessary to remove the excess

water from the layer of pulp as it is introduced to the mandrel. This is generally accomplished by the use of various mechanisms to apply pressure to squeeze the water out of the pulp and usually consists of a pressure roller acting against the mandrel. In the prior art device, the layer of pulp is compressed along a generatrix of the mandrel at the nip between the pressure applying means and the mandrel. This mode of operation has the disadvantages of extreme difficulty in maintaining an even pressure on the pulp being deposited on the mandrel; results in excessive pinching of the belt to reduce its life; and unnecessarily limits the speed of operation of the machine.

It is an object of this invention to provide a method and apparatus for hydrostatically loading a continuously moving belt with a layer of pulp so that the layer of pulp is evenly distributed and properly fixed to the continuously moving belt.

It is a further object of the instant invention to provide a method and apparatus for applying a uniform pressure throughout a relatively large surface area to remove the water from a pulp build-up on a rotating mandrel.

According to the present invention there is provided apparatus for the manufacture of sheets and tubes from a pulp comprising means for depositing under suction a layer of the pulp on a water-permeable belt continuously moving in relation to an opening in the front of a pulp containing vat, said opening extending in a vertical wall from a point close to the bottom to a horizontal line above the normal level of the pulp, a hinged suction box being provided in front of this opening closely abutting the outside of the belt.

In the present invention there is a unique co-operation between the vat in which the pulp is maintained in suspension and the continuously moving belt so that a layer of

pulp is hydrostatically loaded to the continuously moving belt and wherein the hydrostatic loading is assisted by a suction applying device. This is accomplished by providing

5 an opening near the bottom of one vertical side wall of the vat with a closure having a chamber with an opening aligned with the opening in the vertical side wall of the vat. The chamber is connected to a suitable
10 source of vacuum. The continuously moving belt is trained for passage between the vertical side wall and the closure so that a layer of pulp is hydrostatically loaded to the belt. The suction existing in the chamber
15 assists in the hydrostatic loading for an even distribution of the pulp to the belt. The continuously moving belt then carries the layer of pulp to a collection station where it is deposited on a rotating mandrel under
20 pressure until a predetermined thickness of pulp has been built up on to the mandrel. In accordance with the instant invention the pressure applied in the formation of the pulp on the mandrel consists of the weight of the
25 forming mandrel and an additional force applied thereto. The mandrel is rotatably supported on a pair of spaced driven rollers, having a resiliently compressible peripheral surface, so that the axes of the mandrel and
30 the rollers are substantially parallel. The continuously moving belt is trained between the rollers and the mandrel and is under sufficient tension so as to apply an even pressure to the pulp between the mandrel and the
35 rollers. The rollers are rotatably supported in a frame which is mounted on a common pivot so that a uniform pressure will be applied to the pulp between the mandrel and the rollers over a relatively large surface
40 area.

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

Fig 1 is an overall view of the machine, partially in section;

Fig 2 is an end view of the pulp vat looking from the left in Fig. 1;

Fig. 3 is a view in partial horizontal section taken on the plane passing through the line III-III of Fig. 2;

Fig. 4 is a view in vertical section taken
55 on the plane passing through the line IV-IV of Fig. 5;

Fig. 5 is a view in vertical section taken on the plane passing through the line V-V of Fig. 4, with part broken away;

60 Fig. 6 is an end view of the machine looking from the left in Fig. 1;

Fig. 7 is a partial plan view corresponding to Fig. 6;

Fig. 8 is a pictorial view of the device for
65 suspending the shafts of the rollers on which

the mandrel rests.

In the various figures, the same parts have been given the same reference numbers. In Fig. 1, the pulp vat is indicated at 1 and consists of a raised vat, the width of which
70 is equal to that of the permeable belt or felt 2 and the depth of which, measured perpendicular to the belt, is relatively small as compared with the height. The bottom of
75 the vat 1 comprises an arcuate section 3 having an arcuate contour with its longitudinal axis extending substantially parallel to the plane defined by the face of said water-permeable continuous belt adjacent to said
80 opening, a second planar section which is substantially perpendicular to the plane defined by said face of said water-permeable continuous belt, and a third planar section 3' which is inclined relative to the plane defined
85 by said face of said water-permeable continuous belt. Adjacent the bottom of the vat, there is located a rotatable blade agitator 4 driven by a motor 5 via a speed reducer 6 and a transmission 7. On the upper part of
90 the vat there is a funnel 8 transversely by a plate 9 in which there are large crescent shaped orifices 10. The funnel or hopper 8 is further defined by a vertical deflecting wall 13, the upper edge of which is naturally
95 above the level of the pulp and the lower edge of which limits the top of an opening 14 placed near the level of the agitator 4. Due to this arrangement, the streams caused by the descent of the pulp cannot interfere
100 with the loading of the pulp on the felt which is on the other side of the vat. The front wall 11 of the vat (see Figs. 1, 3 and 5) has a large rectangular opening 12, produced in present example by the elimination of an
105 entire portion of this wall. The opening 12 extends between the edge of the bottom section 3' and a horizontal line located above the normal level of the pulp in the vat. The opening 12 is limited over its entire perimeter
110 by a rubber packing 15 forming a joint to which the felt 2 is applied, this felt 2 thus constituting a movable vertical wall element of the vat.

In order to contact the rubber packing with the belt, the vat is provided at its front
115 face with a door 16 mounted on hinges 17 and closed by a bolt 18 with hinge 19 and locking wheel 20. The door 16 is perforated over a portion of its extent with staggered
120 holes 21, in front of which there is fastened in a hermetic manner a suction box 22 connected to a suction device (not shown) by a conduit 23. Water is also removed from the mechanism in the usual manner. The door
125 16 also bears two cheeks or flanges 24, 25 each of which has notches such as 26, 27 (visible in Fig. 4) for the mounting therein of cylinders 28, 29 serving to guide the belt 2.

At the upper part of the vat 1, there is
130 mounted another cylinder 30 for guiding the

belt 2. A roller 31, driven from the speed reducer 6, has protruding portions 32 which beat the pulp contained in the upper part of the vat and eliminate air bubbles.

- 5 In operation, the vat 1 is provided with pulp through the hopper 8 and the agitator 4 maintains the latter in suspension. The belt 2 is placed in motion in the direction indicated by the arrow F by a device incorporated in another part of the machine, which will be described below. The belt 2 receives on its face adjacent the opening 12 in the side wall 11 of the vat a hydrostatic load to which is added the suction exerted by the box 22 through the moving water permeable belt 2 to form an adherent layer of pulp on the belt 2.

- The driving and receiving system for the belt 2 comprises a frame 33 bearing all the rollers 34, 35, 36, and cylinders 37, 38, 39, 40, 41, 42, 43, 44, 45, with which the belt is in contact. All the cylinders, like the cylinders 28, 29, and 30 of the tank, are mounted on shafts journaled in notches which are so oriented that one component of the tension of the belt has the effect of urging the shafts toward the bottom of the notches. This permits the immediate replacement of the cylinders or of the belt.

- 30 The rollers which receive the belt 2 are the mandrel 34, which receives the layer of pulp, and the rollers 35 and 36 on which the mandrel 34 rests. The belt coming from the vat 1 passes between the cylinders 37 and 38 over a tank 47 where it drains excess water. The supporting bracket 48 of the cylinder 38 is mounted on a screw 49 carrying a handwheel 50. By turning this handwheel, the belt 2 is applied over a larger or smaller arc against the mandrel 34 beneath which the belt 2 passes.

- The upper face of the belt 2 which bears the layer of pulp is held against the mandrel 34 by the press rollers 35 and 36 having rubber-covered peripheral surfaces. The rollers 35 and 36 have gears 51 and 52 engaging with a gear 53 (see Fig. 6) driven by a variable speed motor 54 via a transmission 55. The rollers 35 and 36 are rotated in the same direction (indicated by the arrows, F', F'') and as a result of the friction produced between the rollers 35 and 36 and the belt 2, drive the belt 2 in the direction indicated by the arrow F and, also drive the mandrel 34 in the direction indicated by the arrow F'''. The rollers 35 and 36 rotate on stationary shafts enclosed in protective housings and each end of the supporting shafts 35', 36' rests in a bracket such as 56, 57, the details of which are shown in Fig. 8. Each bracket comprises a double flange such as 58 of U-shape, which flanges support bearings 59, 60 covered by a common cover 61, bolted onto the upper part of the flange by bolts 62, 63 or the like. The

double flange is connected to bushings 64, 65 traversed by the shaft 66 which carries the driving gear 53. This unit is mounted in bearings 67, 68 fastened to the ground. It results from this construction that the rollers 35 and 36 can pivot as a single unit around the shaft 66. The mandrel 34 also has a twofold freedom of movement as the result of a special suspension system. This system comprises, on each side of the mandrel, a notched bearing (69, 70) supported by an arm (71, 72) pivotally connected to the frame at a point (73, 73') selected from among several possibilities 73, 74, 75 etc., depending on the diameter of the roller. Each bearing 69, 70 carries a rod 76, 77 connected to the bearing by the pivots 78, 79. The rod 76, 77 is part of a system of levers 80, 81, 82, 83, the first pivoted at 84, the second at 85 and cooperatively connected to each other by tie-rods 86, 87. To the levers 82, 83, there are attached weights 88, 89, the size of which determines the pressure of the mandrel 34 on the rubberized rollers 35, 36. It is clear that by this system there is obtained a cooperating assembly of rollers which immediately adapts itself to all circumstances and never acts abruptly on the felt.

The liquid expressed from the contact of the mandrel and the rubberized rollers is collected in a small sheet-metal tank 90 located under the unit and then discharged to sewer.

After its passage in the above unit, the belt 2 which has deposited its layer of pulp on the mandrel 34 moves back toward the tank passing over the cylinders 39, 40, 41, 42 (which is adjustable in height along the threaded column 91), 43, 44, and 45. After having gone beyond cylinder 43, the belt receives from both sides a spray of water through the nozzles 92, 93 fed with a source of water under pressure (not shown in the figure). It is then struck by blades 44', attached to the cylinder 44 and squeezed out between the cylinders 45 and 46, the upper cylinder 46 of pivots around the pin 94. The belt is thus thoroughly cleaned before it arrives at the vat 1.

Various changes may be made in the machine which has been described above. Thus, the variable speed motor can be replaced by a constant speed motor while the speed reducing transmission can be so adapted that it can vary the speed of the belt (for instance from 0 to 75 metres per minute).

The cooperating rollers can be driven just as well from one side as the other of the machine or even from both sides at once, in order to avoid any twisting of the shafts.

WHAT WE CLAIM IS:

1. Apparatus for the manufacture of sheets and tubes from a pulp comprising means for depositing under suction a layer of the pulp on a water-permeable belt continuously moving in relation to an opening in the front of a pulp containing vat, said opening extending in a vertical wall from a point close to the bottom to a horizontal line above the normal level of the pulp, a hinged suction box being provided in front of this opening closely abutting the outside of the belt.

2. Apparatus according to claim 1, wherein said vat has a width which is at least equal to the width of said water-permeable continuous belt and the height of said vat is greater than its depth wherein said depth is that distance extending perpendicular to said one vertical side wall.

3. Apparatus according to claim 1 or 2, wherein said vat has a bottom which is defined by a plurality of differing sections including a first section having an arcuate contour with its longitudinal axis extending substantially parallel to the plane defined by the face of said water-permeable continuous belt adjacent to said opening, a second planar section which is substantially perpendicular to the plane defined by said face of said water-permeable continuous belt, and a third planar section which is inclined relative to the plane defined by said face of said water-permeable continuous belt.

4. Apparatus according to claim 3, comprising a rotary agitator in said vat, said rotary agitator mounted so that its longitudinal axis is substantially parallel to the plane defined by said one face of said water-permeable continuous belt, and said rotary agitator being adjacent but spaced from said arcuate section of said bottom of said vat.

5. Apparatus according to claim 4, comprising a feed hopper connected to said vat and extending toward said bottom of said vat, said feed hopper having an outlet positioned below the normal level of said liquid medium in said vat and adjacent to the side of rotary agitator farthest removed from said one side wall of said vat.

6. Apparatus according to claims 1 to 5, comprising a mandrel supported for rotation, said mandrel contacting said layer of pulp to transfer said layer of pulp from said continuous belt to said mandrel, and means for applying a uniform pressure to said layer of pulp over a relatively large surface area immediately after said layer of pulp is transferred to said mandrel.

7. Apparatus according to claim 6, com-

prising a pair of press rollers for rotatably supporting said mandrel, said rollers being parallel to but spaced from each other, and said continuous belt passing between said mandrel and said rollers to exert a force against said mandrel over a relatively large surface area to force water from said layer of pulp.

8. Apparatus according to claim 7, comprising means for varying the tension in said continuous belt to vary said force applying surface area between said mandrel and said belt.

9. Apparatus according to claims 7 and 8, comprising a plurality of rotatable cylinders over which said continuous belt is trained, said cylinders being mounted on shafts *journalled* in open notches, and said notches being so oriented that the component of tension in said continuous belt will urge all shafts toward the bottom of said notches.

10. Apparatus according to claims 7 to 9 wherein the press rollers are rotatably mounted in a frame supported on a fixed pivot.

11. Apparatus according to claim 10, wherein each of said press rollers is connected to a common source of power by appropriate gearing, and said frame is rotatably mounted about said source of power so that each of said rollers remains connected to said source of power as said frame moves about said pivot.

12. Apparatus according to claim 11, wherein each of said press rollers has a resiliently compressible peripheral surface.

13. Apparatus for the manufacture of sheets and tubes from a pulp constructed and arranged substantially as herein described and shown in the accompanying drawings.

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Sheerness: Printed for Her Majesty's Stationery Office, by Smiths, Printers and Duplicators.—1961.
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