Dec. 30, 1930. E. C. LOETSCHER 1,787,047

PULP FILTERING MACHINE

Filed Sept. 12, 1929 2 Sheets-Sheet 1

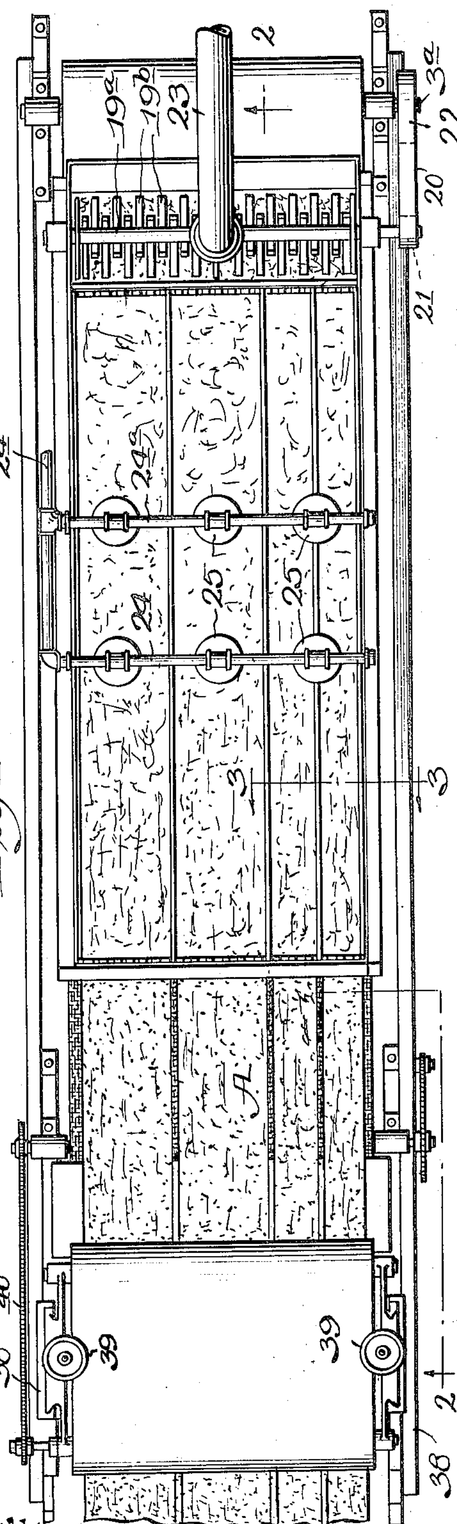

Fig. 1

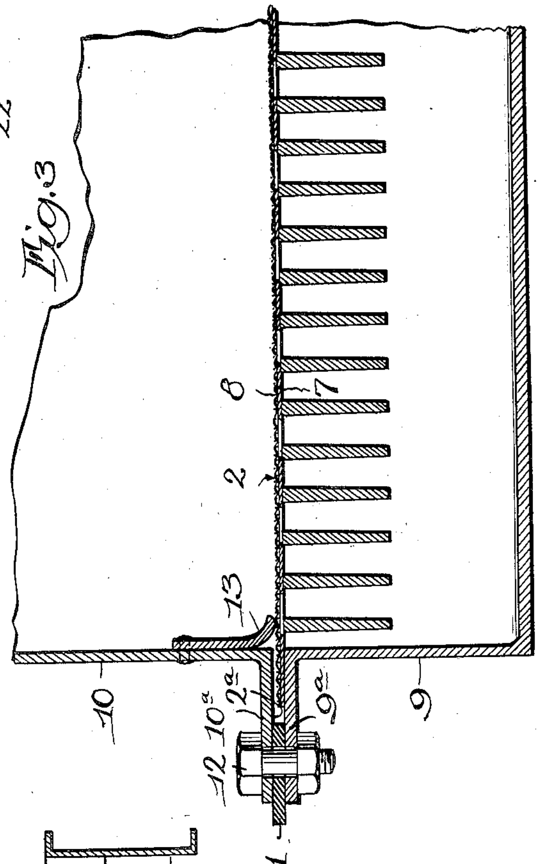

Fig. 3

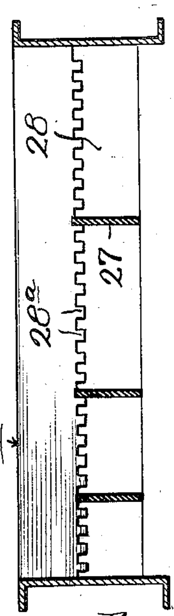

Fig. 5

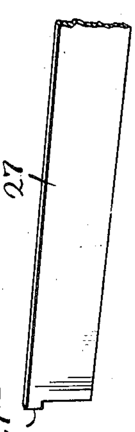

Fig. 6

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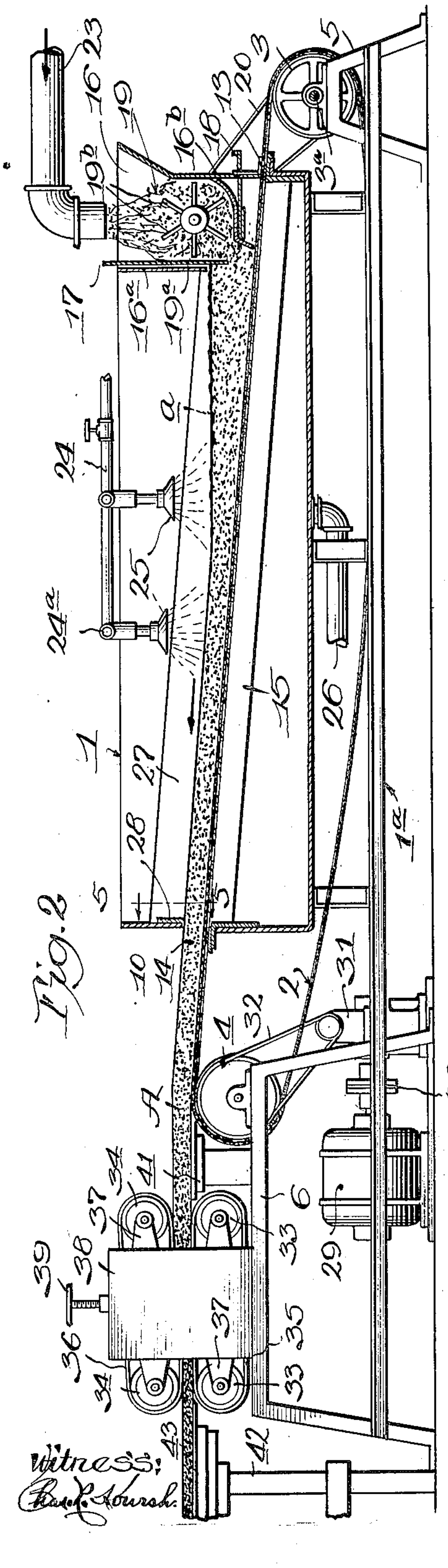

Fig. 2

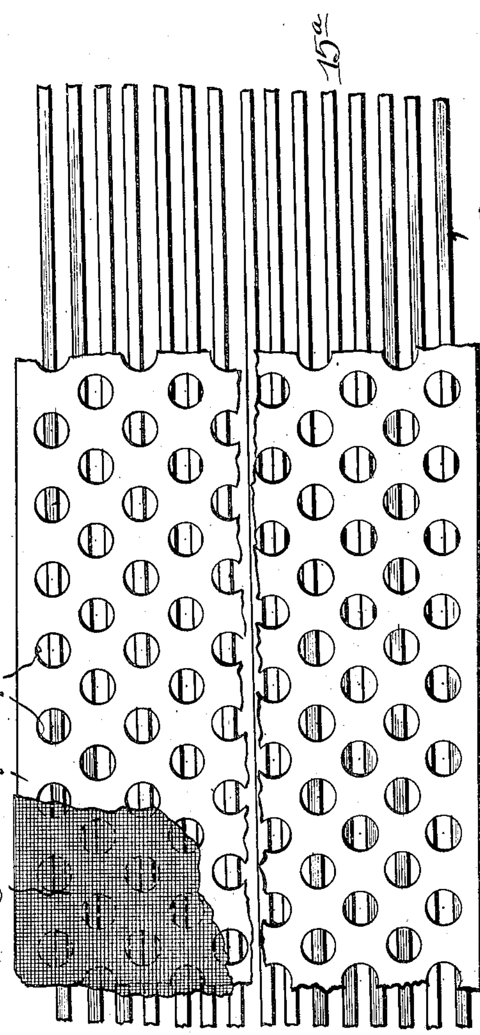

Fig. 4

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Patented Dec. 30, 1930 1,787,047

UNITED STATES PATENT OFFICE

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PULP-FILTERING MACHINE

Application filed September 12, 1929. Serial No. 392,061.

This invention relates to improvements in pulp filtering machines, and more particularly to machines for use in the initial preparation of cellulose fibrous materials to be eventually fabricated into boards, panels, and the general run of millwork stock.

In general the process of manufacturing such materials consists in forming a pulp of the particular fibrous substance to be used, such as cornstalks or other vegetable fibre, and then reducing the pulp to a mat of uniform thickness from which an excess of the water has been removed by a partial compression, and subsequently to be compressed to the required thickness and density and otherwise treated to give it the characteristics and properties of natural wood.

An essential step in the process of manufacture is the preparation of the mat, and it is the object of the present invention to provide a machine which will fulfill the commercial requirements, both as to quality and quantity. Among the desirable, if not necessary qualities, may be mentioned uniformity in density and thickness of the mat as well as the texture of arrangement of the fibrous structure of which it is composed. Again, its production in a form suitable for subsequent treatment is essential to economical production, not to mention its production in quantities which will keep pace with the output of the finished material.

So far as I am aware, the apparatus heretofore used for this purpose has been in the form of a cylindric screen turning in a vat into which pulp is introduced, a partial vacuum being maintained within the cylinder so that a layer is gradually built up around the rotating cylinder, which is then peeled off. Aside from the fact that this method is not continuous, it is open to other objections, the chief of which are,—the limited thickness of the mat produced and the tendency toward non-uniformity in thickness, due primarily to the fact that the suction being the only impelling force, becomes increasingly less effective as the fibre mass is deposited on the screen, so that the limit of thickness is soon reached, or being more effective in some areas than others, the mat will vary in thickness.

In the present machine gravity is utilized largely and suction but secondarily, and hence the mat can be built up to any desired thickness, depending on the speed at which the machine is operated. Other advantages in the use of a machine embodying the features of the invention will be apparent from the following description of my preferred embodiment, as disclosed in the accompanying drawings, in which

Figure 1 is a top plan view of the machine.

Figure 2 is a view in vertical longitudinal section of the machine taken on line 2—2 of Figure 1.

Figure 3 is an enlarged detail view through the tank and screen as taken on line 3—3 of Figure 1.

Figure 4 is a top plan view of a section of the filter belt and the supporting bars thereof.

Figure 5 is a detail view in vertical section taken on line 5—5 of Figure 2 showing the racks at one end of the tank for supporting the dividing bars; and

Figure 6 is a perspective view of one end of a dividing bar.

An elongated open rectangular tank 1 is elevated from the floor and rests upon a low supporting frame 1*a*. The tank is preferably constructed of sheet steel suitably braced and reinforced. The length and width of the tank may be varied but in general proportions its length would be about two and one-half times its width, the latter dimension being determined by the maximum width of mat to be produced. The interior of the tank is divided vertically by a continuously moving belt 2 carried on drums or pulleys 3 and 4 located adjacent each end of the tank and journalled in bearings carried by bearing standards 5 and 6 forming the end portions of the supporting frame 1*a*. The belt 2, of a construction presently to be described, is slightly wider than the tank and its upper lead passes lengthwise from one end to the other in a plane slightly inclined to the horizontal, the direction of travel of the belt being from the head to the tail or discharge end of the tank, namely, from right to left in Figure

1, and its inclination being upwardly in the same direction.

The belt 2 consists of an endless band or strip of thin steel 7 perforated throughout with relatively large circular holes 7*a*, preferably arranged in staggered rows as shown in Figure 4. Applied over the top face of the perforated band is a covering of fine wire mesh 8 although if preferred the perforated band may be interposed between two layers of fine wire mesh, the two or three layers, as the case may be, forming the complete belt. The belt supporting drums 3 and 4 are positioned a short distance beyond the ends of the tank and the upper lead on leaving the drum at the head or lower end, passes through the tank, thence around the drum at the tail end and returning to the head end beneath the tank.

To provide for the passage of the upper lead of the belt through the tank, the latter is constructed in two sections, namely, lower and upper sections 9 and 10, respectively. The lower section consists of bottom, side and end walls, the upper edges of said side and end walls conforming to the inclination of the plane of travel of the belt, and provided with outwardly projecting flanges 9*a*. The upper section of the tank consists of end and side walls having their lower edges inclined also to the plane of the belt travel, and having flanges 10*a* complementary to the flanges 9*a* of the lower tank section. The two sections are bolted together with their flanges in register but spaced apart by a strip or gasket 11 of resilient material, such as rubber extending along the outer edges of the flanges and bolts 12 passing through the same (Figure 3).

The longitudinal spacing strips or gaskets 11 are narrower than the edge flanges 9*a* and 10*a*, thus leaving inwardly opening slots 2*a* along the inner side walls of the tank of a width to receive the edges of the travelling belt 2, as shown in Figure 3, said belt as before stated being slightly wider than the tank. In order to form an air seal around the edges of the belt 2, flexible sealing strips 13 are secured to the side walls of the upper tank section along the line of the belt, with their free lower edges curving inwardly and resting on the top side thereof. At the head or lower end of the tank is a narrow entrance slot 13 for the belt 2, suitably packed so that a water-tight connection is made between the entrance slot and the moving belt. At the upper or discharge end, a considerably wider slot 14 is provided, the width thereof being equal to the combined thickness of the belt and the mat of fibre pulp which is continuously conveyed from the tank or the belt.

In order to support the belt as it travels through the tank, a supporting rack 15 is mounted immediately below it, the same consisting of a plurality of parallel bars 15*a* arranged edgewise and extending longitudinally of the tank and inclined to the same angle as the plane of the belt. These bars are supported at their ends against the end walls of the tank, and as will be observed from Figure 4, the bars although parallel with each other, are arranged slightly oblique to the travel of the belt, the reason for this being to avoid the wearing of grooves in the belt, as would occur if the bars were parallel with the line of travel of the belt.

At the head end of the tank and above the belt 2 is a separate compartment 16 extending crosswise the end of the tank, the same being formed by a vertical front and a curved bottom wall 16*a*, 16*b*, respectively, which terminate short of each other to form a discharge opening along what would be the inner lower edge of the compartment. This opening is dimensioned for a maximum discharge, and for regulating its size two gate members 17 and 18 are used,—one being vertical and sliding along the vertical wall 16*a* and the other horizontal and sliding on the bottom wall 16*b*, with their outer edges projecting from the tank for manual adjustment to control the size of the discharge opening formed between their edges.

Within the compartment and extending crosswise of the tank is an agitator 19 consisting preferably of a shaft 19*a* journalled in bearings at each end of the compartment, and rows of paddles or agitating fingers 19*b* projecting therefrom. As shown in Figure 1, the agitator shaft is driven by a belt 20 from a small pulley 21 on said shaft, to a large pulley 22 on the shaft 3*a* of the belt drum 3 at the head end of the tank. Opening into the compartment is a large supply pipe 23 leading from a source of pulp supply and regulated by a suitable valve. Located centrally above the tank is a water pipe line 24 divided into branches 24*a* extending crosswise of the tank, and from which depend several spray heads 25. By means of valves, the water is controlled to direct a spray of water onto the material deposited on the traveling belt, as will be described later and in more detail.

Beneath the tank is another pipe 26 opening upwardly through the bottom wall of the lower section at its central point. This pipe leads to a wet vacuum pump (not shown), its function being to remove the water accumulating in the bottom of the tank and also to maintain the space below the belt at less than atmospheric pressure, hence the reason for the sealing of the belt along its edges.

Extending lengthwise of the tank and just above the belt are several thin dividing bars 27 supported on edge by plates 28, 28 secured flatwise against the vertical end wall at the tail end of the tank and vertical wall 15 of the compartment, these plates being slotted at short intervals throughout their

length to form a multiplicity of upwardly facing seats 28*a* into which lugs 27*a* at the ends of the bars 27 may be dropped (Figures 5 and 6). These bars 27, of any desired number, are supported with their lower edges just clear of the top surface of the belt and act to divide the material as it is being formed thereon into sections of different width, ranging from the full width of the belt to numerous narrow strips, depending on the number of dividing bars used, which are removable and adjustable to any width of material desired.

This completes the tank and parts associated therewith. A short distance beyond the tail or discharge end of the tank is the supporting standard 6 previously referred to as supporting the bearings for the tail end belt drum 4. This standard, it will be observed, is higher and longer than the drum supporting standard 5 at the head end of the tank and serves to support a set of presser rolls and belts presently to be described.

Just below the tail end belt drum 4 which is journalled at the end of the standard 6 adjacent the tank, is a motor 29 bolted to the floor and directly connected through a flexible coupling 30 to a worm gear speed reducing unit 31 which drives the tail end belt drum 4 at a relatively slow speed through sprocket wheels and chain 32.

Mounted on the standard 6 just beyond the end of the filter belt is an arrangement of pressure rolls and belts, their purpose being to partially compress the material as it leaves the filtering tank and thus remove a portion of the water contained in the pulp. There are two pairs of rolls 33, 33 and 34, 34, one below and the other above the horizontal path of the material, and carried by each pair of rolls are belts 35 and 36 of heavy felt. These pairs of pressure rolls are journalled at the ends of bearing arms 37 supported by side frame members 38, 38 mounted upon the standard 6. The lower pair of rolls is mounted so that the upper lead of the lower belt 35 is horizontal, while the upper pair of rolls is offset vertically so that the upper belt 36 is slightly inclined thus forming a rearwardly tapering space between the belts. By preference the upper rolls and belt are mounted in a sliding carriage regulated by adjusting screws 39 so that they may be adjusted vertically.

Between the forward end of the filter belt and the pressure rolls is a short table 41 erected on the supporting standard 6 to support the material in its travel across the intervening space. Beyond the pressure rolls is a long table 42 for supporting a removable caul 43 onto which the material is discharged on leaving the pressure rolls. The table and cauls are dimensioned to the lengths to which the material is to be cut for convenient handling in the subsequent processing, thus when the mat of material has filled one caul it is cut to length, the loaded caul removed and another placed on the table to receive the next length.

Referring now to the formation of the mat within the filter tank, the operation is as follows: A continual supply of pulp of the desired grade and consistency is supplied to the agitator compartment 16 through the supply pipe 23 and kept in a constant state of agitation by the rotor 19. From the compartment the pulp is continually discharged downwardly and forwardly into the space above the lower end of the filter belt 2 which is moving slowly in a forwardly and upwardly inclined direction, as indicated by the arrow in Figure 2. The amount of pulp discharged into the tank proper is regulated by the position of the two gate members 17 and 18, the purpose being to maintain a certain pulp level substantially throughout the space above the lower half of the belt surface, as indicated by the horizontal line *a* in Figure 2. In other words, the pulp is not discharged directly onto the belt, but rather the belt emerges from a mass of pulp kept in a continuous state of movement and agitation, and in a relatively fluid condition by the water being constantly sprayed from the sprinkler heads 25. In this way the pulp is deposited or deposits itself onto the filter belt in a uniform layer or mat A, and furthermore, since the pulp is in solution by reason of the water being continually added, the separate fibres tend to arrange themselves so that as they are picked up by the advancing belt they extend more or less uniformly in the same direction, that is, parallel with the direction of movement of the belt.

Inasmuch as the filter belt is perforated, there is a continual passage of the water through the belt, this being promoted by the reduced pressure in the space below the belt and maintained through the suction pipe 26. The suction acting on the under side of the belt manifestly draws or pulls the fibres toward the surface of the belt, with the result that the greater the suction the more rapid the deposit and the thicker the layer or mat to be produced, hence by regulating the suction the desired thickness of mat can be obtained. Once the layer has been deposited on the belt and passes beyond the pulp level in the lower end of the tank, its thickness and texture remains uniform during the remainder of its travel on the belt, although the suction, still active, aids in draining the excess of water so that on reaching the end of the belt, it contains from 60% to 70% moisture.

As heretofore explained, the mat A is led directly from the filter belt to the pressure rolls, whereby the thickness is somewhat

reduced in its passage therebetween and more of the water pressed out, so that on leaving the rolls it contains from 40% to 50% of moisture.

While this disclosure does not deal with the subsequent processing of the material, it may be stated that it is utilized in the making of various kinds of finished materials, by further pressing and drying processes which eventually reduces it to a density equal to that of natural wood.

In the manufacture of different materials, various widths of mats are required and this is the purpose of the dividing bars 27 which may be placed in the tank in any number and spacing, so that instead of a mat of the full width of the belt being formed, it may be divided into several narrow sections of the same or different widths, as requirements demand.

Having set forth the novel features of the machine or apparatus embodying my invention,

I claim:

1. A pulp filtering apparatus comprising a tank, an endless screen belt adapted to travel in an upwardly inclined direction through said tank, means for continuously feeding pulp into said tank above said belt whereby the fibres are deposited on said belt in a mat of predetermined thickness as said belt emerges above the level of said pulp.

2. A pulp filtering apparatus comprising an elongated tank, a filter belt adapted to travel in an upwardly inclined direction lengthwise through said tank above the bottom thereof, means for continuously feeding pulp into said tank above said belt, and means for draining the tank below said belt.

3. A pulp filtering apparatus comprising an elongated tank, an endless belt of filtering material travelling lengthwise through said tank in a plane inclined upwardly in the direction of its travel, an agitator compartment in said tank having a discharge opening above the belt, means for supplying pulp to said compartment, and a water outlet from the space in said tank below said belt.

4. A pulp filtering apparatus comprising an elongated shallow tank, an endless filter belt adapted to travel lengthwise through said tank and divide the space therein along an inclined plane, means for continuously feeding pulp into said tank above said filter belt, and means for discharging the water passing through said belt from the space below the same.

5. A pulp filtering apparatus comprising an elongated tank, a filter belt mounted beyond each end of said tank, means for driving said belt whereby its upper portion travels lengthwise through said tank in a plane inclined upwardly in the direction of its travel, and means for maintaining a predetermined level of pulp at the end of the tank above the entering portion of said belt.

6. A pulp filtering apparatus comprising an elongated shallow tank, a filter belt of substantially the width of said tank passing lengthwise through said tank in an inclined plane spaced above the bottom thereof, means for driving said belt in a direction to travel upwardly in said inclined plane, means for feeding pulp into the end of said tank above the entering portion of said belt, and means for maintaining a partial vacuum in the space below said belt.

7. A pulp filtering apparatus comprising an elongated tank, a filter belt extending transversely of said tank and adapted to travel from end to end and through the same above its bottom in an inclined plane sloping upwardly in the direction of its travel, a compartment at the end of said tank and connecting with the space above the lower entering portion of the belt, an agitator in said compartment, a gate for controlling the discharge of pulp from said compartment, means for supplying pulp to said compartment, and means for removing water from the space in said tank below said belt.

8. A pulp filtering apparatus comprising a relatively shallow elongated tank, a filter belt having its upper lead passing through said tank from end to end and sloping upwardly in the direction of its travel, a rack supporting said belt within said tank, a compartment at the end of said tank and connecting with the space above the lower entering portion of the belt, an agitator in said compartment, a gate for controlling the discharge of pulp from said compartment, means for supplying pulp to said compartment, and means for removing water from the space in said tank below said belt.

9. A pulp filtering apparatus comprising a relatively shallow elongated tank, a filter belt moving through said tank from end to end and sloping upwardly in the direction of its travel, means for feeding pulp into said tank at a rate to maintain a predetermined pulp level substantially throughout the lower portion of the belt, and means for maintaining the space below said belt at less than atmospheric pressure.

10. A pulp filtering apparatus comprising a tank, a filter belt traveling through said tank from end to end in a plane inclined upwardly in the direction of travel, means for continually supplying pulp to said tank above said belt, means for spraying water on to the belt beyond the point of pulp supply, and means for maintaining the space below said belt at less than atmospheric pressure.

11. A pulp filtering apparatus comprising a tank, a filter belt adapted to travel lengthwise through said tank in an upwardly inclined direction, said tank having openings at each end through which said belt enters

and leaves, and inwardly facing channels along the sides into which the margins of said belt extend forming a support for said belt, means for sealing the edges of said belt with the side walls of said tank above said belt, means for supplying pulp to said tank above said belt, and suction producing means communicating with the space in said tank below said belt.

12. A pulp filtering apparatus comprising an open tank, a filter belt adapted to travel lengthwise through said tank in an upwardly inclined direction, drums journalled beyond each end of said tank for supporting said belt, said belt entering said tank through a liquid tight slot and having its edges engaging in inwardly facing channels in the side walls of said tank, means for sealing the edges of said belt with the side walls of said tank above said belt, means for maintaining a predetermined level of pulp at the end of said tank adjacent the lower entering portion of said belt, and means for draining the space in said tank below said belt and for maintaining the same at less than atmospheric pressure.

13. A pulp filtering apparatus comprising a tank, an endless filter belt moving lengthwise through said tank, means for supplying pulp to said tank to be deposited on said belt, and a dividing bar supported edgewise above said belt and extending longitudinally thereof.

14. A pulp filtering apparatus comprising an elongated tank, an endless perforated belt having a portion extending lengthwise through said tank and supported therein to travel in an upwardly inclined direction, means for supplying pulp to said tank, a dividing bar adapted to be removably supported edgewise in said tank with its lower edge adjacent to the upper surface of said belt, and transverse racks at each end of said tank adapted for supporting the ends of said bar in several positions transversely of said belt.

Signed at Dubuque, Iowa, this 7th day of September, 1929.

EMIL C. LOETSCHER.