June 17, 1930. O. MANTIUS 1,764,456

FIBER BOARD MACHINE

Filed March 16, 1928 4 Sheets-Sheet 1

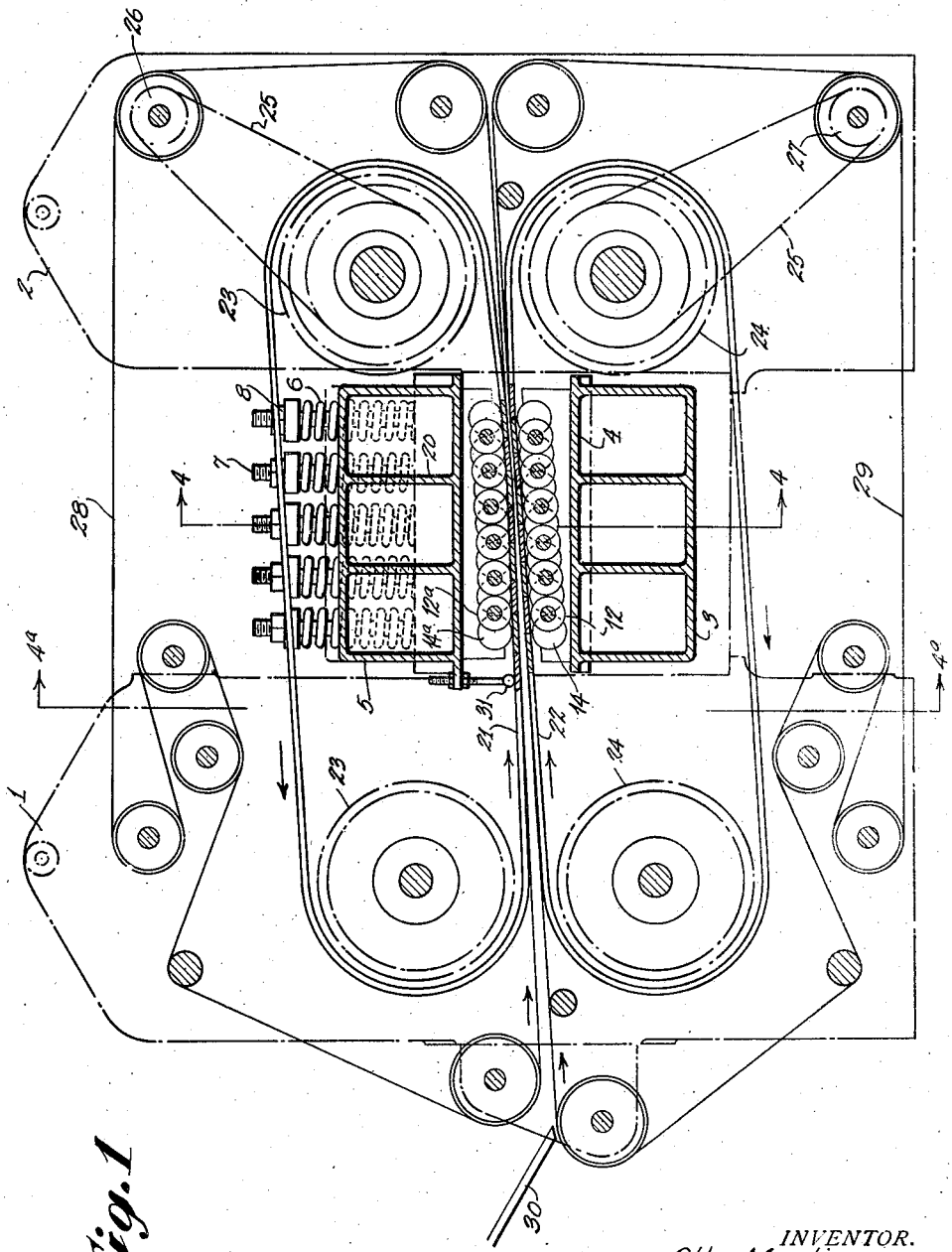

Fig. 1

INVENTOR.
Otto Mantius
BY Cornelius Zahnisky
ATTORNEYS.

June 17, 1930. O. MANTIUS 1,764,456

FIBER BOARD MACHINE

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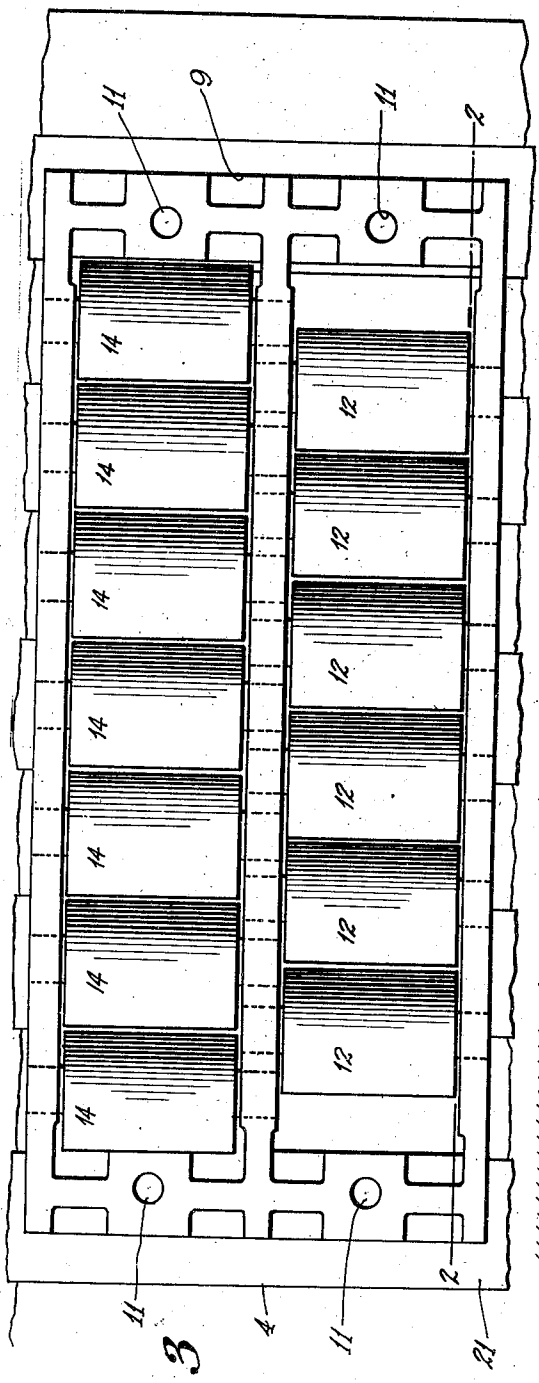

Fig. 3

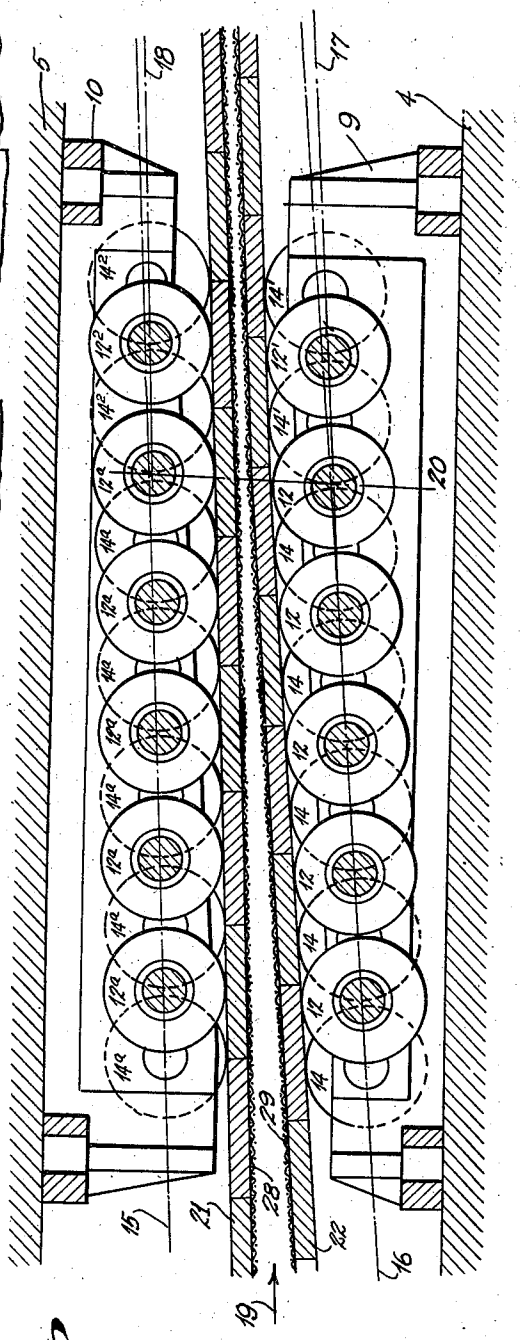

Fig. 2

INVENTOR.
Otto Mantius
BY Cornelius Fabricius
ATTORNEYS.

June 17, 1930. O. MANTIUS 1,764,456

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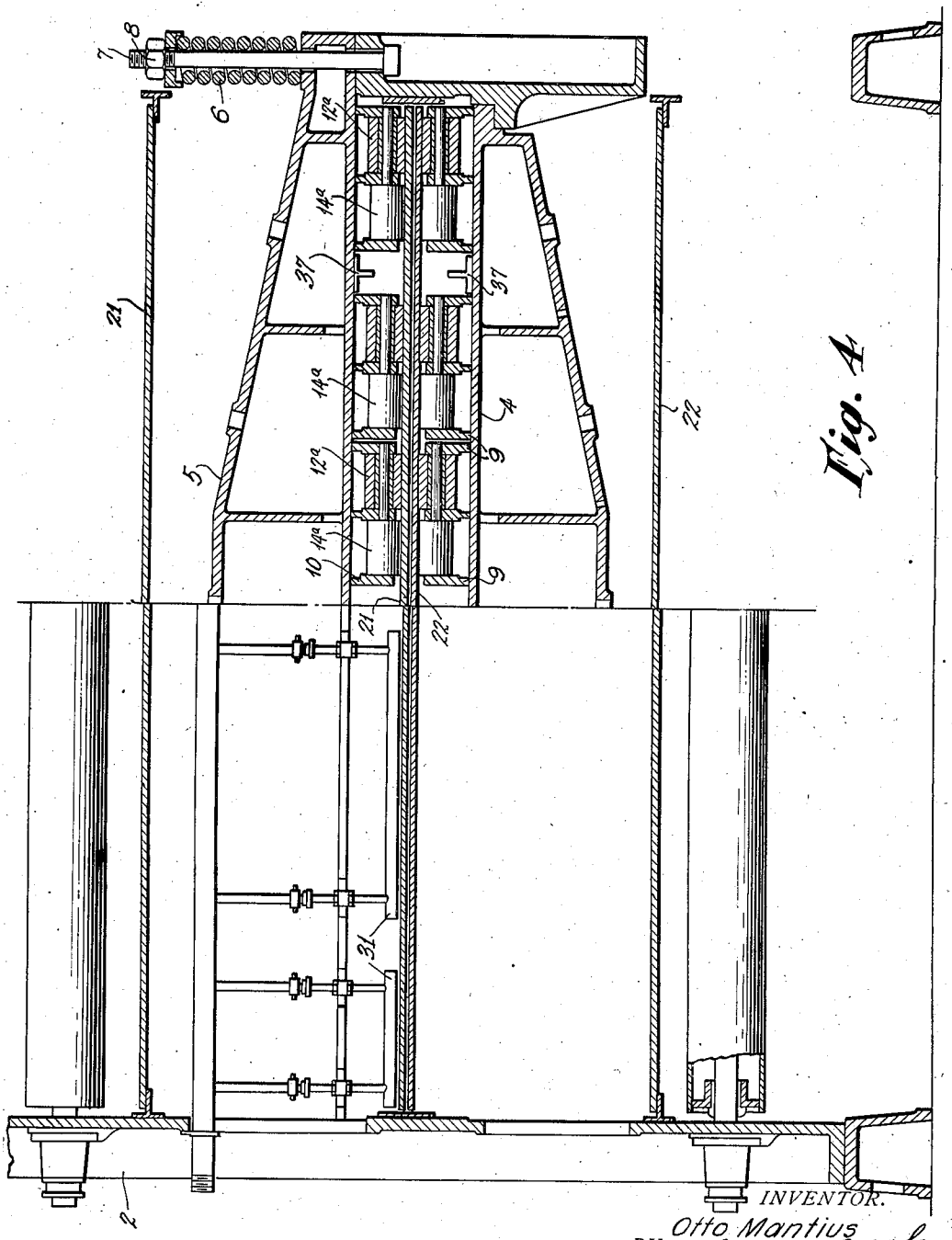

Fig. 4

INVENTOR.

BY Otto Mantius

Cornelius Zalbrisky

ATTORNEYS.

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FIBER BOARD MACHINE

Filed March 16, 1928 4 Sheets-Sheet 4

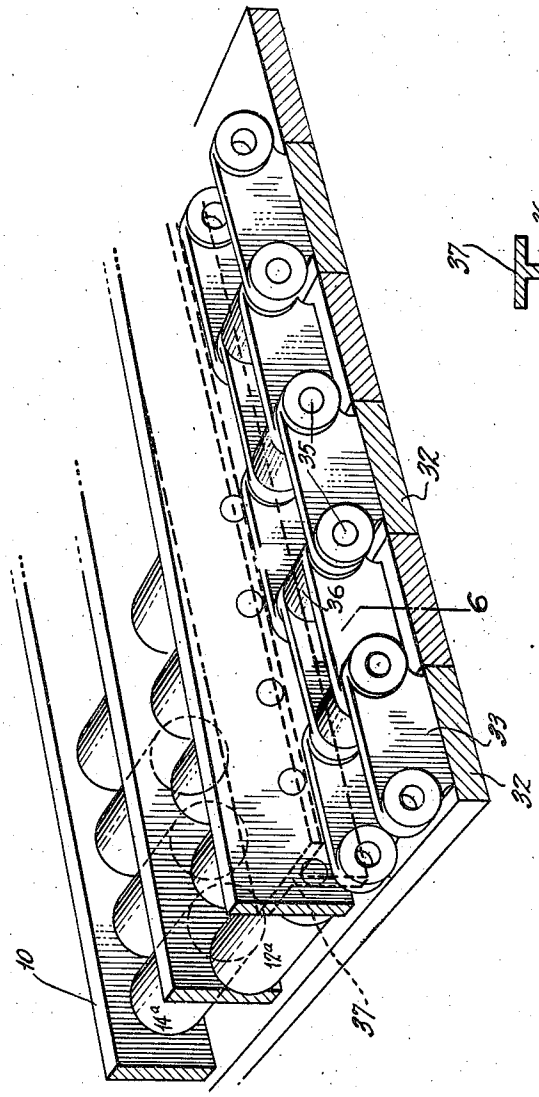

Fig. 5

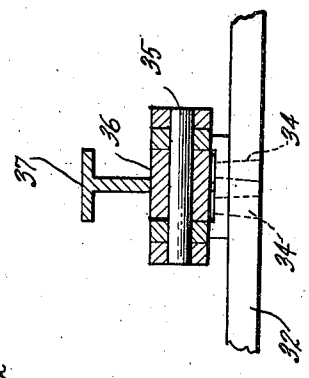

Fig. 6

INVENTOR.
Otto Mantius
BY Cornelius Gabrielse
ATTORNEYS.

Patented June 17, 1930 1,764,456

UNITED STATES PATENT OFFICE

OTTO MANTIUS, OF NEW YORK, N. Y.

FIBER-BOARD MACHINE

Application filed March 16, 1928. Serial No. 262,224.

This invention relates to the manufacture of fiber board and is directed more particularly to a machine for converting loose watery fiber into a solid sheet of board, and for simultaneously removing from the fiber a large part of the water embodied therein, so that the board may be suitable for drying.

In practice, the pulp after thorough mixture is collected on a Fourdrinier wire screen or a vacuum suction filter and formed thereby into a loose sheet generally from one to two inches thick and containing about ninety per cent of water. This sheet generally has a width of about 8 feet and it is the practice to pass sheets of this character between a succession of spaced apart pairs of rolls for the purpose of squeezing out the surplus water and simultaneously forming the loose watery pulp into a solid sheet of materially less thickness. It has long been the practice to position these rolls an appreciable distance apart so that the pulp is passed between two rolls and then moves for a distance without pressure before passing between the next two rolls and so on.

My experience with machines of this character has convinced me that they are lacking in efficiency for the reason that the pressure to which the pulp is applied is at most intermittent. That is to say, the pressure is applied to the pulp, is thereafter relieved and the pulp travels along without pressure for a period before it is again compressed and rolled. These pressing or rolling operations are repeated along the path of travel of material, but between the successive pressing operations, the pulp is without pressure. Being of a spongy nature, it has a tendency to expand as soon as pressure is released and I have observed that after pulp leaves any particular set of rolls as used in prior practice, it immediately expands in thickness and acts after the manner of a sponge to again suck up a considerable amount of water before it is acted upon by the next set of rolls which are meanwhile squeezing out water from a forward portion of the pulp in feeding it to a following portion which is expanding and sucking up such water. It is thus apparent that in machines as now used, there is by no means a continuous drawing or pressing of the pulp, but rather an alternate drying and wetting, so that the efficiency of such machines is materially lowered.

My discoveries along the lines stated have convinced me that in order to provide for efficient drying and forming of the pulp, it is essential that such drawing operation be carried out in a continuous and uninterrupted manner, and the object of the present invention, generally stated, is to provide means for so acting upon the pulp that it is subjected to a constantly and uniformly increasing pressure, the effect of which is to progressively remove the water from the pulp and simultaneously form the pulp into a sheet suitable for the final drying operation.

In practically carrying out the invention, the apparatus employed is so constructed as to act upon the pulp while the pulp travels along a predetermined path and to uniformly increase such pressure as the pulp proceeds for a predetermined portion of its travel in order to reduce the pulp ribbon to the desired thickness and such mechanism is furthermore preferably so constructed that after the desired reduction in the thickness of the pulp has been accomplished, means will act upon the sheet thus formed to maintain it for a further period of its travel at such predetermined thickness in order that the sheet may be "set" to obviate its tendency to appreciably expand after being delivered from the pressure zone.

In the manipulation of pulp in the manner specified, considerable water is squeezed from pulp and the machine embodies means for removing such water in a manner to preclude a detrimental wetting of the pulp that is being fed to the pressure applying means.

The apparatus of this invention may thus be generally stated to consist, in the generic sense, in the provision of means for moving pulp along a predetermined path with means for subjecting such pulp during its passage to constantly uniformly increasing pressure. In addition to these means, the machine may include further means for maintaining the predetermined maximum pressure for a predetermined period and for removing water

substantially as soon as it is freed from the pulp during the pressing operations.

In carrying out the invention in one of its practical forms, I find it convenient, economical and efficient to introduce the pulp between hard, plane surfaces positioned in converging relation and traveling in the same direction as the pulp. These hard plane surfaces may constitute cooperating reaches of two endless conveyors (preferably, though not essentially, slat conveyors) and providing means for supporting the conveyors in such manner as to hold them to their work of uniformly and progressively compressing the pulp into a solid sheet with consequent freeing of excess water content. This type of apparatus has been found to give excellent results and is the one preferred.

Features of the invention, other than those specified, will be apparent from the hereinafter detailed description and claims, when read in conjunction with the accompanying drawings.

The accompanying drawings illustrate one practical embodiment of the invention, but the constructions therein shown are to be understood as illustrative, only, and not as defining the limits of the invention.

Figure 1 is a central vertical longitudinal section of apparatus embodying the present invention showing portions of the apparatus in a diagrammatic manner with details of construction being omitted in the interest of clearness.

Figure 2 is an enlarged, vertical section showing one group of pressure applying rollers illustrated in Figure 1 and the means whereby they are supported. This section is taken in the plane of the line 2—2 of Figure 3.

Figure 3 is a plan view of the lower set of rolls shown in Figure 2.

Figure 4 is a transverse section through the machine of Figure 1, the right hand portion of this section being taken in the plane of the line 4—4 of Figure 1 and the left hand half of Figure 4 being taken in the plane of the line 4^a—4^a of Figure 1.

Figure 5 is a fragmental perspective view showing a portion of one of the conveyors and associated parts.

Figure 6 is a detail section taken on the line 6—6 of Figure 5.

The machine shown in the drawings embodies a suitable frame. The frame is illustrated as embodying castings 1 and 2 connected together by side plates 3, one of which is positioned at each side of the machine and is rigidly bolted to the castings 1 and 2. The castings 1 and 2 are also duplicated at opposite sides of the machine, so that these parts when firmly bolted together constitute collectively the rigid frame of the apparatus.

Extending transversely of the machine and rigidly bolted at its opposite ends to the side plates 3 is a bed 4 preferably in the form of a casting (see Fig. 4) suitably ribbed to impart strength thereto, but cored out so that it will not be excessively heavy.

Positioned in spaced relation above the bed 4 is what may be termed a cross head 5. This cross head extends transversely of the machine and is of the same general form as the bed 4 although inverted with respect thereto. This cross head normally seats on the upper edges of the side plates 3 and is held to this seat by a number of springs 6 which embrace threaded posts 7 as shown best in Fig. 4. These posts are anchored at their lower ends in the side plates 3 and project upwardly in parallel vertical relation to one another.

One spring 6 is coiled about each post and a nut 8 cooperates with the upper threaded end of each post in order that the springs may be placed under the desired tension sufficient to hold the cross head seated upon the upper edges of the side plates 3 while permitting of an upward yielding movement of the cross head in the event that the rollers which are associated therewith, as hereinafter more fully described, engage some non-yielding foreign substance which may be found in the pulp on which they are adapted to operate. The normal position of the cross head is that wherein it rests upon the upper edges of the side plates 3 and this position may be regulated by introducing shims between the upper edges of the side plates and the cross head for reasons hereinafter more fully explained.

Mounted on the undersurfaces of the cross head 5 and on the upper face of the bed 4 are a plurality of rollers which may be secured to these parts in any suitable manner, but may conveniently be mounted as shown in Figs. 2 and 3. In these figures, 9 and 10 designate castings suitably reinforced and provided with holes 11 through which screws or bolts may be passed to secure the castings to the bed and cross head.

Each casting is formed to provide bearings for a number of rollers mounted in the casting in staggered relation to one another as shown in Fig. 3. That is to say, the rollers 12 are positioned in staggered relation to the rollers 14, i. e., the axes of the rollers 12 lie midway between the axes of the rollers 14, as viewed in Figs. 2, 3, and 5. The rollers 12^a and 14^a are similarly disposed in the holder 9. The rollers 12′ and 14′ are the same as the rollers 12 and 14 in structure and are disposed in substantially the same manner except that their axes are mounted in slightly different relation presently to be explained and the same holds true of the relationship between the rollers 12^2 and 14^2 as compared with the rollers 12^a and 14^a.

In a machine such as shown in Fig. 1, several holders of the character described are employed. That is to say, for example, six of

such holders are mounted side by side on the bed 4 as shown in Fig. 4 and are firmly secured to the bed in such manner that the axes of the respective rollers will extend in a direction transversely of the machine. A like number of holders 10 are secured to the under face of the cross head 5, as shown in Fig. 4 so that the upper face of the cross head will also carry a large number of rollers positioned in staggered relation on these respective parts, but with the corresponding rollers of both parts in juxtaposed relation to one another. Thus each roller 14 will be directly below its corresponding roller 14^a and each roller 12 will be similarly disposed with respect to its corresponding roller 12^a. It will be noted that the rollers 12 and 14 and 12^a and 14^a are so mounted on their respective holders that they are of progressively decreasing distance apart in a direction from left to right in Figures 1 and 2. This will be apparent from the latter figure, wherein 15 designates a plane in which the axes of the rollers 12^a and 14^a are included while 16 designates the plane in which the axes of the rollers 12 and 14 are included.

It will be noted that these planes converge to the right in this figure. Attention, however, is called to the fact that the axes of the rollers 12′ and 14′ are not included in the plane 16, but in another plane 17, while the axes of the rollers 12^2 and 14^2 are not included in the plane 15, but in a different plane 18. These planes 17 and 18 are preferably parallel with respect to one another. As a result, the rollers 12, 14 and 12^a and 14^a present a tapering mouth to material fed thereto in the direction of the arrow 19 in Figure 2 and that these rollers are progressively closer to one another as far as the line 20. Beyond this line are located the rollers 12′, 14′ and 12^2, 14^2 which are spaced equal distances apart in a vertical direction.

The upper and lower roll sets which I have described as mounted on the bed and cross head of the machine are spaced apart predetermined distances and between them pulp is adapted to be carried on endless conveyor belts which travel between the rolls. These belts which are designated 21 and 22 are preferably slat conveyors. They may be conveniently formed of steel slats positioned edge to edge and extending transversely of the machine and mounted in this relation upon endless conveyor chains which serve to hold them in the desired relation and impart movement thereto.

The conveyor construction is best shown in Figures 5 and 6. The slats are designated 32. They are preferably steel slats which extend the full width of the machine and they are mounted upon sprocket chains 33. These sprocket chains are constructed as shown in Figure 6 and each link is of such length as to be substantially equal to the width of one of the slats. Rivets or tapered pins 34 permanently secure the slats to the links. The consecutive links are pivoted together by pins 35 on which are mounted antifriction rolls 36 and these rolls cooperate with guides 37 as shown so as to properly guide the chains and thus lead the conveyor along a predetermined path. The same general construction is carried out in both the upper and lower conveyors.

The chains 33 of the upper conveyor 21 are passed about sprockets 23 carried by the frame of the machine, while the corresponding chains of the lower conveyor are passed about sprockets 24 similarly mounted, as best shown in Fig. 1. These sprockets are driven through belts or chains 25 from any suitable source of power connected to shafts 26 and 27, so that the upper and lower conveyors are caused to continuously travel as shown.

Because of the pronounced liquid condition of the pulp to be operated upon, I find it desirable to associate with the conveyors feed aprons. These feed aprons are in effect endless conveyors. They are designated in the drawings by the reference characters 28 and 29 and are preferably wire mesh aprons. As shown in Figure 1, they are led about appropriate directional and tensioning rolls and pass between the operative reaches of the upper and lower conveyors 21 and 22. The purpose of these mesh aprons is to carry the pulp into cooperative relation with the conveyors 21 and 22 in order that the pulp may be fed to the pressure zone and to thereafter remove the finished sheet from the zone of pressure and feed it to an appropriate discharge table or out of the machine.

In practically operating the apparatus which I have described, the fiber pulp after having been suitably collected on a vacuum suction feeder, or otherwise, and thereby formed into a ribbon of from one to two inches thick is fed down a table 30 or in any other suitable manner to the lower apron 29 and is immediately carried by this apron into cooperative relation with the upper apron 28. Thereafter these two aprons conjointly serve to move the pulp ribbon in the direction of the pressure rolls and thus carry it between the lower reach of the upper conveyor 21 and the upper reach of the lower conveyor 22. This ribbon of pulp generally contains about ninety per cent of water and the aprons 28 and 29 are thus well suited to handle the pulp in this wet, semisolid condition.

As the pulp is carried by the upper and lower slat conveyors in a direction to the right in Fig. 1, it is gradually compressed and the water therein is gradually squeezed out so that by the time the pulp reaches the first of the pressure rolls, it has been freed of some of its water content and in this condition it passes into the tapering mouth between the pressure roll sets. The slats of the conveyors

are substantially rigid and are sufficiently wide to bridge over adjacent rolls of these sets. As a result the continued passage of the pulp into the constricted zone of pressure brings about the application of a constantly increasing amount of pressure which is not relieved, but in fact constantly increases from the time the pulp enters the pressure zone between the rollers until the time that it reaches the point designated by the line 20 in Figure 2.

By this time, the pulp has been subjected to a steady increase in pressure. As it continues beyond the line 20 in Fig. 2, the pressure is maintained substantially constant until it passes beyond the last rollers $14'$ and 14^2. As the pressure constantly increases as the pulp moves along, the water is squeezed out of the pulp in substantially a constant stream and the pulp becomes dryer and dryer as it approaches the end of the pressure zone. The water thus squeezed from the pulp is drained through the small cracks between the slats of the conveyors. From the lower conveyor it will drop by gravity while from the upper conveyor, the water is removed by a suitable suction pump acting through a suction pipe 31. It will be noted from the drawings that the web travels in an upwardly inclined direction so that the water which is squeezed out between the slats of the upper conveyor will flow down to the pipe 31.

I wish to particularly stress the fact that when the parts are associated as described, the pressure rolls so act upon the slats of the conveyor that once they have entered between the upper and lower pressure rolls, the pressure is never relieved from these slats until the time they leave the pressure zone and pass between said rollers.

On the contrary, the pressure is constantly increased without diminution at any point until the line 20 is reached, beyond which the pressure is maintained constant until the slats leave the last rolls in the pressure zone. Thus the structure shown not only serves to exert constantly increasing pressure for the purpose of drying the pulp by squeezing the water therefrom, but it simultaneously serves the purpose of forming the pulp into a solid sheet and gradually decreasing such sheet to the predetermined thickness, this thickness being maintained during the latter part of the pressure zone in order to produce a fixed "set" in the finished product.

After leaving the pressure zone, the moist sheet or web is led by the lower apron out of the machine to be received at a suitable discharge table or otherwise. It is thereupon cut to suitable sizes and put in a drying oven as in prior practice.

From the foregoing detailed description of the present invention, it will be apparent that the disadvantages of prior practice to which I have referred are wholly eliminated by the machine of this invention. The formation of the sheet is efficiently accomplished and a uniform product is produced through the employment of relatively simple mechanism. I have not considered it necessary to show all the details of construction, such, for example, as bearings for shafts, etc., as these may be readily supplied by those skilled in the art. It may be stated in passing, however, that while the taper of the pressure mouth is substantially fixed in the apparatus as shown, the thickness of the finished sheet may be controlled by introducing shims between the cross head and the upper edges of the side plates 3.

The purpose of the springs 6 is to permit the cross head to yield in the event that hard extraneous substances are entrained and carried along by the pulp into the pressure zone. If an unyielding arrangement were employed breakage of the apparatus might result, but with the arrangement as shown, the parts will yield and permit the passage of the extraneous matter without damage to the apparatus.

The foregoing detailed description sets forth the invention in its preferred practical form. There is here disclosed, broadly speaking, mechanism for causing pulp to travel between and with substantially plane, hard surfaces positioned in converging relation to one another and adapted to simultaneously travel in the direction of their convergence. The invention is not limited, however, to the particular illustrative arrangement shown, but is to be construed as fully commensurate with the appended claims.

The apparatus forming the subject matter of this invention is well adapted for the performance of the method described and claimed in my Patent No. 1,723,051, filed on even date herewith and issued August 6th, 1929.

Having thus fully described the invention, what I claim as new and desire to secure by Letters Patent is:

1. In an apparatus of the character described, a pair of hard surface conveyors positioned in cooperative relation with one another and with one reach of each conveyor traveling in spaced apart cooperative relation with one reach of the other conveyor, gangs of rollers back of the cooperating reaches of said conveyors, each gang of rollers embodying a plurality of rolls positioned in overlapping staggered relation and engaging with said conveyors to form between the cooperating reaches thereof a converging mouth terminating in a passage of uniform dimension and appreciable length, means for feeding pulp to the converging mouth, and means for causing the conveyors to travel in the direction of their convergence, whereby the pulp is compressed into a sheet while passing through the converging mouth and thereafter set dur-

ing continued passage through the uniformly spaced apart walls of the passage.

2. In an apparatus of the character described, a pair of hard surface slat conveyors positioned in cooperative relation with one another and with one reach of each conveyor traveling in spaced apart cooperative relation with one reach of the other conveyor, gangs of rollers back of the cooperating reaches of said conveyors, each gang of rollers embodying a plurality of rolls positioned in overlapping staggered relation and engaging with said conveyors to form between the cooperating reaches thereof a converging mouth terminating in a passage of uniform dimension and appreciable length, means for feeding pulp to the converging mouth, and means for causing the conveyors to travel in the direction of their convergence, whereby the pulp is compressed into a sheet while passing through the converging mouth and thereafter set during continued passage thru the uniformly spaced apart walls of the passage, the slats of each conveyor being of sufficient width to bridge over the spaces between consecutive rolls of the gang with which it cooperates, whereby said conveyors are constantly held to their work while compressing and setting the pulp.

3. In a machine of the character described, a table extending transversely of the machine and mounted rigidly therein, a gang of rollers mounted on the table and positioned in overlapping staggered relation to one another for rotation on fixed axes, a slat conveyor operable for a portion of its length over said rollers, a cross head positioned above the table and extending transversely thereof, a gang of rolls carried by the cross head and positioned in staggered overlapping relation and mounted on fixed axes on the cross head, a second conveyor, a portion of which passes between the rollers of the cross head and the first conveyor, and said portion of the second conveyor operating against rollers of the cross head to form with the corresponding portion of the first conveyor a tapering mouth, a gang of rolls associated with the cross head being positioned above the gang of rolls associated with the table, means for feeding pulp to the tapering mouth, and means for operating the conveyors to feed the pulp through said mouth for the purpose of squeezing water from the pulp and simultaneously forming it into a sheet, and resilient means for normally holding the cross head in position to form said resilient mouth, said means being yieldable to permit lifting of the cross head and consequent opening of the mouth in the event that hard, unyielding material is fed into the tapering mouth.

4. In a machine of the character described, a table extending transversely of the machine and mounted rigidly therein, a gang of rollers mounted on the table and positioned in overlapping staggered relation to one another for rotation on fixed axes, a slat conveyor operable for a portion of its length over said rolls, a cross head positioned above the table and extending transversely thereof, a gang of rolls carried by the cross head and positioned in staggered overlapping relation and mounted on fixed axes on the cross head, a second conveyor, a portion of which passes between the rollers of the cross head and the first conveyor, and said portion of the second conveyor operating against rollers of the cross head, the rollers of the cross head and table being so positioned with respect to one another as to form between the conveyor portions cooperating therewith a converging mouth terminating in a passage of uniform dimension and appreciable length, means for feeding pulp to the converging mouth, and means for operating the conveyors to feed the pulp through the converging mouth to compress the pulp into a sheet and to thereafter pass said sheet through said passage to set the thickness of the sheet.

5. In an apparatus of the character described, cooperating members having hard opposing surfaces, so positioned as to form between them a converging mouth terminating in a passage of uniform dimension and appreciable length, means for feeding pulp to and through said converging mouth and thence through said passage of uniform thickness, to compress the pulp into a sheet while it is passing through said converging mouth and to thereupon set the thickness of the sheet while it is passing through said passage of uniform dimension.

6. In an apparatus of the character described, a walled converging mouth, a walled passage of uniform dimension and appreciable length positioned at the small end of the converging mouth and forming an exit passage therefrom, and means for feeding pulp to and through the converging mouth in the direction of its convergence and thence through the passage of uniform dimension, whereby the pulp is compressed into a sheet while traversing the converging mouth and the thickness of the sheet thereafter set while traversing said passage.

7. In a machine of the character described, a pair of hard surface conveyors mounted in opposed, spaced apart relation to form between them a converging mouth terminating in a passage of uniform dimension and appreciable length, means for feeding pulp to the larger end of said mouth, and means for causing both conveyors to travel in the direction of their convergence to compress the pulp into a sheet in said mouth and set the thickness of the sheet in said passage.

In testimony whereof I have signed the foregoing specification.

OTTO MANTIUS.