

[54] **SUCTION CYLINDER PAPER FORMING MACHINE WITH ADJUSTABLE DOCTOR KNIFE SUPPORT STRUCTURE FOR CONTROLLING PAPER THICKNESS**

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[58] Field of Search 162/323, 324, 325, 326,
162/327, 328, 329, 316, 317, 318, 319, 320,
321, 276, 297, 344, 347

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[57] **ABSTRACT**

A wet paper producing apparatus has a tank divided into two chambers by a partition wall. A rotary suction drum is mounted in the first chamber and a doctor knife supporting box having a doctor knife at the upper end thereof is mounted in the second chamber. A lip board is mounted on the partition wall so as to abut on the periphery of the suction drum below the doctor knife for defining a paper material suction area on the suction drum. A doctor knife adjustment system is connected to the supporting box and extends by a link outside the second chamber which pivots the supporting box to adjust the distance between the knife and the periphery of the suction drum. Another adjustment system is connected to the supporting box and extends outside the second chamber to adjust the supporting box around another pivot towards and away from the suction drum and to adjust the angle of the doctor knife with respect to the suction drum. A lip board adjustment system is provided to adjust the distance between the lip board and the doctor knife.

7 Claims, 5 Drawing Figures

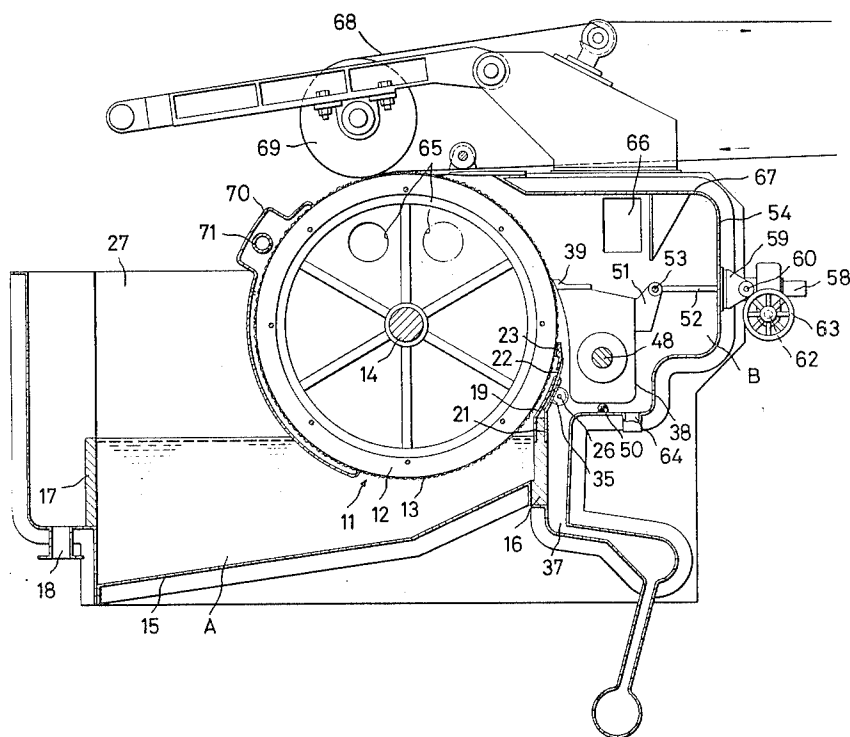


FIG. 1

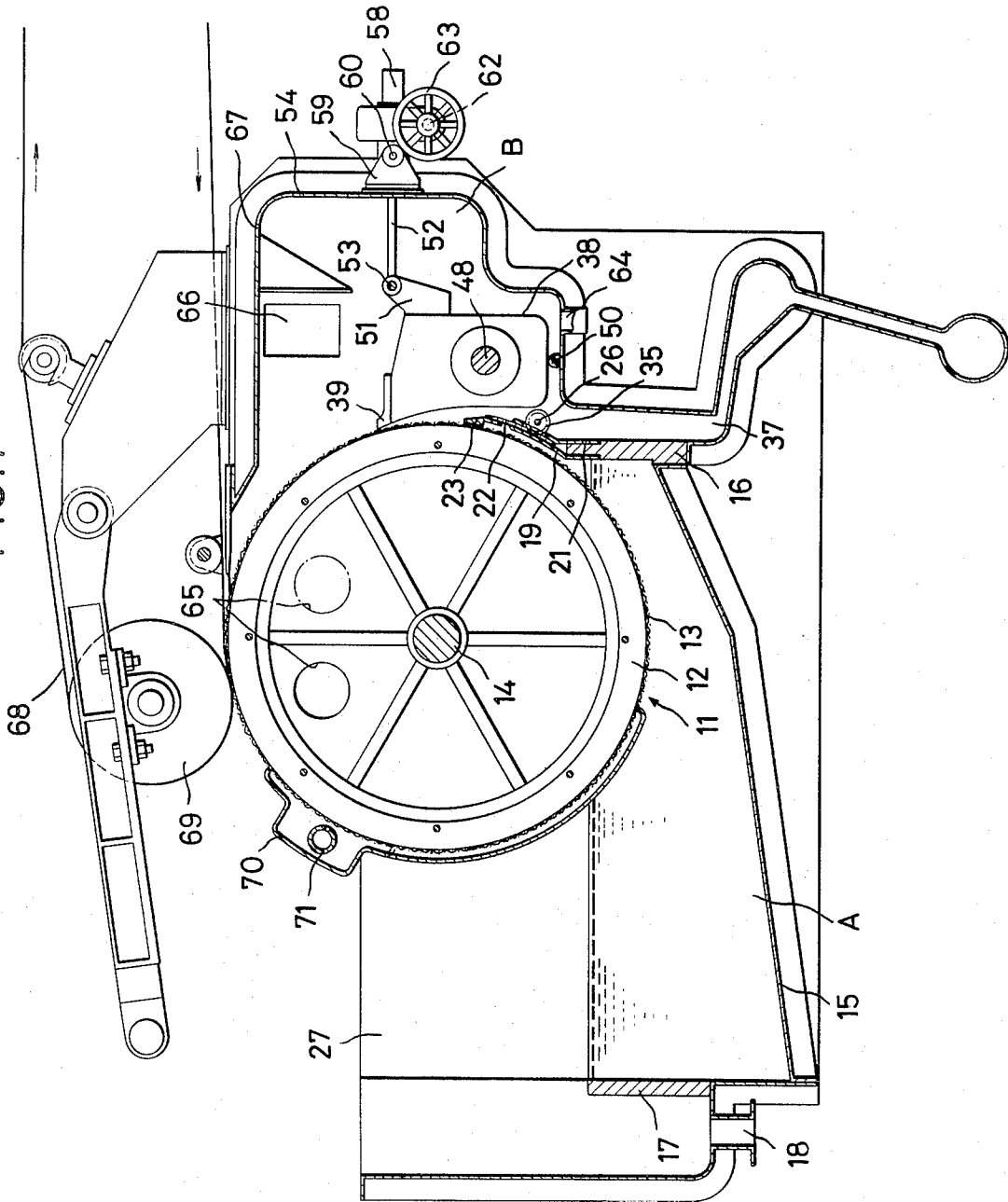


FIG. 2

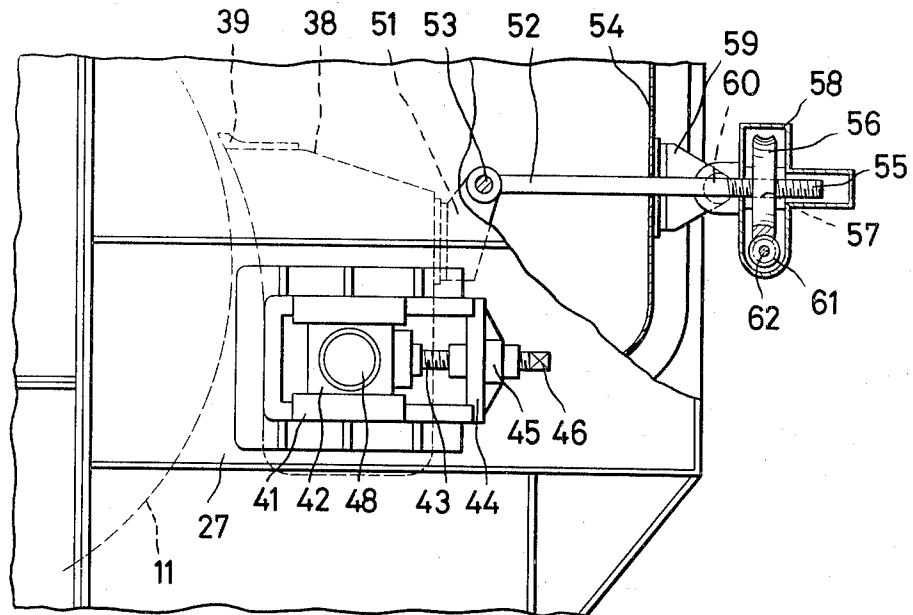


FIG. 3

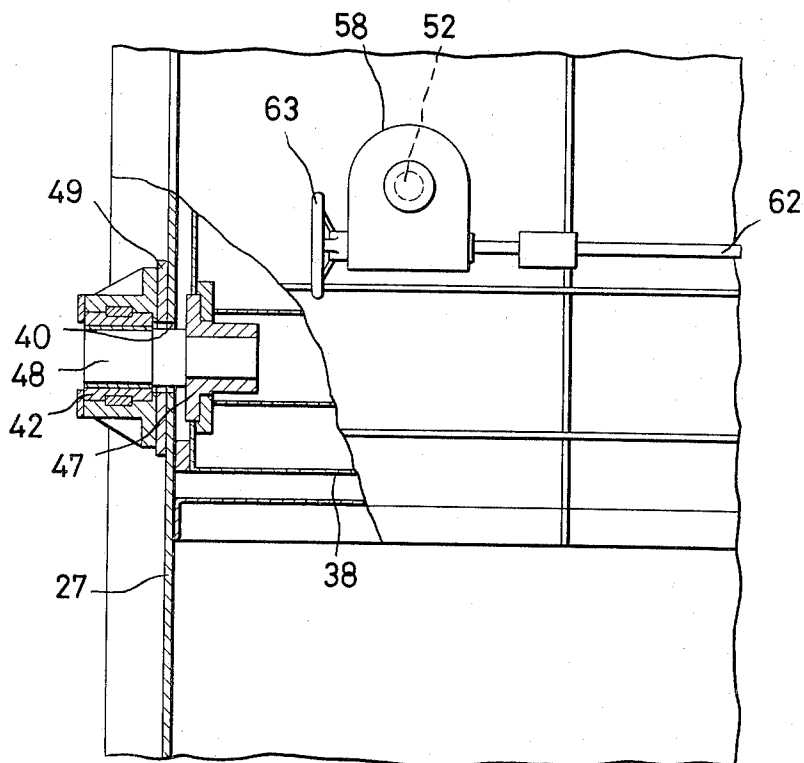


FIG. 4

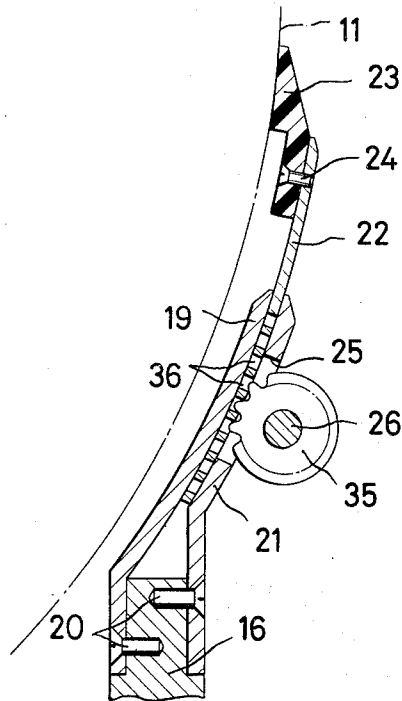
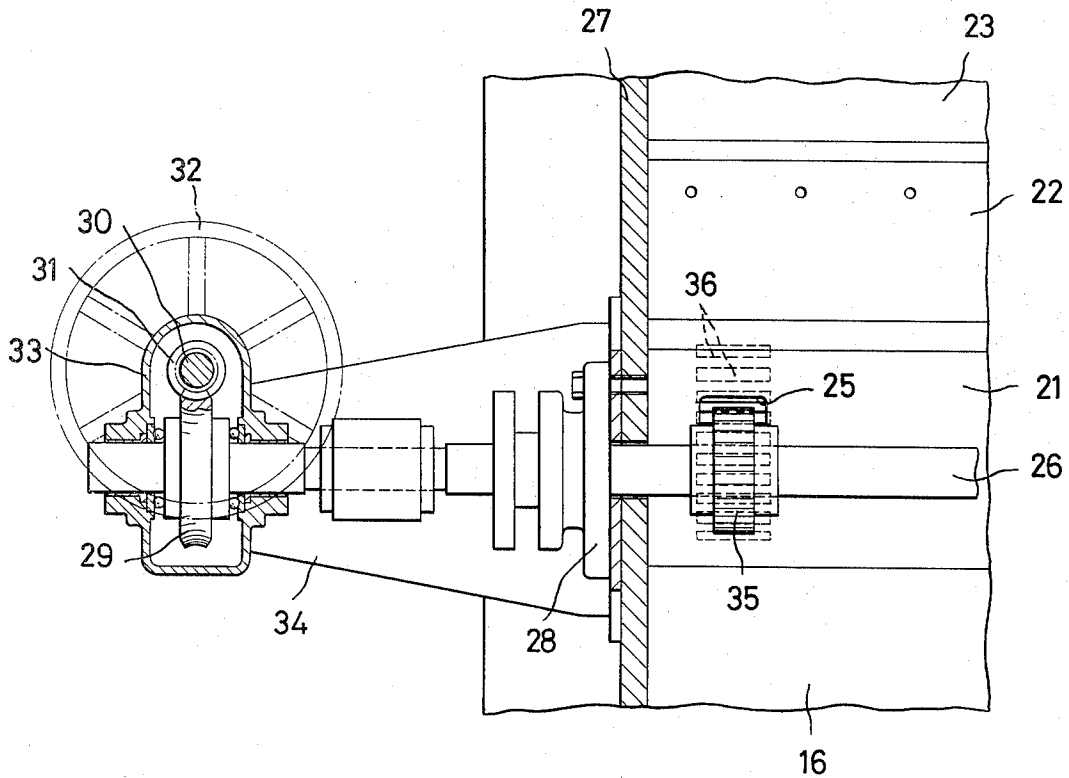


FIG. 5



SUCTION CYLINDER PAPER FORMING MACHINE WITH ADJUSTABLE DOCTOR KNIFE SUPPORT STRUCTURE FOR CONTROLLING PAPER THICKNESS

The present invention relates to an apparatus for producing wet paper.

The quality of paper is determined by the suction area of paper material sucking drum, and the suction area is adjusted by a distance between a lip board abutting on the suction drum and a doctor knife above said lip board. The thickness of paper depends on a space between the doctor knife and the periphery of the suction drum.

In the conventional wet paper producing apparatus, however, it was impossible to adjust the distance between the doctor knife and the lip board at the outside of the casing of the apparatus. The adjustment had to be conducted by entering the inside of the casing each time after stopping the operation of the apparatus, resulting in much inconvenience for operators and reduction of operation efficiency.

A first object of this invention is to provide a device for enabling adjustment of the position of a doctor knife by an external operation thereof.

A second object of this invention is to provide a device for enabling elevation of a lip board by an external operation thereof.

A third object of this invention is to provide a device for enabling obtaining of a substantially dry paper after travelling past the doctor knife.

These and other objects will be apparent from the following description of the invention with reference to the accompanying drawings, in which:

FIG. 1 is a longitudinal, sectional side view showing an apparatus for producing wet paper according to the invention;

FIG. 2 is an enlarged side view, partially broken away showing the adjustment mechanism for a doctor knife;

FIG. 3 is a front view of the foregoing;

FIG. 4 is a longitudinal, sectional side view, on a magnified scale, showing the main part of adjustment mechanism for a lip board; and

FIG. 5 is a front view of the adjustment mechanism of a lip board, broken away in part.

In FIG. 1, the numeral 11 designates a drum opened at both ends thereof and provided with a number of holes in the entire periphery thereof, the drum 11 comprising radial arms, an opposed pair of annular end plates 12 with the outer ends of the radial arms connected thereto, and a cylindrical wire net supported by the end plates 12. The numeral 14 designates an axle extending through the center of the wire net 13 so as to project outwardly through the centers of the end plates 12. The numeral 15 designates a tank opened at the upper edge thereof and divided into a compartment A and another compartment B by erecting a partition wall 16 on the bottom wall of said tank 15, said wall 16 being watertightly secured to side walls of the tank 15, the rotary drum 11 being transversely mounted in the compartment A by means of bearings, the peripheral surface of the drum 11 being brought adjacent to but not in contact with the upper edge of the partition wall 16, the drum 11 being rotated counterclockwise at a predetermined speed by a driving means (not shown). The numeral 17 designates a wall member erected on the bottom wall of the compartment A so as to be lo-

cated at the other end of the tank 15, said wall member 17 being watertightly connected to the inner faces of the side walls of the tank 15, the upper edge of the wall member 17 being adapted to be slightly lower than that of the partition wall 16 thereby enabling the water in the compartment A to be maintained at a predetermined level, the lower peripheral face of the drum 11 being submerged. The water over-flowing the upper edge of the wall member 17 being adapted to flow out through a draining port 18 provided in the bottom wall on the left-hand side of the water tank 15.

Referring now to FIGS. 4 and 5, the numeral 19 designates a guide plate of which the lower end is secured by a screw 20 to the surface of the partition wall 16, said guide plate 19 being slightly spaced from the peripheral wall of the drum 11, the numeral 21 designated a guide plate of which the lower end is secured by a screw 20 to the wall 16 so as to be parallel to the guide plate 19 with a predetermined space therebetween. The numeral 22 designates a plate member of which the lower portion is slidably inserted between the guide plates 19 and 21, a lip 23 comprising rubber or a like material being secured by a screw 24 to the upper end of the plate member 22 in pressure-contact with the wire net 13 of the drum 11. The numeral 25 designates an opening provided on each end of the guide plate 21. The numeral 26 designates a horizontal shaft traversing the opening 25, the shaft 26 extending at one end thereof through a side wall 27 of the tank 11, said shaft 26 being rotatably supported by a bearing 28 mounted on the outer face of said side wall 27, a worm wheel 29 being mounted on one end of the shaft 26, a worm gear 31 provided on one end of an axle 30 being engaged with the worm wheel 29, a handle 32 being attached to the other end of the axle 30. The numeral 33 designates a bearing serving also as a cover for the worm wheel 29 and the worm 31, the bearing 33 being supported by a support member 34 mounted on the side wall 27. The numeral 35 designates a pinion fixed to the shaft 26 so that a peripheral edge thereof is positioned between the guide plates 19 and 21 through the opening 25. The numeral 36 designates a tooth member provided on the plate member 22 so as to be engageable with the pinion 35 through the opening 25, the tooth member 36 being defined by horizontal slots provided in parallel to one another in the plate member 22 as shown in FIG. 5. The numeral 37 in FIG. 1 designates a paper material supply pipe provided on the bottom wall of the compartment B so as to communicate therewith, the paper material supplied through the pipe 37 flowing upward along the partition wall 16.

In FIGS. 1 to 3, the numeral 38 designates a doctor supporting box mounted in the compartment B, the end faces of the box 38 confronting the inner faces of the side walls 27 of the tank 15, the front face of the box 38 confronting the net 13 of the drum 11 being formed in a curved face along the periphery of the drum 11 in a manner that the space between the front face and the net 13 increases from the upper toward the lower portion. A doctor knife 39 abutting the net 13 is mounted on the upper edge of the box 38 so as to be positioned right above the lip 23. The numeral 40 in FIG. 3 is a square opening provided in the side wall 27 so as to coincide with the end face of the box 38, a pair of upper and lower rails 41 being secured to the side wall 27 along the upper and lower edges of said square opening 40, a bearing 42 being mounted on the rails 41 so as to

be slidable away from and toward the drum 11 by means of threaded shaft 43 which is fixed at one end thereof to the bearing 42 and is threaded at the other end thereof into a threaded member 45 which is securely supported by a support plate 44 which is fixed to the rails 41 at one end thereof. A handle (not shown) is detachably secured to a square shaft portion 46 formed at the other end of the threaded shaft 43 thereby making it possible to slide the bearing 42 along the rails 41 by the revolution of the threaded shaft 43 by means of the handle. The numeral 47 designates a cylindrical member mounted on the end face of the box 38 at a position coinciding with the bearing 42, a shaft member 48 being fitted at one end thereof into the cylindrical member 47 through the opening 40 and being rotatably supported by the bearing 42, the shaft member 48 being movable together with the bearing 42 in the opening 40. Packing 49 is interposed between the side wall 27 and the bearing 42 so as to prevent the fluid from leaking out of the compartment B through the opening 40. The numeral 50 in FIG. 1 designates a ridge provided on the bottom wall of the compartment B for supporting the underside of the box 38, the ridge 50 comprising an elastic material, such as rubber. The numeral 51 designates a projection provided on the upper portion of the rear face of the box 38, a link 52 being pivotally connected at one end thereof to the projection 51 by means of a pin 53, the other end of the link 52 being adapted to project outwardly through an end wall 54 of the compartment B. The numeral 55 designates a thread formed on the exterior periphery of the other end of the link 52, the thread 55 being threaded into a threaded hole 57 provided in the center of the worm wheel 56, the worm wheel 56 being built so as to be rotatable inside the bearing 58 serving also as a cover, the bearing 58 being rotatably supported through a pin 60 by a projecting piece 59 fixed to the outer face of the end wall 54 as shown in FIG. 2. The numeral 61 designates a worm gear located inside the bearing 58 so as to be engageable with the worm wheel 56, a shaft 62 being fixed to the worm gear 61, a handle 63 for rotating the shaft 62 being fixed at one end thereof. The numeral 64 in FIG. 1 designates a draining port provided on the bottom wall of the compartment B.

The inside of the drum 11 is subjected to constant suction from both end faces thereof by means of a suction means known per se. By way of example, however, an annular plate facing the peripheral edge of the end plate 12 may be provided on the inner face of the side wall 27, an annular sealing means not interfering the rotation of the drum 11 being provided between the peripheral edge of the annular plate and that of the end plate 12, suction ports 65 being formed on the side wall 27 so as to be located at the inside of the annular plate and above the water level inside the compartment A, a high pressure turbofan or the like being connected to the suction ports 65, the discharge port of said fan being connected to a port 66 formed in the side wall 27 of the compartment B so as to be located above the doctor knife 39. The numeral 67 designates a top wall integrally formed from the upper edge of the end wall 54 and the side wall 27 so as to cover the compartment B, the front edge of the top wall 67 confronting the drum 11 being slightly spaced from said drum 11. The numeral 67 designates a belt conveyor consisting of felt or the like provided in a manner such that the end of

the returning run thereof is brought into contact with the upper peripheral face of the drum 11. The numeral 69 designates a pulley supporting each end of the conveyor 68, the numeral 70 designating a cover provided on the side of the drum 11 opposite to the box 38 so as to enclose substantially the left half of the peripheral face of said drum 11, the lower portion of the cover 70 being submerged under the water in the compartment A, the cover 70 preventing the atmosphere from being sucked into the drum 11. The numeral 71 designates a sprinkler pipe located inside the upper part of the cover 70, the wire net 13 being cleaned by the sprinkling of water through the sprinkler pipe 71.

In the wet paper producing apparatus according to the invention, water containing paper material is constantly supplied under pressure between the box 38 and the drum 11 from the pipe 37 to the compartment B, the drum 11 being rotated counterclockwise at a predetermined speed, the inside of the drum 11 being subjected to suction through the suction ports 65, the sucked air being drawn into the compartment B through the port 66, the belt conveyor 68 traveling in the direction shown by the arrows in FIG. 1.

Consequently, the paper material adheres to the peripheral face of the wire net of the drum 11 in the area between the lip 23 and the doctor knife 39 because of the suction inside said drum 11, paper material exceeding a predetermined thickness being scraped off by the doctor knife 39.

The paper material travelling past the doctor knife 39 is in a substantially dried state, being dehydrated by the pressure applied to the surface of the wire net by the air coming into the compartment B from the port 66 and the suction inside the drum 11.

The wet paper reaching the upper peripheral face of the drum 11 is transferred to the belt conveyor 68 and transported to the drying and finishing processes.

After the transfer of the wet paper the wire net 13 is cleaned by sprinkling water from the sprinkler pipe 71.

The water collected in the drum 11 remains inside the compartment A. However, the excessive water flows out of the compartment through the port 18 over the upper edge of the wall member 17 so that the water inside the compartment A is constantly at a predetermined level thereby making it possible to constantly submerge the lower peripheral face of the drum 11.

The doctor knife 39 for regulating the thickness of the wet paper adhering to the periphery of the drum 11 is adjustable by the following method: the worm wheel 56 is rotated by the worm gear 61 rotatable with the shaft 62 by turning the handle 63, as a result of which the link 52 provided at its end with the thread 55 threaded into the threaded hole 57 of the worm wheel 56 is caused to move forward or backward thereby enabling to rotate the box 38 around the shaft member 48 as a fulcrum. Thus, the adjustment of the doctor knife 39 away from and toward the periphery of the drum 11 is carried out from the outside of the tank 15.

Moreover, the determination of the confronting space between the box 38 and the drum 11 as well as the positioning of said box 38 so as to locate the doctor knife 39 at the most effective angle relative to the periphery of the drum 11 is carried out by the following method: the threaded shaft 43 is rotated by turning a handle (not shown) fitted to the square portion 46 thereby causing said shaft 43 to advance or retreat guided by the threaded member 45, as a result of which

the bearing 42 connected to the shaft 43 is caused to slide along the rails 41 thereby making it possible to adjust the box 38 away from or toward the periphery of the drum 11 by rotation about pin 53 acting as a pivot.

Furthermore, the quality of the wet paper is determined by the distance between the lip 23 and the doctor knife 39. In this invention, the shaft 26 having a worm wheel 29 meshing the worm gear 31 rotatable with the shaft 30 is rotated by turning the handle 32, as a result of which the plate member 22 having a tooth member 36 engageable with the gear 35 of said axis 26 is elevated or lowered between the guide plates 19 and 21 thereby making it possible to adjust the distance between the lip 23 and the doctor knife 39.

As described hereinbefore, this invention makes it possible to adjust from the outside of the apparatus the position of the doctor knife for regulating the thickness of the wet paper as well as the distance between said doctor knife and the lip for determining the quality of said wet paper, with the result that this invention obviates the inconvenience and low efficiency in the conventional apparatus which necessitated stoppage of the operation each time to carry out manual adjustment in the tank after removal of the paper material.

Moreover, since the wet paper after travelling past the doctor knife is pressed by the compressed air, said wet paper when transferred to the conveyor is dehydrated to a substantially dried state as a result of the pressure of the air and the suction inside the drum, thereby economizing on the heat source of the drying apparatus and reducing the drying path.

What is claimed is:

1. A wet paper producing apparatus comprising a tank having two chambers partitioned by a wall; a rotary suction drum mounted in one chamber; a doctor knife supporting box operatively positioned and having a doctor knife at the upper edge of a curved front face of the supporting box confronting the periphery of the suction drum above said partition wall; means coupled to said supporting box for rotating said supporting box about a first pivot for the adjustment of a distance between the doctor knife and the periphery of the suction drum; means coupled to said supporting box for adjusting the angle of said doctor knife with respect to the suction drum and for rotating said supporting box around a second pivot toward and away from the suction drum for the adjustment of the distance between the front face of the supporting box and the periphery of the suction drum; a lip board mounted on the partition wall so as to abut the periphery of the suction drum below said doctor knife; a lip board adjustment means connected to said lip board and adapted to move said lip board up and down for the adjustment of the dis-

tance between the doctor knife and the lip board; and a means for supplying slurry to the surface of said suction drum between said lip board and said doctor knife.

2. A wet paper producing apparatus as claimed in claim 1, wherein a cover is provided along the periphery of the suction drum so as to cover substantially half the periphery thereof opposed to the periphery confronting the supporting box.

3. A wet paper producing apparatus as claimed in claim 1, wherein a water sprinkling means is provided adjacent the periphery of the suction drum in order to clean the periphery thereof.

4. A wet paper producing apparatus as claimed in claim 1, wherein a water level maintaining wall is provided at the end of the one chamber opposed to said partition wall, and adapted to maintain the water level so as to submerge the lower portion of the suction drum by allowing the water extracted from the paper material to flow out over the upper edge of the level wall.

5. A wet paper producing apparatus as claimed in claim 1, wherein said lip board adjustment means comprises a guide member secured to the upper end of the partition wall along the periphery of the suction drum, said guide member having an aperture for slidably supporting a support plate having teeth at the lower portion thereof and the lip board at the upper end thereof, a pinion engaging with said teeth through an opening provided in the guide member so as to communicate with said aperture, said pinion having a shaft projecting outward of the tank, and a worm gear and wheel mechanism connected to said shaft of the pinion for rotating it.

6. A wet paper producing apparatus as claimed in claim 1, wherein said means for adjusting the angle comprises a shaft connected to the side wall of the supporting box and rotatably supported by a bearing slidable along the side wall of the tank, a threaded shaft connected to said bearing and threaded into a threaded member fixed to the side wall of the tank and wherein said means for adjusting distance comprises a link pivotally connected to the upper portion of the supporting box at the rear thereof, a thread formed at the rear end portion of the link, and a worm gear and wheel mechanism engaging with said thread for advancing and retreating said link thereby rotating said supporting box around the shaft connected to the side wall thereof as a fulcrum.

7. A wet paper producing apparatus as claimed in claim 1, wherein means forming a port is provided in the other chamber for supplying air sucked from the suction drum into said other chamber.

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