March 22, 1938. E. E. BERRY 2,111,833

TABLE ROLL STRUCTURE FOR PAPER MACHINES

Filed Dec. 23, 1935 4 Sheets-Sheet 1

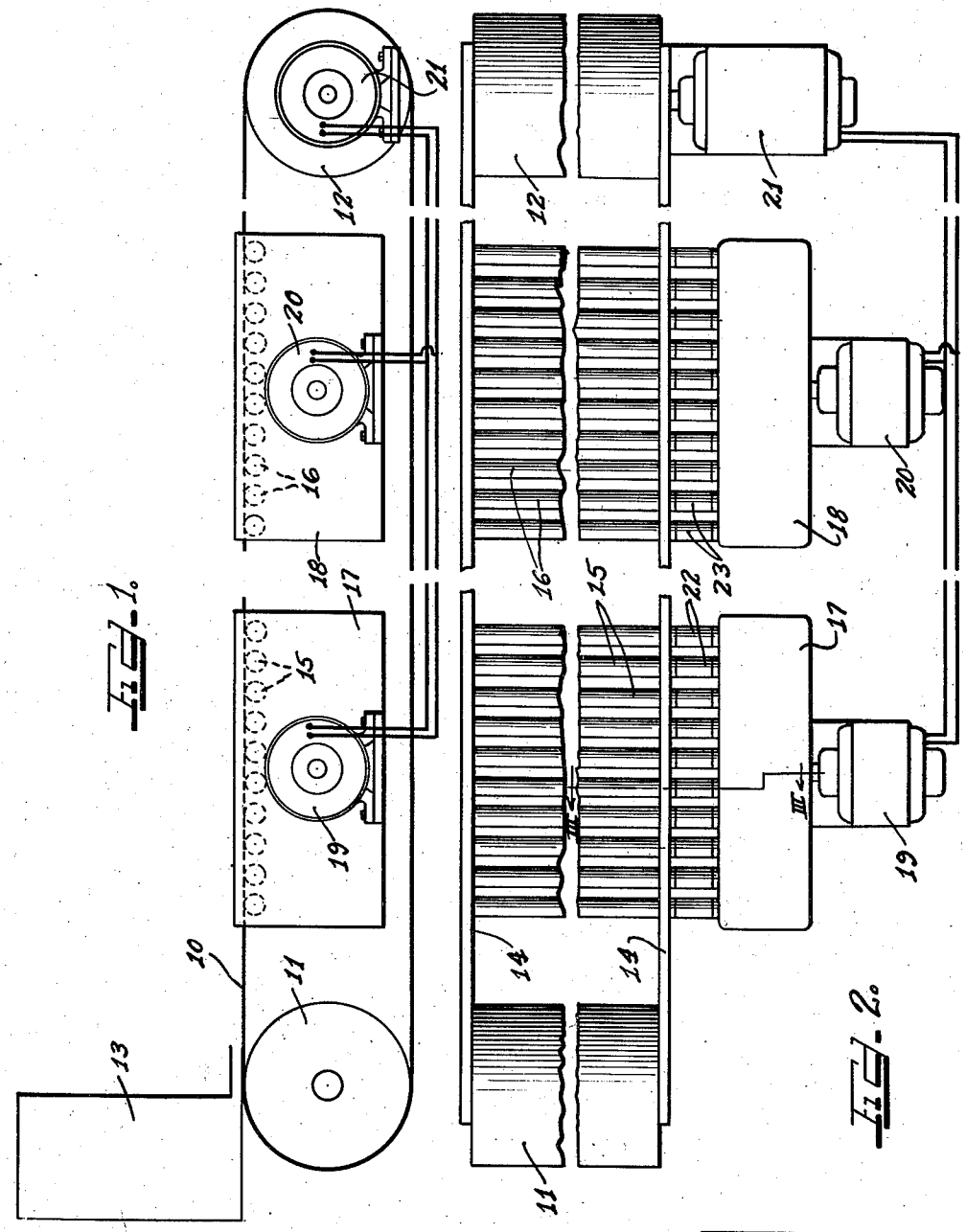


Fig. 1.

Fig. 2.

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TABLE ROLL STRUCTURE FOR PAPER MACHINES

Filed Dec. 23, 1935 4 Sheets-Sheet 2

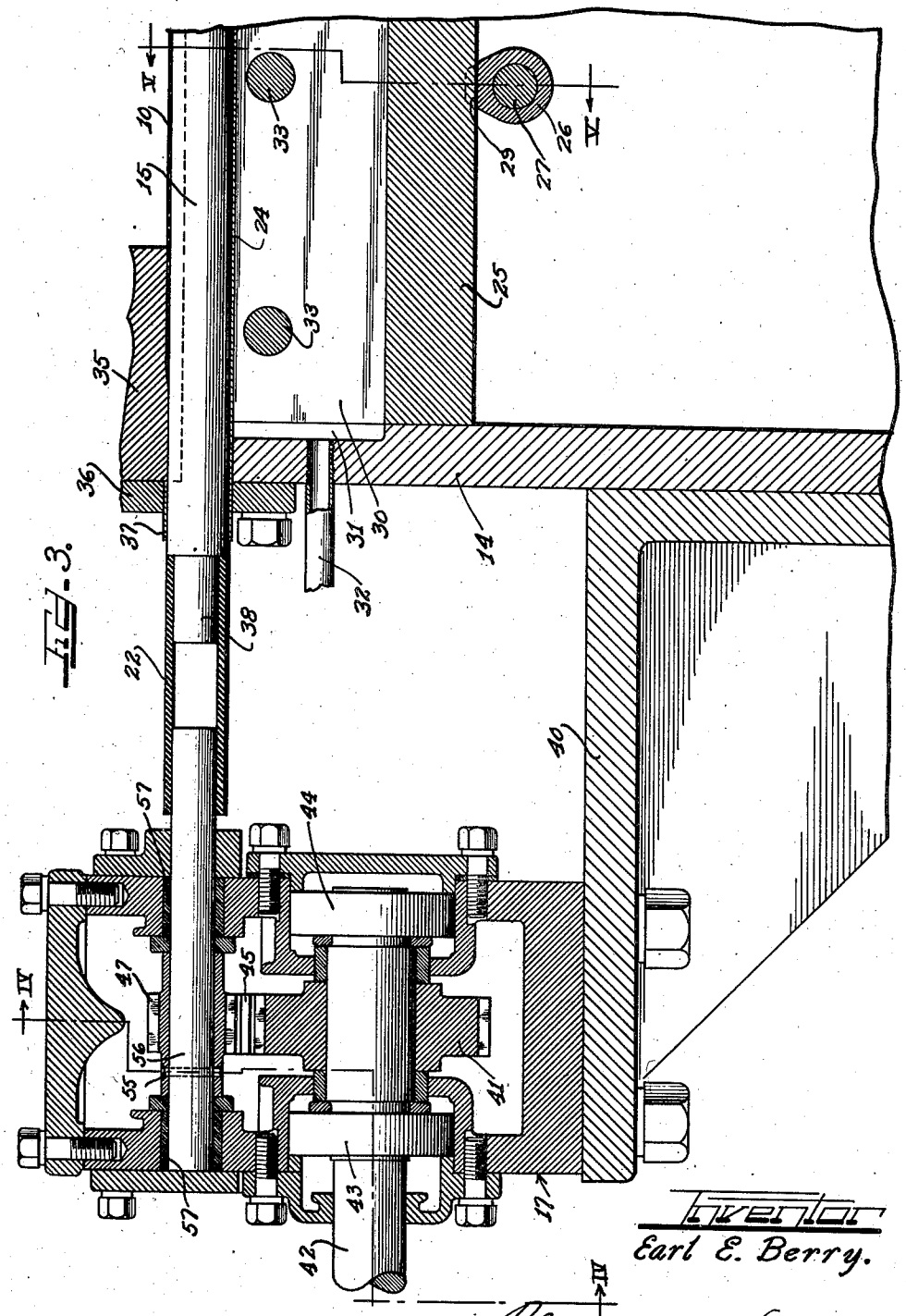


Fig. 3.

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TABLE ROLL STRUCTURE FOR PAPER MACHINES

Filed Dec. 23, 1935 4 Sheets-Sheet 3

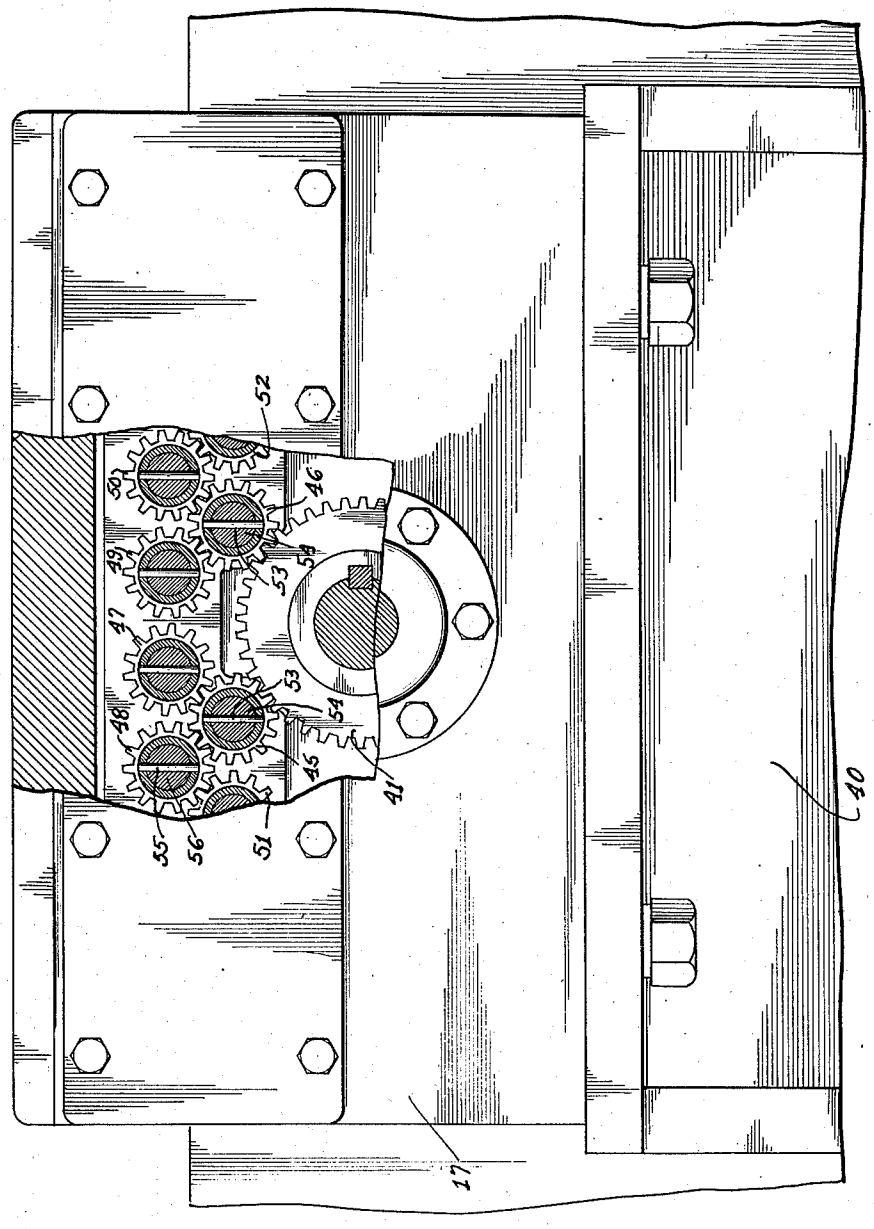


Fig. 4.

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TABLE ROLL STRUCTURE FOR PAPER MACHINES

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Fig. 5.

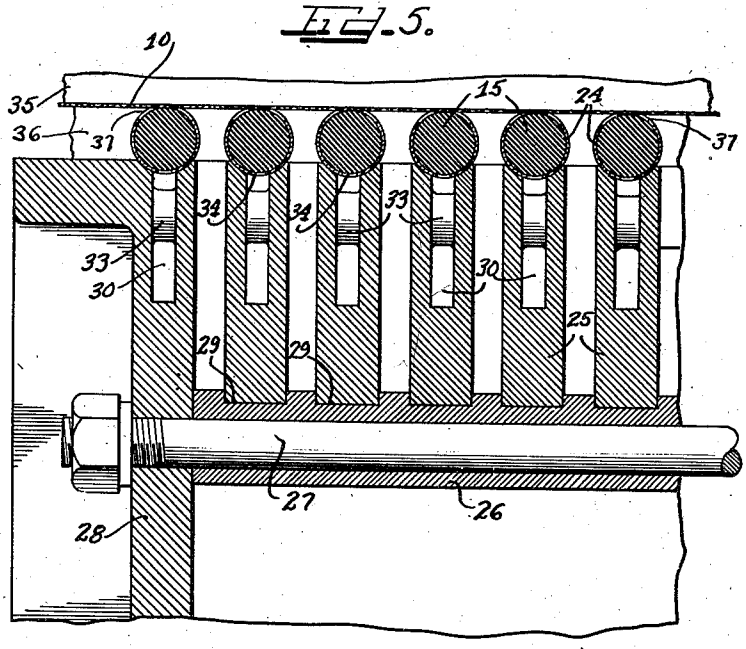


Fig. 6.

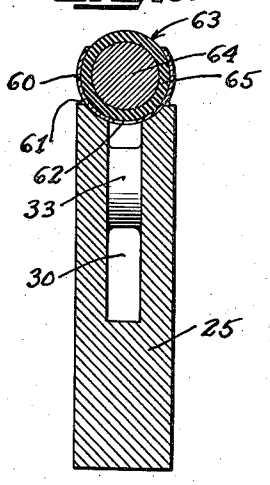


Fig. 7.

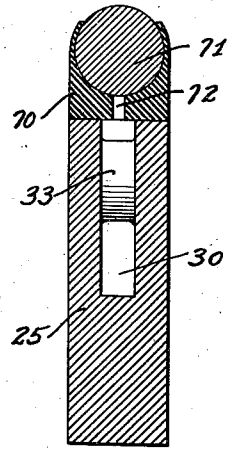


Fig. 8.

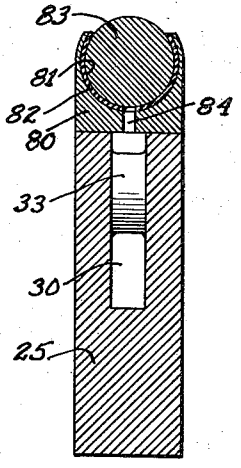
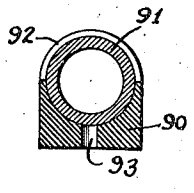


Fig. 9.



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2,111,833

UNITED STATES PATENT OFFICE

2,111,833

TABLE ROLL STRUCTURE FOR PAPER MACHINES

Earl E. Berry, Beloit, Wis., assignor to Beloit Iron Works, Beloit, Wis., a corporation of Wisconsin

Application December 23, 1935, Serial No. 55,753

9 Claims. (Cl. 92—44)

This invention relates to mechanism for rotatably supporting forming surfaces on dewatering machines such as paper machines.

More specifically, this invention relates to small diameter table rolls for paper machines adapted to rotate at high speeds and includes attendant mechanism for driving the table rolls.

This invention will be particularly described in connection with a paper machine of the Fourdrinier type, but it should be understood that the invention is adapted for use on other types of dewatering or paper machines.

It has heretofore been customary to support the upper run of forming wires in Fourdrinier paper machines on a plurality of table rolls adapted to rotate at the same speed that the forming wire is driven. With the advent of long and wide forming wires on Fourdrinier machines, it has been necessary to use table rolls having a considerable diameter to obtain sufficient strength and rigidity for resisting a bending or bellying of the rolls. These rolls have customarily been supported only at the ends thereof.

The use of increased diameter table rolls has rendered it necessary to space the centers of these rolls at greater distances with the result that the forming wire must travel, unsupported, over a considerable distance as it passes from roll to roll. This is highly objectionable since the wire tends to loop down at these unsupported areas, thereby resulting in uneven paper formation and increased wear of the forming wire.

I have now provided table rolls for paper machines that are adapted to span great widths without bending or bellying under the weight of the forming wire and stock thereover. Furthermore, according to this invention, I am able to use rolls having smaller diameters than, to the best of my knowledge, were ever used as table rolls in commercial size paper machines.

According to this invention, I am able to use either solid or hollow table rolls having a diameter of one inch or less without danger of bending or bowing, since the rolls are supported throughout the greater part of their length on the underside thereof by a bearing member which can be readily lubricated with a fluid allowed to flow upwardly from the bottom of the bearing member around the table roll. The rolls of this invention are not journaled in a tight fixed bearing support, and when rotated at high speeds tend to seek their own dynamic center. This tendency is overcome by the weight of the forming wire and paper stock thereover, thereby producing, if desired, a vibrating effect which aids the fiber formation of the paper. Of course, any vibrating effect can be prevented by holding the rolls in tighter bearing supports or by a more accurate fabrication of the parts or both.

It is obvious that with the use of small diameter rolls, the distance between the rolls and the unsupported areas of the forming wire are materially decreased so that the wire may have a practically continuous supporting surface. Since the rolls are of considerably less weight than has been heretofore necessary, they can be rotated at much higher speeds, and I have found that speeds exceeding 11,000 R. P. M. are entirely commercially practical with the structure of this invention.

It is, therefore, an object of this invention to provide belt or band supporting rollers of smaller diameter than heretofore used.

A further object of this invention is to provide supporting roller structure for forming wires of dewatering machines adapted to be mounted in closer proximity than was heretofore possible.

Another object of this invention is to provide a table roll for paper machines supported along the greater part of its length.

Another object of this invention is to provide table roll structure for paper machines and the like, adapted to be rotated with safety at greater speeds than heretofore possible.

A further object of this invention is to provide a table roll structure for paper machines and the like in which each individual table roll is supported along the greater part of its length by a supporting member and lubricated with a fluid adapted to flow between the supporting member and table roll.

Still another object of this invention is to provide a table roll structure adapted to be conveniently mounted in units having a desired number of table rolls therein and driven at the same speed as the speed of the forming wire or at any other desired speed.

A specific object of this invention is to provide a table roll structure for paper machines including table rolls of a size insufficient to support the forming wires when journaled at their ends alone but being supported along the bottom portions thereof for the greater part of their length.

Other and further objects of this invention will become apparent from the following detailed description of the annexed sheets of drawings which disclose preferred embodiments of the invention.

On the drawings:

Figure 1 is a broken diagrammatic side eleva-

tional view of a Fourdrinier type of paper machine having table roll structures according to this invention.

Figure 2 is a broken top plan view of the machine shown in Figure 1 but having the forming wire and head box removed for purposes of clarity.

Figure 3 is an enlarged detailed cross-sectional view, with parts in elevation, taken substantially along the line III—III of Figure 2.

Figure 4 is a side elevational view of the driving mechanism for the table rolls, with parts shown in cross-section, taken substantially along the line IV—IV of Figure 3.

Figure 5 is a vertical cross-sectional view, with parts in elevation, taken substantially along the line V—V of Figure 3.

Figure 6 is an enlarged vertical cross-sectional view, illustrating the construction of a modified form of table roll and bearing support according to this invention.

Figure 7 is an enlarged vertical cross-sectional view, illustrating another modified form of table roll and bearing support structure according to this invention.

Figure 8 is an enlarged vertical cross-sectional view, illustrating still another modified form of table roll and bearing support therefor according to this invention.

Figure 9 is another enlarged vertical cross-sectional view of an alternative form of table roll and bearing support according to this invention.

As shown on the drawings:

As shown in Figures 1 and 2, the reference numeral **10** indicates the forming wire of a Fourdrinier paper machine trained around a breast roll **11** and a couch roll **12**, and adapted to receive paper stock along its upper run from a head box **13**. As shown in Figure 2, the machine includes the usual side frame **14**.

According to this invention, one or more units or batteries of table rolls, such as **15** and **16**, are mounted under the top run of the forming wire **10** along the run of the forming wire usually supported by table rolls. Obviously, of course, the usual suction boxes can be disposed between the last battery of table rolls and the couch roll if desired. Since these suction boxes form no part of the invention, they have been omitted from the drawings.

According to one embodiment of the invention, the batteries of table rolls, such as **15** and **16**, can be positively driven from gear boxes **17** and **18**, respectively, mounted adjacent the side frame of the machine. Gears in the gear boxes **17** and **18** are driven by electric motors **19** and **20**, respectively. If desired, these motors can be energized from a generator **21** coupled to the couch roll **12**.

Since the speed of rotation of the couch roll **12** determines the speed of travel of the forming wire **10** and since the generator **21** is driven directly by the couch roll **12**, the motors **19** and **20** can be perfectly synchronized to drive their battery of table rolls **15** and **16** to travel at the exact speed with the forming wire **10**. This synchronous motor drive, however, only represents one of a great many ways in which the table rolls of this invention can be positively driven to rotate and have a surface speed identical with or different from the speed of the forming wire. Obviously, the table rolls could be driven by means of a gear train, a chain or a belt directly from either the couch or breast rolls or any other section of the paper machine rotating with the speed of the traveling forming wire. Likewise, in some installations, the table rolls of this invention could be driven by the forming wire itself and would not be coupled with any mechanical driving means.

For convenience, a battery of ten table rolls has been illustrated as driven from a single gear box. It is obvious that any number of table rolls can be mounted in a battery and ten have been illustrated for purposes of convenience only.

The table rolls **15** and **16** are coupled with driving members in the gear box by means of flexible connections such as rubber tubes **22** and **23** which, if desired, can be vulcanized to the ends of the table rolls and to the drive shafts from the gear boxes.

As shown in Figures 3 and 5, table rolls **15** are rotatably mounted in bearing shells **24** along substantially their entire length. The bearing shells **24** do not extend across the top of the table rolls so that the forming wire **10** can contact the table rolls. The bearing shells **24** are mounted on individual supporting bars **25** extending across the full width of the machine. The bars **25** are supported on a notched sleeve **26** carried by a tie bolt **27** secured at its ends in frame members, such as **28**, forming the end walls for each battery of table rolls. The sleeve **26** has transversely extending grooves **29** for receiving the bottoms of the supporting bars **25**. If desired, as shown in Figure 5, the end table roll bearings may be mounted on the end frames **28** housing the battery of rolls.

The supporting bars **25** and the end frames **28** are provided with hollow chambers **30** extending longitudinally along the entire length of the bars **25** and communicating at their ends with recessed portions, such as **31**, in the side frame **14** of the machine (Figure 3). The side frame **14** abuts the ends of the bars **25** and end frames **28** in tight engagement therewith, and the recessed chambers **31** in the side frame are merely wide enough to register with the chambers **30** in the bars **25**.

A tube or pipe **32** communicates with each recessed portion **31**, and thus with each chamber **30** in the supporting bars **25** and end walls **28**. As will be hereinafter described, water or other fluid can be flowed through the pipes **32** into the chambers **30**. If desired, a single pipe may be used and the recessed chambers **31** can be connected with this single pipe through a manifold.

The side walls defining the chambers **30** in the bars **25** can be reinforced with a plurality of metal cores **33** cast integrally with the side walls at spaced points therealong. The side walls defining the chambers **30** in the end frames **28** can likewise be reinforced with metal cores **33**.

The bearing shells **24** shown in Figures 3 and 5 with the table rolls **15** thereon are welded, brazed or otherwise integrally secured to the tops of the supporting bars **25** and end frames **28** above the chambers **30**, and contain a plurality of openings or slots **34** in the bottoms thereof so as to provide communication between the chambers **30** and the table rolls. The bearing shells **24** extend above the centers of the table rolls. Water or other fluid can be flowed through the chambers **30** along these slots **34** and into the bearing shells **24** to lubricate the table rolls **15** therein.

As shown in Figure 3, flexible deckle straps, such as **35**, run over the sides of the forming wire **10**, as is customary in Fourdrinier paper machine constructions to seal the sides of the

forming wire. The deckle straps 35 may be held in position along the top run of the forming wire by end plates, such as 36, bolted on the side frame 14 of the machine. The plates 36 are apertured to receive the bearing shells 24 therethrough and, as shown in Figure 3, the bearing shells 24 may extend entirely around the table rolls at the end portions thereof, as indicated at 37. The ends of the table rolls 15 adjacent to the gear boxes 17 and 18 are preferably provided with a reduced shank portion 38 which can be vulcanized or otherwise secured to the flexible tubes 22.

As shown in Figures 3 and 4, the gear boxes for driving the batteries of table rolls according to this invention can be mounted on angle beams 40 carried by the side frame 14 of the paper machine. The gear box 17 has a main drive gear 41 keyed to a shaft 42 which is coupled with a prime mover, such as the electric motor 19 shown in Figure 1. The shaft 42 is rotatably mounted in bearings shown in elevation at 43 and 44 in Figure 3.

The main drive gear 41 meshes with two smaller gears 45 and 46, as shown in Figure 4. The small gears 45 and 46 in turn mesh with superimposed gears 47—48 and 49—50, respectively. The gears 48 and 50 in turn mesh with gears 51 and 52, respectively, which latter gears are in horizontal alignment with the gears 45 and 46. This gear train is extended throughout the full length of the gear box 17.

Each gear in the lower row of gears, including gears 45, 46, 51 and 52, is pinned, by means of a pin 53, to a stub shaft 54 rotatably mounted in the gear box. This lower row of gears serves as a driving means for the upper row of gears, including gears 47, 48, 49 and 50. Each gear in the upper row of gears is pinned, by means of a pin 55, to a drive shaft 56 rotatably mounted in bushings 57 in the side walls of the gear box 17 and extending through the back wall of the gear box, as shown in Figure 3, for receiving thereover a flexible coupling 22 to journal the shaft with a table roll 15. The gear box 18 has the same structure as the gear box 17 described above.

The gear box mechanism, therefore, provides for the driving of a plurality of table rolls at the same speed through intermeshing gear engagement with a single driving gear. The gear boxes can be lubricated with grease and operate very smoothly with little wear.

As shown in Figures 3 and 5, the table rolls 15 are seated in metal bearing shells 24. Since it is undesirable to have a metal to metal bearing contact between the table rolls and the shells, the table rolls themselves can be made of composition material, such as phenolic resin condensation products, vulcanized rubber, wood, or the like materials. The composition material does not need to possess the high strength hereto required for table rolls since the table rolls of this invention are supported along the greater part of their lengths by the bearing shells.

The fluid, such as water, introduced between the bearing shells and table rolls adequately lubricates the bearing surfaces. If desired, the water can be under pressure or overbalanced to flow out over the tops of the bearing shells and thus prevent any deposit of fibers or filler material that might filter through the forming wire from getting caught between the bearing surfaces. The edges of the bearing shells act as doctors for scraping off the fibers or filler materials from the rolls. Alternatively, the water pressure can merely partially or wholly counterbalance the weight of the rolls and forming wire without flowing from the shells. The overbalancing, counterbalancing or underbalancing of the rolls can thus be controlled to a nicety by merely regulating the water pressure.

The hydraulic balancing of the table rolls of this invention eliminates practically all friction between the rolls and their bearing supports leaving only liquid friction to resist rotation of the rolls. This decreases the power required to rotate the rolls and also lessens wear of the bearing surfaces.

When the rolls of this invention are rotated at high speeds, they tend to seek their own center of dynamic balance, and I have found experimentally that an air space is actually formed between the bearing shells and the periphery of the rolls since the rolls will rise in the shells due to the high speed of rotation. The table rolls of this invention have been driven at speeds exceeding 11,000 R. P. M. over prolonged periods of time without even lubricating the bearing surfaces with water or any other lubricant.

It is desirable that the table rolls be constructed of material having a relatively low specific gravity and a low modulus of elasticity. The vulcanized rubber, wood, and phenolic condensation products mentioned above possess these desired properties.

In Figure 6, there is shown a modified form of table roll structure wherein a metal bearing shell 60 is welded or brazed, as at 61, to the top of the supporting bars 25 and has slots or holes 62 communicating with the chambers 30 in the bars 25. The bearing sleeve 60 can be composed of any suitable bearing metal or alloy, such as brass, bronze, hard steel, for example, a nitrided steel, or the like and, if desired, may be chromium-plated so as to be resistant to corrosion from the chemicals used in the paper pulp.

A table roll 63 has a metal core 64 with a rubber or phenolic condensation product sleeve 65 vulcanized therearound. This composite table roll 63 is stronger than a non-metallic roll and at the same time has an outer bearing surface composed of the desired composition product.

In Figure 7, the supporting bar 25 has mounted thereon a bearing sleeve 70 composed of composition material, such as vulcanized rubber, phenolic resin condensation products and the like and receives an all-metal table roll 71. The composition bearing sleeve 70 can be secured on the supporting bar 25 by vulcanization or by means of any suitable retaining devices, and is likewise provided with openings 72 in communication with the chamber 30 in the supporting bar 25.

In Figure 8, still another modification is illustrated in which a supporting block or strip 80 is mounted on top of the bar 25 in any suitable manner, such as by butt-welding, mechanical holding devices or the like, and provides a segmental cylindrical housing 81 on which may be vulcanized or otherwise secured a composition bearing sleeve 82. A table roll 83 can be formed of metal and seated in the bearing sleeve 82 in bearing engagement therewith. Openings 84 are provided through the block 80 and sleeve 82 in communication with the chambers 30 of the supporting bars 25.

In Figure 9, still another alternative modification is shown wherein a bearing block 90 of wood or composition material extends around the bot-

tom portion of a hollow metal table roll 91 for supporting the same intermediate its ends. The bearing block only extends up to the center line of the roll 91. The ends of the table roll, outside of the forming wire area are covered with bearing straps 92 to hold the table roll on the supporting block 90. The straps 92 only extend around the portions of the table roll that are outside of the forming wire area. The supporting block 90 is provided with the usual openings 93 for permitting the passage of water therethrough to lubricate the bearing surfaces. Obviously, hollow rolls or tubes, such as 91, made either of metal or non-metallic materials can be used in place of the solid rolls in the bearing supports described above.

From the above description, it should be evident that this invention relates broadly to table roll structures for supporting solid or hollow table rolls along the bottoms thereof intermediate the ends of the rolls. Means are provided for lubricating the bearing surfaces of the rolls and supports and, if desired, the ends of the table rolls outside of the forming wire can be completely encased in bearing members. The bearing surfaces of the rolls and bearing supports therefor can be formed of any materials capable of being lubricated with fluids such as water.

The invention provides for the use of very small diameter rolls adapted to be rotated at higher speeds than was heretofore possible in conventional table rolls. The table rolls of this invention can vary from less than 1 inch in diameter up to 6 inches, although the supporting structure of this invention can obviously be used on larger sized rolls.

The rolls are readily adaptable for mounting in close proximity to each other and can be positively driven through a number of suitable mechanisms or merely by frictional contact with the forming wire.

I am aware that many changes may be made and numerous details of construction may be varied through a wide range without departing from the principles of this invention, and I, therefore, do not purpose limiting the patent granted hereon otherwise than is necessitated by the prior art.

I claim as my invention:

1. In a Fourdrinier type paper machine having side frames and a forming wire trained between a breast roll and a couch roll, supporting structure for the top run of the wire between said breast and couch rolls comprising a plurality of table rolls extending through a side frame and rotatably supported therein, flexible couplings secured to the ends of said rolls, a gear box having a plurality of drive shafts extending therefrom for receiving said couplings, gears in said gear box for driving said shafts at the same speed, and segmental cylindrical bearings beneath said forming wire for supporting said table rolls intermediate the ends thereof.

2. In a Fourdrinier type paper machine having side frames and a forming wire trained between a breast roll and a couch roll, supporting structure for the top run of the wire between said breast and couch rolls comprising spaced transverse frames carried by the side frames of the machine, tie rods extending between said transverse frames, notched sleeves on said tie rods, vertical bars seated in the notches of said sleeves, said bars extending into tight abutment with the side frames and having elongated chambers therein, recessed portions in at least one of said side frames communicating with said chambers, segmental cylindrical housings on top of said bars in communication with said chambers, table rolls rotatably seated in said housings for supporting the forming wire, and means for introducing water into the recessed portions of the side frame for flowing through the chambers of said bars to lubricate the table roll housings thereon.

3. Table roll structure for Fourdrinier type paper machines including side frames and a forming wire comprising transverse members carried by said side frames extending therebetween below the forming wire, a plurality of vertical bars supported from said transverse members extending therebetween in parallel relation thereto, said members and bars having recessed chambers across the length thereon, segmental cylindrical housings on top of said member and bars in communication with the chambers thereof, table rolls rotatably supported in said housings for carrying the forming wire, and means for flowing water through said chambers into the housings for lubricating the table rolls whereby the reaction of the forming wire on the rolls may be resisted.

4. Driving and supporting structure for Fourdrinier forming wires trained between a breast roll and a couch roll comprising a plurality of table rolls extending transversely below the upper run of the wire, bearing supports for said rolls extending intermediate the ends of the roll for a substantial portion of the wire area, drive shafts for each of said rolls, an electric motor for actuating said drive shafts, and a generator driven by said couch roll for energizing said motor to synchronize the rotation of the table rolls with the speed of the forming wire.

5. In a paper making machine having a forming wire, a battery of small diameter table rolls supporting said wire, a gear box mounted alongside of said paper machine having a plurality of drive shafts extending therefrom, separate flexible couplings for joining each table roll with a separate drive shaft extending from said gear box, and means for rotating said drive shafts at the same rate of speed to drive the table rolls at identical predetermined speeds.

6. Supporting structure for Fourdrinier forming wire which comprises side frame members in spaced opposed relation, spaced transverse bars abutting at their ends the inner faces of the frame members, tie rods extending transversely under the bars between the side frame members, fingers on said tie rods extending between the bars to hold the bars in fixed spaced relation from each other, elongated open topped bearing housings on top of said bars and having interior circumferences of more than 180°, table rolls loosely journaled in said housings, said bars having longitudinal slots at the tops thereof communicating with the bottoms of the housings, and means supplying liquid to said slots for flowing into the housings to lubricate the rolls.

7. The method of supporting a forming wire which comprises disposing elongated small diameter table rolls beneath the wire, surrounding the underside of each roll with an open topped bearing shell extending more than 180° around the roll, said shells having interior diameters larger than the external diameters of the rolls to loosely journal the rolls therein and flowing a fluid into the shells beneath the rolls under sufficient presure to raise the rolls off of the bottoms of the shells.

8. The method of supporting a forming wire which comprises disposing elongated small diameter table rolls beneath the wire, surrounding the underside of each roll with an open topped bearing shell extending more than 180° around the roll, said shells having interior diameters larger than the external diameters of the rolls to loosely journal the rolls therein and flowing a liquid into the shells beneath the rolls under sufficient pressure to raise the rolls against the tops of the shells.

9. The method of supporting a forming wire which comprises disposing elongated small diameter table rolls beneath the wire, surrounding the underside of each roll with an open topped bearing shell extending more than 180° around the roll, said shells having interior diameters greater than the external diameters of the rolls and introducing a liquid into the shells at superatmospheric pressures independent of loads carried by the rolls to relieve the pressure between the rolls and the bottoms of the shells to any desired amount.

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