

April 27, 1926.

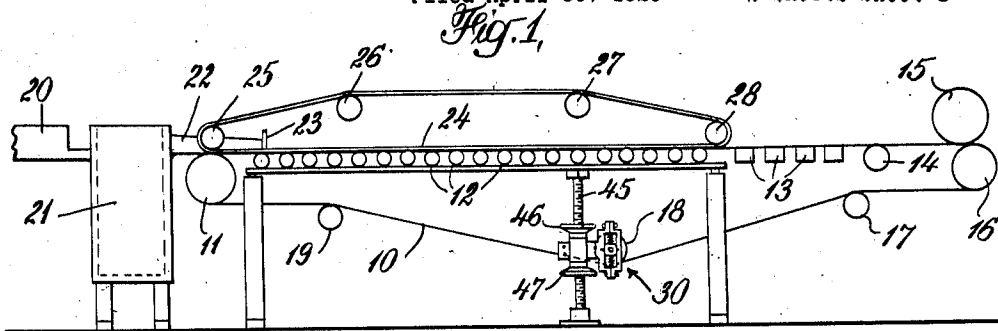
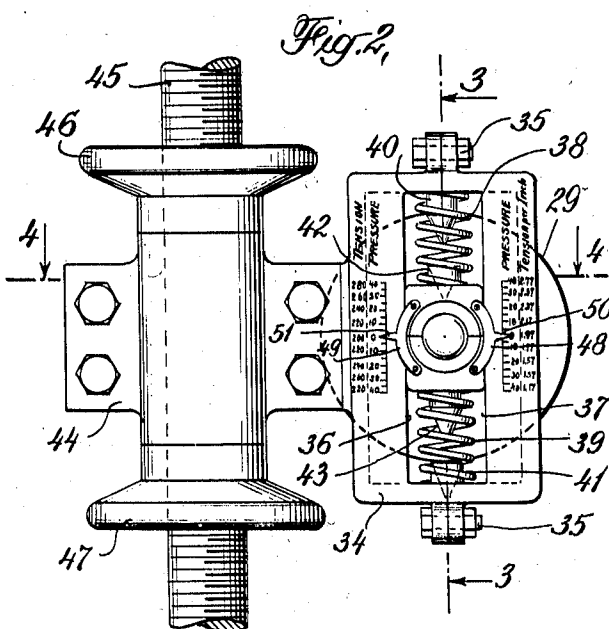
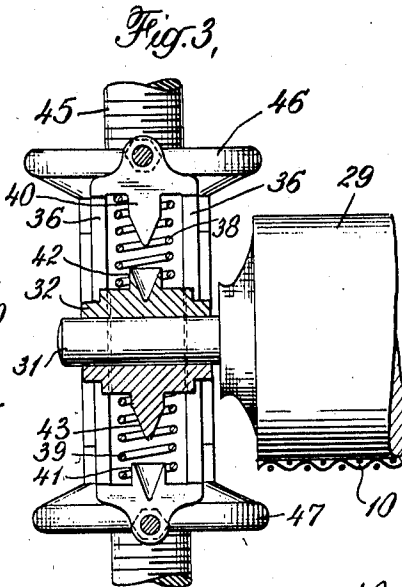
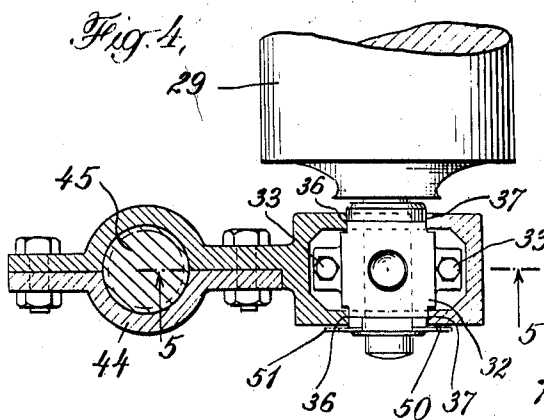
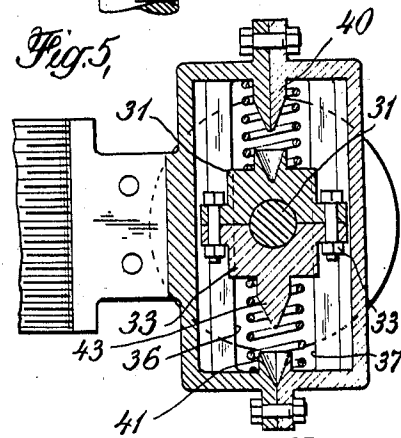
1,582,322

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CONTROL OF BELT TENSION IN PAPER MACHINES

Filed April 30, 1925

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 6,

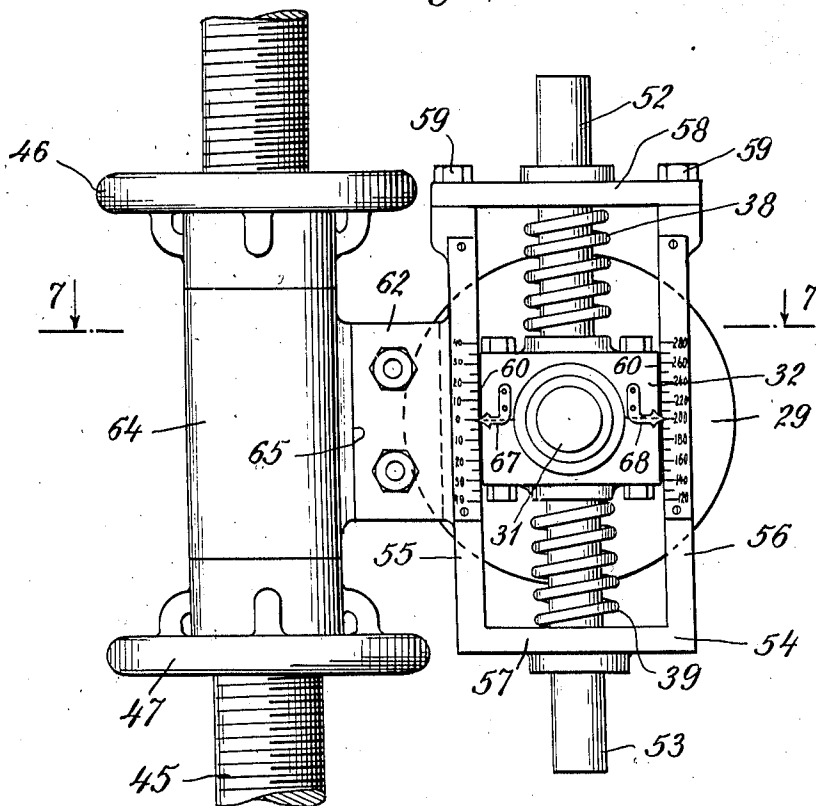
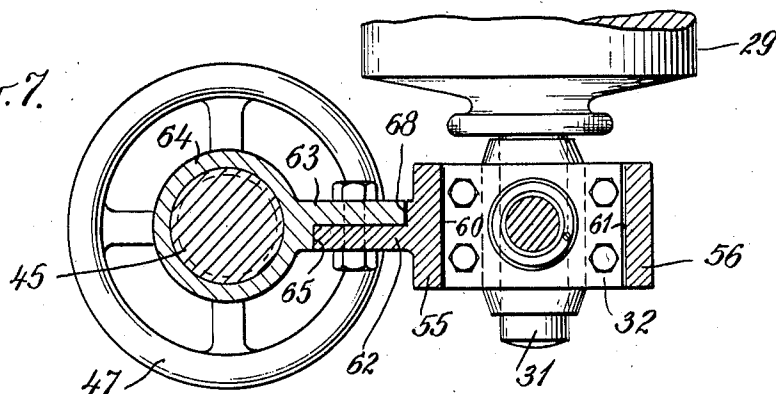


Fig. 7.



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UNITED STATES PATENT OFFICE.

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CONTROL OF BELT TENSION IN PAPER MACHINES.

Application filed April 30, 1925. Serial No. 26,867.

To all whom it may concern:

Be it known that I, FRANCIS W. WARREN, a citizen of the United States, residing at Paris, France, have invented certain new and useful Improvements in the Control of Belt Tension in Paper Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to paper machinery and particularly to the handling in paper machines of paper-forming wires, paper-carrying felts and the web of paper itself. In the operation of paper machines it is of great importance to produce and maintain an appropriate tension in the paper-forming wire, the carrying felts and the paper web and it is the object of the present invention, more particularly, to control in an improved manner the tension in these felts, webs of paper, and especially in the paper-forming wire.

In the Fourdrinier or wet end of a paper-making machine an endless belt in the form of a wire fabric is caused to travel by frictional contact with power-driven rolls over a series of table rolls. After passing over the table rolls the wire proceeds over a series of suction boxes and then around one of the power-driven rolls termed a "couch" roll, from whence it returns underneath the table rolls to the "breast" roll, at the front end of the machine.

The paper stock is flowed onto the traveling wire screen at a point near the breast roll and the initial stages of the formation of the paper web occur during the journey over the table rolls. During this time much of the water from the stock drains through the meshes of the wire and, in order to facilitate this action and more especially, to cause the paper fibres to properly arrange themselves in felted relation, the paper-forming wire is given a lateral rocking or shaking motion from the breast roll to the first suction box.

The wire over the suction boxes is prevented from shaking by the suction, and although the mechanism for imparting the rocking or shaking motion to the table rolls is usually designed so as to effect a relatively large movement of the table rolls

which are near the breast roll, and a relatively small movement of those table rolls which are near the suction boxes, nevertheless because of the relatively great width of the wire screen, there is produced a variation in the tension of the wire throughout its width adjacent the first suction box. Wires of from 156" to 200" in width are not uncommon and there is not only produced a variation in the tension but not infrequently a movement of the strands of the wire fabric relative to one another. Although this movement is of relatively small magnitude, it produces rapid wear of the wire.

It is usual to provide a roll, termed a "stretch" roll, in such position as to bear upon the upper surface of the wire as it returns from the couch roll to the breast roll for the purpose of producing a proper tension in the wire to cause it to operate in the desired manner. This stretch roll is journaled in vertically adjustable bearings, but, in accordance with the usual practice, these bearings are rigidly fixed to their supports. Hence, in some paper machines, the shaking motion above referred to has a tendency to alternately stretch the edges of the wire at each stroke of the shake. It has also hitherto been proposed to independently journal the opposite ends of the stretch roll and this would have to a certain extent alleviated the stretching of the wire had it not been for the fact that the journaling mechanism employed was so constructed that its moving parts were of a relatively large mass and therefore possessed relatively great inertia. In these prior machines, therefore, the shake motion continued to cause stretching of the wire and neither the cause of the stretching nor its remedy was discovered.

It will be understood that the stretching of the Fourdrinier wire above referred to it highly objectionable for the reason that it reduces the life of the wire which is extremely expensive to replace. The stretching of the edges of the wire causes it to wrinkle and therefore lie unevenly on the table rolls and when it passes between the couch rolls and the breast roll, these wrinkles are compressed. Then as the wire proceeds, they are partially straightened out again, thus fatiguing the wire at such points and eventually causing it to crack.

This tendency of the edges of the wire to stretch because of the action of the shake motion has been largely overcome by the present invention and according to this invention the wire is operated under a condition of tensional equilibrium produced by a stretch roll which with its moving parts possesses a minimum of inertia, this roll being arranged to float, or in other words, to be freely movable vertically at each end under the support of the wire. The vertical movement of both ends of the roll is resiliently opposed both upwardly and downwardly.

When the shaking motion tends to pull one side of the wire more than the other, the floating roll is slightly lifted by the wire and the stretching reduced. The resilient mounting of the ends of the roll causes a variation in the initial tension produced by the weight of the roll in accordance with the lifting or sagging of either side of the wire.

The improved apparatus of my invention includes a journal bearing disposed at each side of the Fourdrinier wire and carrying the journals of the stretch roll which extends throughout the width of the wire, and vertical guides for each of these journal bearings which allow the roll to move freely either up or down under the support of the wire. Means are also included, such for example, as a pair of spiral springs, one arranged above and the other below each journal bearing for increasingly opposing the movement of the roll either above or below this floating position. In addition, an indicating device is provided so that the total tension on the wire may be read at any instant, and means for independently adjusting the vertical position of the springs for the purpose of equalizing the tension throughout the width of the belt.

The invention will be better understood by referring to the accompanying drawings which illustrate by way of example a specific embodiment of the invention. In these drawings—

Fig. 1 is a view in elevation of the Fourdrinier part or wet end, of a paper making machine embodying my invention.

Figs. 2 to 5 inclusive are detailed views illustrating the construction of the bearings at each end of the tension or stretch roll.

Fig. 2 is an end elevation of the journal bearing, vertical guides and their support.

Fig. 3 is a vertical section taken on line 3—3 of Fig. 2.

Fig. 4 is a horizontal section taken on line 4—4 of Fig. 2.

Fig. 5 is a vertical section taken on line 5—5 of Fig. 4.

Fig. 6 is a view similar to Fig. 2 illustrating a modified form of the journal bearing, vertical guide means, and adjustable spring support, and

Fig. 7 is a transverse section taken on line 7—7 of Fig. 6 looking in the direction of the arrows.

Referring now to these drawings, the Fourdrinier wire 10 forms an endless belt which passes from the breast roll 11 over the table rolls 12 and the suction boxes 13 to the guide rolls 14 and the couch rolls 15 and 16. The wire passes around lower couch roll 16 over supporting roll 17, underneath the tension or stretch roll 18 and over a second supporting roll 19 back to the breast roll 11.

The paper-forming wire 10 is driven continuously in a direction to carry the upper part of the wire over the table rolls 12 from breast roll 11 toward the suction boxes 13, power being applied to the shaft of lower couch roll 16. For this purpose a suitable clutch (not shown) is provided on the shaft of roll 16 for starting and stopping the wire. The paper stock or pulp supplied by means of a trough 20 to the head box 21 flows over apron 22 and underneath the sluice 23 onto the moving wire. It will be understood that the wire 10 is slightly wider than the web of paper which it is desired to form and according to present practice, wires having a width of from 156 to 200" are not unusual. Along each edge of the portion of the wire passing over the table rolls, and driven by frictional engagement therewith, there is a deckle strap 24. These deckle straps serve to keep the liquid pulp upon the wire and prevent it from overflowing the edges of the wire as it emerges from the sluice 23 and spreads out in the form of a thin layer. The deckle straps are of endless construction and are supported on rolls 25, 26, 27 and 28.

As the wire 10 passes over the table rolls, it is necessary that it be kept flat and smooth and for this purpose, suitable tension is applied to the wire by means of the tension roll 18 which is constructed in accordance with the principles of my invention and which will be described in detail below. As mentioned previously, the portion of the machine between the breast roll 11 and the suction boxes 13 is rocked or shaken by suitable mechanism. This mechanism is not illustrated, but it will be understood that it causes a movement or shaking of the table rolls and wire 10 thereon in a direction transverse to the direction of movement of the wire. This motion causes the fibres of the paper pulp to intermingle and interlock with one another as to produce, when the moisture has been removed and the paper web dried, a tough and strong product.

Tension or stretch roll 29 is slightly greater in length than the width of wire 10 and is supported at each end by an improved take-up bearing which is indicated generally by reference numeral 30 and one of which is located on each side of the machine. The

take-up bearing on the side of the machine nearest the reader is shown in Fig. 1 and a similar bearing is employed on the opposite side of the machine.

5 In this take-up or tension roll bearing the journal 31 is carried in a journal bearing 32 which is composed of similar upper and lower sections appropriately bolted together by bolts 33 as may be seen in Figs. 4 and 5.
10 The journal bearing 32 is thus a unitary structure in which journal 31 is freely rotatable. Journal bearing 32 is mounted so as to be freely slidable in the vertical direction in a frame-work 34 composed of sections secured together by bolts 35 and cast hollow so as to form a housing for the journal bearing 32. Each of these frame sections has a pair of relatively narrow vertical faces 36 and 37 respectively which co-act with flat faces on journal bearing 32 and serve as vertical guides therefor. The flat faces of bearing 32 which co-act with these guides are of considerable length, the exterior of the sections of which bearing 32 is constructed being of rectangular shape, so that the bearing slides freely in the guides 36 and 37 without any tendency to bind or stick.

Within the chamber of the frame-work in which bearing 32 slides, there is provided a pair of spiral springs 38 and 39 respectively above and below the bearing. These springs are of similar strength and cooperate with frame 34 and bearing 32 to hold the bearing normally in position midway between the top and bottom of the guide-ways. They are held in position by projections 40 and 41 on frame 34 and 42 and 43 on respectively the upper and lower sections of bearing 32. Each pair of cooperating projections have interfitted cone shape seats as indicated in the drawings to assist in maintaining the alinement of the bearings when either of the springs is fully compressed. The frame-work 34 is equipped with a clamp support 44 loosely encircling a threaded post 45 so that it is free to move up and down over the threads thereon. Hand wheels 46 and 47 engage the threads of shaft 45 and serve to adjustably hold the support 34 between them and thus afford a ready means of raising or lowering the tension roll bearing 30 as a whole.

As will be understood from Fig. 1, the tension or stretch roll 29 is supported upon the Fourdrinier wire screen 10 and the weight of this roll is such as to cause a total tension of about 200 pounds in the wire, this being the usual tension in a relatively wide wire. A pair of semi-circular strips 48 and 49 carry pointers 50 and 51 respectively and are fastened upon the outer end of journal bearing 32 in proper position to cooperate with scales on the frame 34. By adjusting hand wheels 46 and 47 the tension roll bear-

ing 30, both at the front and also at the rear of the machine, that is, at each side of the wire 10, may be vertically adjusted so that the pointers 50 and 51 indicate zero on the scales. In this position neither of springs 38 and 39 of either bearing 30 is stressed and the tension in the wire 10 is caused entirely by the weight of roll 29.

If the weight of tension roll 29 is not uniform from end to end, this can be compensated for by adjusting the tension roll bearing 30 at one side of the wire or the other so as to compress spring 38 or spring 39 and thereby increase or decrease the tension on the wire at that side of the machine. Springs 38 and 39 may not be of the same size as indicated but may be of different strengths in order to provide, in combination with the weight of the roll, the proper tension on the wire 10. Different strength springs may also be used at the opposite ends of the roll 29 to secure proper compensation for longitudinal variation in the weight of the roll. Also, if it is desirable to operate the paper-forming wire 10 at a higher or a lower total tension than 200 pounds, both of the stretch roll bearings 30 can be raised or lowered by manipulating hand wheels 46 and 47 and reading the tension on the scales provided. The total tension of the wire may be read on the scale at the extreme left as viewed in Fig. 2 and the tension per inch of width of wire may be read on the opposite scale at the extreme right. The other two scales, however, indicate the pressure exerted by the springs in pounds.

The modified form of tension or stretch roll bearing illustrated in Figs. 6 and 7 is operated in a manner similar to the bearing above described, and possesses certain additional features of advantage. In this modification a rigid rod or post 52 is secured to the upper section of journal bearing 32 and a similar rod 53 is secured to the lower section. The coil springs 38 and 39 are mounted upon these two rods respectively, the inner ends of the springs pressing against the journal bearing sections, and the outer ends of the springs being confined by the spring support 54.

The spring support 54 is a frame structure of rectangular form having two upright members 55 and 56 which are joined at the bottom by a cross member 57, and at the top by a cross member 58 which is removably fastened to the upper ends of the uprights 55 and 56 by means of bolts 59. The outer ends of springs 38 and 39 consequently bear against the members 58 and 57 respectively. The rods 52 and 53 which are coaxially arranged pass through apertures in the cross members 58 and 57 respectively, these apertures serving as guide-ways in which the rods loosely fit and freely slide. The members 58 and 57 are provided with bosses so

as to increase the bearing surface in contact with the rods 52 and 53.

The flat sides 60 and 61 of the journal bearing 32 are preferably spaced from the interior faces of the uprights 55 and 56 by an amount which will allow the guiding of the bearing as it moves upon and down to be done entirely by means of the rods 52 and 53. This tends to reduce the friction of the parts and to allow greater freedom of motion of the journal bearing 32 in the vertical direction. When, however, the journal bearing as a whole is removed from the journal 31 of the tension roll, the sides 60 and 61 by coaction with the interior faces of uprights 55 and 56, prevent the turning of the journal bearing 32 and hold it in position. This facilitates the handling of the apparatus during assembly and disassembly.

The spring support 54 in the modified form of the apparatus is secured to the threaded post 45 in a somewhat different manner from the frame work 34 of Fig. 2. Spring support 54 has a laterally projecting lug 62 which is bolted to a corresponding lug 63 on a member 64 which encircles the threaded post 45 and which is held in place by the hand wheels 46 and 47. The outer ends of lugs 62 and 63 coact with shoulders 65 and 66 on the opposite lugs 63 and 62 which, because of their relatively great vertical length, securely position the spring supports 54. With this arrangement, when it is desired to disassemble a tension roll, for example, for repairs, or for the replacement of the Fourdrinier wire, the tension roll bearing may be easily removed and replaced in the exact position that it formerly occupied. It is only necessary to remove the two bolts which clamp together lugs 62 and 63, leaving member 64 in the position to which it has been adjusted on post 45.

The rods or plungers 52 and 53 not only serve as guides for the journal bearing 32, but they also maintain the coils of springs 38 and 39 in proper alignment so as to prevent the buckling of the springs, that is, the tendency for some of the coils to move outwardly and interfere with the functioning of the spring. Pointers 67 and 68 are mounted on the journal bearing 32. Pointer 67 moves over a scale at the left which indicates the force in pounds exerted by springs 38 or 39 and pointer 68 moves over a scale at the right which indicates the total tension or stretch existing in the wire caused by the combined weight of tension roll 29 and the force exerted by the springs.

When a wire is operating in combination with a tension or stretch roll mounted as above described, the alternate stretching of the opposite edges of the wire which is caused by the table roll shake motion will

be taken up by a lifting or lowering of one side or the other of the stretch roll 29; this freedom of movement being possible because of the floating arrangement of the roll under the action of the wire 10 and the springs 38 and 39. The initial tension applied to the wire depends primarily upon the weight of roll 29 and the relatively small parts directly connected thereto and therefore moving up and down with the roll, these parts being only the journals 31 and bearings 32. For this reason the inertia of these parts is relatively low and, even though the shake motion is operated rapidly so that the tension in the wire is varying rapidly from side to side, nevertheless these changes are compensated for in a practical manner so as to materially reduce the amount of "stretch," or in other words the amount of permanent set in the wire.

Furthermore, by supporting the roll in a floating condition on the wire and providing the springs 38 and 39 which increasingly oppose any movement of the roll either upwardly or downwardly from this floating position, the stretch or tension roll is made to be in a sense self-adjustable. By this it is meant that as the Fourdrinier wire expands under the action of heat or from any other cause, the change in tension is to a certain degree compensated and is accurately indicated by the change of position of the pointers on their respective scales. Thus the operator of the machine has a means of knowing accurately the exact tension under which the wire is operated. Any slackening of the wire caused by expansion will immediately show on the scale, thus allowing the operator to adjust the bearings accordingly and to avoid wrinkling of the wire when passing through the couch rolls and over the breast roll.

Should the stretch or tension roll not be of uniform density, that is, heavier at one end than the other, as is sometimes the case, especially in old machines, then, when starting a Fourdrinier wire, the indicating pointers on each side of the machine may be set so as to produce a uniform tension by a simple manipulation of the hand wheels 46 and 47 which varies the position of support of springs 38 and 39 and thus adds to or reduces the weight of the roll.

By controlling the wire in the manner described above, it is given a completely elastic working condition which eliminates severe strains and stresses, especially when accelerating the wire from rest to full speed. Inasmuch as these wires are now operated at speeds as high as 1,000 feet per minute, it is easily understood that great care must be used in bringing the wire up to this speed inasmuch as it is an easy matter to accelerate too rapidly and permanently stretch the wire. The elasticity provided by this

improved control of the tension of Four-drinier wires practically eliminates this hazard.

I claim:

5 1. In a paper machine, an extensible and contractible belt, a roll supported thereon for applying tension thereto, journal bearings for the roll having vertical guides which allow the roll to float freely under the support of the belt, and means associated with said guides for increasingly opposing the movement of the roll above or below this floating position in proportion to the amount of this movement.

15 2. In a paper machine, an extensible and contractible belt, a roll supported thereon for applying tension thereto, journal bearings for the roll having vertical guides which allow the roll to float freely under the support of the belt, means associated with said guides for increasingly opposing the movement of the roll above or below this floating position in proportion to the amount of this movement, and means for indicating the relative position of the bearings in their respective vertical guides.

20 3. In a paper machine, an extensible and contractible belt, a roll extending throughout the width of the belt and supported thereon for applying tension thereto, a journal bearing for each end of the roll having vertical guides which allow the roll to float freely under the support of the belt, means associated with said guides for increasingly opposing the movement of the roll above or below this floating position in proportion to the extent of this movement, and means for independently adjusting the position of said opposing means with respect to said bearings so as to equalize the tension throughout the width of the belt.

35 4. In a paper machine, an extensible and contractible belt, a roll supported thereon for applying tension thereto, journal bearings for the roll having vertical guides which allow the roll to float freely under the support of the belt, and a pair of springs, one above and one below each bearing and coacting therewith to increase or diminish the pressure applied to the belt by the weight of the roll as the roll moves in said guides respectively above or below said floating position.

45 5. In a paper machine, an extensible and contractible belt, a roll supported thereon for applying tension thereto, journal bearings for the roll having vertical guides which allow the roll to float freely under the support of the belt, a pair of springs, one above and one below each bearing and co-

acting therewith to increase or diminish the pressure applied to the belt by the weight of the roll, and means for indicating the relative position of said bearings in said vertical guides.

65 6. In a paper machine, an extensible and contractible belt, a roll supported thereon for applying tension thereto, and journal controlling means for each end of the roll comprising, a journal bearing, guiding means therefor permitting the roll to float freely under the support of the belt, a spring above and below the journal bearing, said springs coacting therewith to increase or diminish the pressure applied to the belt by the weight of the roll, and a vertically adjustable support for said springs.

70 7. In a paper machine, an extensible and contractible belt, a roll supported thereon for applying tension thereto, and journal controlling means for each end of the roll comprising, a journal bearing, guiding means therefor permitting the roll to float freely under the support of the belt, a coil spring above and below the journal bearing, said springs coacting therewith to increase or diminish the pressure applied to the belt by the weight of the roll, a vertically adjustable support for said springs, and means associated with the journal bearing and said support for preventing the buckling of the springs when compressed.

80 8. In a paper machine, an extensible and contractible belt, a roll supported thereon for applying tension thereto, and journal controlling means for each end of the roll comprising, a journal bearing, guiding means therefor permitting the roll to float freely under the support of the belt, a coil spring above and below the journal bearing, said springs coacting therewith to increase or diminish the pressure applied to the belt by the weight of the roll, a vertically adjustable support for said springs, and a rigid member extending longitudinally of each spring for preventing the buckling of the springs when compressed.

9. In a paper machine, an extensible and contractible belt, a roll supported thereon for applying tension thereto, and journal controlling means for each end of the roll comprising, a journal bearing having rods rigidly secured at the top and bottom thereof respectively, a vertically adjustable spring support having apertures therein in which said rods slide, and a coil spring around each rod and coacting with the bearing and said support.

In testimony whereof I affix my signature.
FRANCIS W. WARREN.