Sept. 4, 1962 E. D. BEACHLER 3,052,293

POSITIONING AND FORCE APPLYING SPRING ARRANGEMENT FOR PAPER MAKING MACHINE

Original Filed Oct. 23, 1958 3 Sheets-Sheet 1

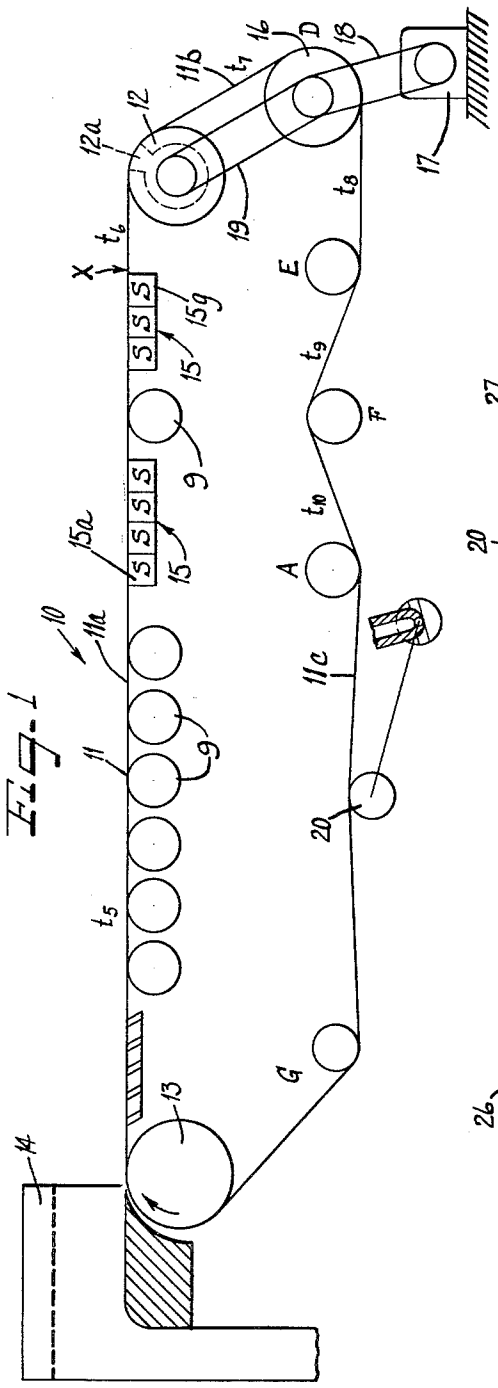

Fig. 1

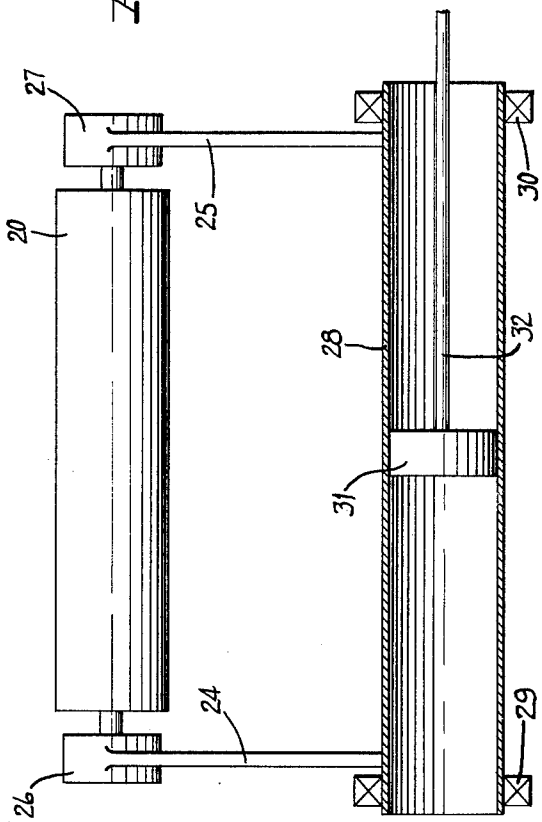

Fig. 2

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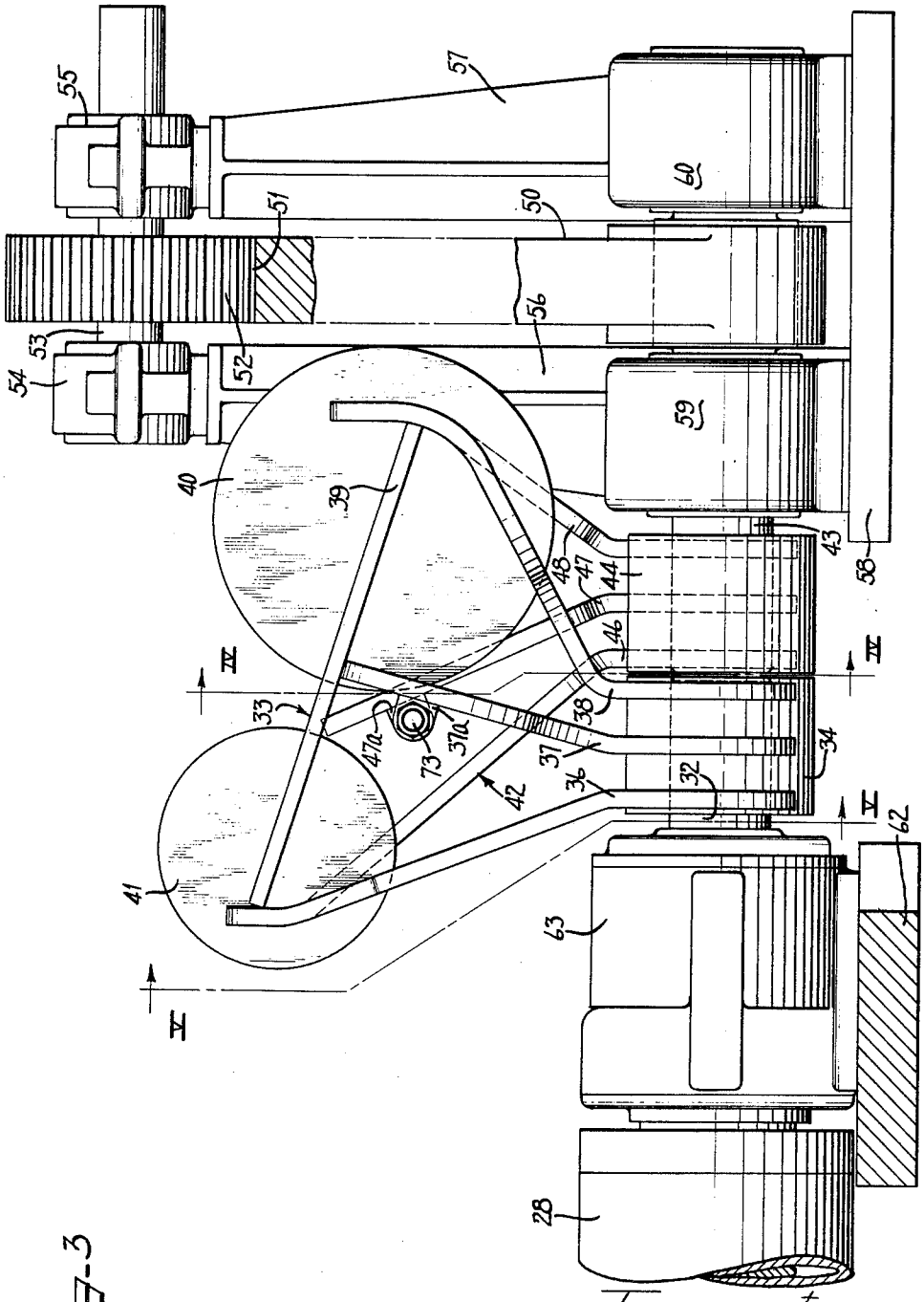

Fig-3

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POSITIONING AND FORCE APPLYING SPRING ARRANGEMENT FOR PAPER MAKING MACHINE

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Fig. 4

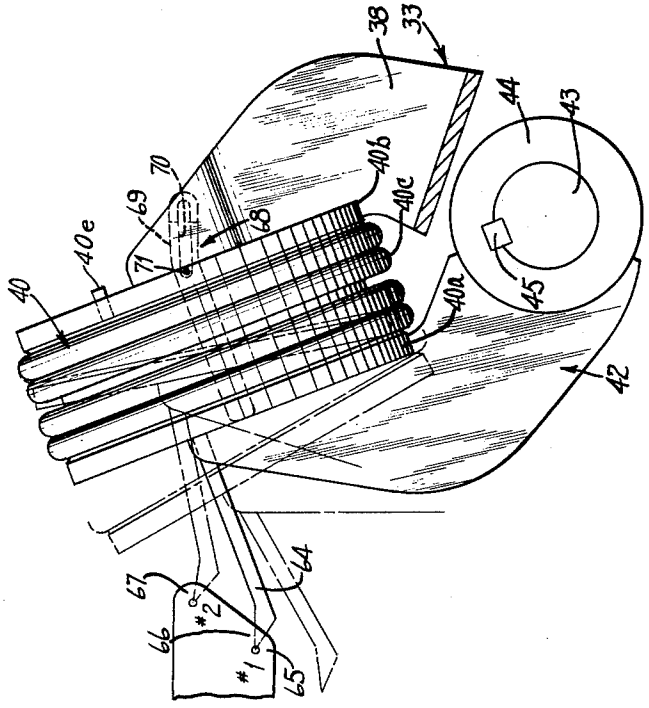
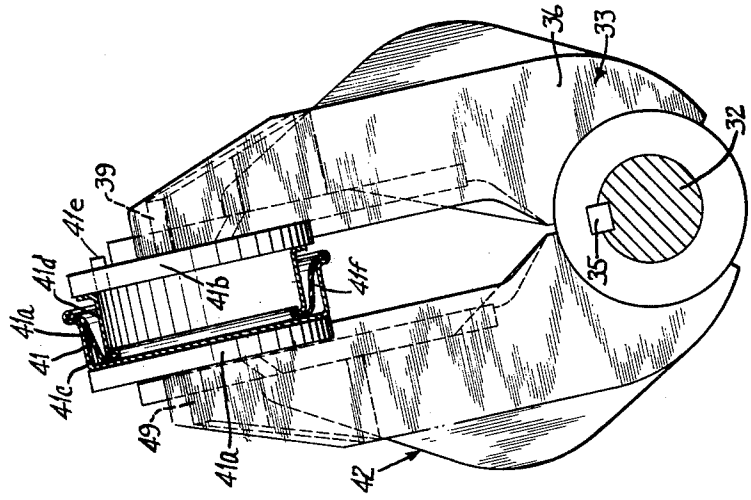


Fig. 5



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3,052,293

POSITIONING AND FORCE APPLYING SPRING ARRANGEMENT FOR PAPER MAKING MACHINE

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Continuation of application Ser. No. 769,166, Oct. 23, 1958. This application June 26, 1961, Ser. No. 123,925
10 Claims. (Cl. 162—273)

This application is a continuation of Serial No. 769,166 filed October 23, 1958, now abandoned.

The present invention relates to devices for controllably adjusting the path length of endless looped bands and particularly to mechanisms suitable for use in Fourdrinier type paper making machines. It is particularly adapted for the controllable adjustment of the operating length of the Fourdrinier wire while maintaining a controllable initial tension in such wire loop.

In the Fourdrinier type paper machine, a looped forming wire is trained over a breast roll (at the end receiving stock from a headbox), over a plurality of suction boxes and the like dewatering devices, and then over a couch roll and a turning roll at the end of the web forming zone. In modern paper machines, the length of the wire required and other considerations dictate the addition of carrying rolls and other devices to support the reach of the forming wire from the breast roll to the suction boxes and couch roll. The forming wire is a critical and comparatively delicate element in the paper machine, and it must be handled with care in order that the forming wire may be driven by its frictional engagement with the surfaces of the turning roll and usually the couch roll, and a certain initial tension is required. This initial tension, besides furnishing the frictional engagement to permit driving the wire, also serves to maintain the smooth level condition necessary for the formation of paper. In addition to this initial tension, there is developed much greater tension in the wire reach between the turning roll and/or couch roll, at which point or points the driving force is supplied to the wire, and the suction boxes. It will be understood that during the normal operation of the paper machine with stock forming on the wire, a considerable drag is introduced by the atmospheric pressure, tending to force the forming wire tightly to the surface of the suction boxes. This effect constitutes the major part of the driving load in a Fourdrinier part of a paper machine.

Despite the efforts of papermakers and machine builders to the contrary, there always remain minor irregularities in the suction forces, in the stretch modulus of the Fourdrinier wire, in the frictional factors causing the wire to drag over the suction box covers and in the friction behavior of the driving rolls themselves. These and other factors make necessary the provision of mechanism to provide for the change of the path length of the Fourdrinier wire during operation. In actual operation, the length of the wire is slightly greater than the length determined only by the initial tension, because of the greater tension resulting from the suction box drag and extending to the driving roll, or rolls.

These continuing variations in length during the operation of the paper machine have heretofore been provided for by devices known generally as stretchers. These stretchers have been, conventionally, rolls so mounted so as to swing on arms about a remote axis and have been weighted (or counterweighted). These devices have usually provided for the minor differences in length of Fourdrinier wires as supplied from the manufacturer and frequently have provided sufficient adjustment to permit the placement of new Fourdrinier wires as well.

For convenience in the removal and replacement of

the Fourdrinier wire, it is desirable that the wire stretcher roll be located outside the wire loop in order to avoid the complication involved in removing such apparatus from within the loop. It is also desirable where possible to use small angles or wrap of the wire over tensioning rolls and other rolls, but for this reason small changes in the total length of the wire make reatively large differences in the position of the tensioning roll. Where tensioning rolls are mounted as described, for pivoting about a remote axis, the arm length required and the counterweights used have become unmanageably large and introduced considerable inertia. These factors made it difficult to compensate for minor fluctuations in the wire path length and caused great difficulties, to the point of damage or destruction of the wires in the event of abrupt loss of suction and the consequent changes in power input.

Heretofore it has not been obvious that a successful stretcher mechanism would require a "controllably elastic" behavior to permit both minor fluctuations in length as well as relative by larger changes due to surges of tension.

The stretcher mechanisms heretofore have not provided for the fluctuations in tension and, therefore, in the path length of the Fourdrinier wire particularly during those instances when the drag due to the suction boxes is lost due to the loss of vacuum. This occurs always when shutting down the paper machine and occasionally during operation. The induced tension between the suction box area and the driving means is dissipated and the wire tends to shorten at the same rate as the tension decays. Conventional stretchers have been relatively rigid because of mass and weight and the abrupt redistribution of the tension results in a damaging surge at the stretcher roll. Despite the advantages of the outside stretch roll, this effect has limited their use.

Stretcher rolls which are swing arm mounted to move with the change of length of the wire, permit large changes in the arc of contact with the wire, usually called angle of wrap. The resultant force on the roll mountings changes significantly in amount and direction. Also, the effective moment about the pivot axis of the arms due to the weight of the apparatus changes. The maintenance of constant initial tension in the Fourdrinier wire with these devices was difficult or impossible.

Accordingly, it is an object of the present invention to provide an improved tensioning mechanism with a minimum of inertia.

It is an object of the present invention to provide an improved tensioning mechanism which is capable of absorbing an abrupt change of length which occurs when suction is lost in the Fourdrinier suction boxes, as, for example, occurs while the paper machine is being shut down.

It is also an object of the instant invention to provide a mechanism including a roll mounted outside of the wire loop which has a minimum of inertia whereby an exact desired initial tension may be maintained in Fourdrinier wires at any position of its operating range.

A further object of the present invention is to provide a mechanism in which the effect of a change in the angle of wrap of the Fourdrinier wire about the stretcher roll does not result in a change in tension in the wire.

An additional object of this invention is to provide for the mounting of an outside stretch roll on pivoting arms in a manner which avoids the effect of the change of gravity moment with a change in stretcher roll position.

A further object of the invention is to provide a stretcher mechanism adapted to follow a change in the path length of a Fourdrinier wire which change is induced by variations in stress in the wire.

Another object of this invention is to permit the mounting of the stretcher mechanism outside of the loop of the Fourdrinier wire to permit convenient and easy disengagement of the mechanism from the wire for wire change.

An additional object of the instant invention is to provide a stretcher mechanism controllable in its degree of elasticity to permit the maintenance of a desired amount of initial tension in a Fourdrinier wire.

Other objects, features and advantages will become more apparent with the teachings of the principles of the invention in connection with the disclosure of the preferred embodiments thereof, in the specification, claims and drawings, in which:

FIGURE 1 is a side elevational view, shown in schematic form, of a Fourdrinier type of mechanism for a paper making machine with a tensioning roll assembly embodying the principles of the present invention;

FIGURE 2 is a plan view in diagrammatic form illustrating a support mechanism for a tensioning roll;

FIGURE 3 is a detailed elevational view, shown partially in section, of a mechanism for applying supporting and tensioning forces to the tensioning roll;

FIGURE 4 is a sectional view taken substantially along the line IV—IV of FIGURE 3, and illustrating the construction of the mechanism applying a counterbalancing force to the tension roll assembly; and,

FIGURE 5 is a vertical sectional view taken substantially along line V—V of FIGURE 3, illustrating the mechanism for applying a tensioning force to the tensioning roll assembly.

As shown on the drawings:

In FIGURE 1, the reference number **10** indicates generally a Fourdrinier wire arrangement for a paper making machine comprising a looped forming wire **11** having the upper run **11***a* thereof stretched between a suction couch roll **12** at the forward end, a breast roll **13** at the rear end whereat a headbox **14** flows stock onto the upper run **11***a* of the wire **11**. Between the breast roll and suction couch roll, are mounted suction boxes **15** which are stationary and which serve to dewater the web passing thereover on wire **11**. Table rolls **9** may also be provided for additional support and for water removal from the upper run **11***a* of the wire. Dewatering of the web is further accomplished at the suction area **12***a* of the suction couch roll **12**. Conventionally, the new formed web is removed from the reach of wire **11***b* following the suction couch roll. As indicated diagrammatically, a motor **17**, suitably connected to the suction couch roll **12** through a belt **18**, drives the turning roll **16** (also indicated as D) which is the main drive for the wire **11**.

Guide rolls E, F and A are mounted to engage the lower or return, run **11***c* of the wire **11**. A tensioning roll **20** is positioned to engage the outside of the wire loop in the return run **11***c*. This tensioning roll applies a force to the outer surface of the wire, and moves to accommodate variations in the path length of the wire. A take-up roll G may be provided which is adjustable for substantial variations in manufactured length, but which is fixed in position during normal operation of the belt.

In the operation of the machine **10**, the main drive including motor **17** and belt **18**, rotates the turning roll D which frictionally engages the wire to move it. The main drive is assisted in this embodiment by the helper drive belt **19** connected to the couch roll **12** and which is interconnected with the main drive. (In certain applications it has been found advantageous to drive the rolls, E, F and A.) It will be understood that the arrangement of the wire carrying rolls and the drive rolls of FIGURE 1 are shown by way of example only, and that the features of the invention may be employed to utilize their natural advantages in other mechanisms and other environments.

In any mechanism such as that shown in FIGURE 1, local variations of tension will occur in the wire due to the effect of the driving forces applied to overcome the resistances present. For example, the drive roll **16** and couch roll **12** tend to move the wire forward and this is resisted normally by the action of the suction boxes **15**, which create a drag on the wire, which drag is the principal component in the power required for driving a Fourdrinier.

It will be observed by FIGURE 1 that the resistance due to the frictional drag over the suction boxes will accumulate as the wire moves from the first suction box **15***a* to the last suction box **15***g*. Under normal operating conditions, it may be observed that the tension in the wire is a maximum at a point indicated by X in FIGURE 1. Upon consideration of FIGURE 1 it will be observed that the tension in the wire will be reduced as it passes over the suction couch roll **12**, inasmuch as power is being applied to the wire at this point. This power input results in a somewhat decreased tension in the wire reach **11***b*. The maximum reduction in tension will, of course, occur as the wire is carried around the turning roll D, which is the major source of power input.

The presence of paper making stock, an aqueous suspension of fiber in water, tends to seal the wire permitting vacuum to exist in the suction boxes **15**. If, for some reason, the stock flow is interrupted, as may be the case when shutting down the paper machine, the level of vacuum in the suction boxes will be decreased or eliminated. This will in turn permit the tension in the wire at T_6 to decay abruptly reducing the power required to drive the wire. Concurrently, this reach of wire will tend to reduce in length as will the remaining reaches of wire due to the marked decrease in power required. This results in a redistribution of tension and a change in total length in a wave around the path length of the wire. This in turn will change the position of the tensioning roll **20**.

It is desirable whenever possible to use small angles of wrap of the wire over the rolls including the tensioning roll **20**, and for this reason, small changes in total length can make large differences in the position of the tensioning roll. This in turn leads to large changes in tension if the roll is provided with mechanisms for applying a tensioning force to the roll of the type heretofore used. In mechanisms heretofore used, the substantial weight of the mechanism created inertia problems with sudden reduction in the length of the wire, and created increase in tensioning forces as the wire shortened to move the tensioning roll against its tensioning mechanism. This created severe fluctuations in wire tension, and was capable of creating wire damage, such as known to the art as ridging, both directly and by changing the deflection of other carrying rolls of the wire loop which in turn introduced damaging stresses in the wire.

As a representation of the distribution of tension in the Fourdrinier wire, dimensions and values may be assigned as in FIGURE 1, to furnish a numeric example of typical conditions.

T_5=12#/inch.
T_6=35#/inch.
T_7=33#/inch.
T_8=20#/inch.
T_9=16#/inch.
T_{10}=14#/inch.

For the purpose of this example, it is assumed that no resistance is offered to the wire by the breast roll **13** or the table rolls **9**. While this is not strictly true these forces are sufficiently small that they may be neglected.

Further, it may be assumed that the length of the wire tension spans involved are as follows:

T_5—79 ft.
T_6—20 ft.
T_7—15 ft.
T_8—12 ft.
T_9—12 ft.
T_{10}—12 ft.

Assuming a representative value for stretch modulus: 8500 pounds per inch, a simple calculation indicates that if the assumed total length of Fourdrinier wire in the unstressed condition will be 150', the same wire will increase to 150.21' under the initial tension as represented by T_5 and further that in the operating stressed condition the same wire will be extended to 150.40'. This represents a difference of .19', or 2.28". It will be understood that these figures will apply only to a particular machine and further that these figures will be an average which will tend to fluctuate.

In the event of loss of suction in the suction boxes, as, for example, during the period of shutdown of the machine, a redistribution of tension will take place which will require the stretch roll to move abruptly to follow a decrease in path length of approximately 2". This, of course, will tend to substantially change the position of any tensioning roll which bears against the substantially straight run of wire. When this change is abrupt, as it must necessarily be at times, the movement of the tensioning roll must be rapid.

It is also desirable that the stretch or tensioning roll of such an apparatus be adapted to compensate for changes in the unstressed length of the wire due to a permanent set which will develop as the wire becomes worn. It is further desirable that such apparatus provide for differences in successive wires to differences in manufacturing length.

The tensioning roll 20 is supported on pivotal arms 24 and 25, as shown in FIGURE 2, which have bearings 26 and 27 at their ends to support the tensioning roll 20 for free rotation. The tensioning roll support arms 24 and 25 are mounted on a tube 28 which is rotatably mounted at its ends in bearings 29 and 30. The tube 28 is controlled in its pivotal position and a rotating torque is applied thereto to hold the tensioning roll 20 against the wire with the proper tension. To equalize the force in the arms 24 and 25, and equalize bending stresses, a tensioning force is applied by a bar 31, secured at the center of the tube, and twisted by a shaft 32 secured to the bar 31. The torque applied to the shaft 32 to cause the roll to apply a tensioning force to the wire is obtained from mechanism shown in detail in FIGURES 3, 4 and 5.

An important feature of the invention is to provide a roll assembly wherein the roll is movable to alter the path length of the wire with the roll being supported by first counterbalancing spring means which are operative to counter the weight of the roll assembly in any position of the roll, and second separate and independent spring means which act on the roll assembly to adjustably control the operating tension of the wire.

As illustrated in FIGURES 3 and 5, a tensioning torque is applied to the shaft 32 by a tensioning arm assembly 33.

The tensioning arm assembly 33 is fabricated and includes a hub 34 secured to the shaft 32 by a key 35. Projecting from the hub are a plurality of shaped bars with the bars 36, 37 and 38 secured at one end to the hub, and secured at the other end to a lateral bar 39. The ends of the bars 36, 37 and 38 and the lateral bar 39 rest on the top surface of air springs 40 and 41. The forces of the air springs are applied to the tensioning arm assembly 33 to thereby apply a tensioning torque to the roll assembly.

The first or counterbalancing air spring 40 acts as a counterbalancing spring supporting the weight of the roll

assembly. In the preferred form, the roll assembly is supported so as to be substantially weightless whereby the second or tensioning air spring 41 applies a net tensioning force to the tensioning roll 20. As will be recognized, the weight of the roll 20 and its arms 24 and 25 applies a different torque with varying tensioning positions. The counterbalancing air spring 40 is designed to have a load deflection characteristic which will change the force on the arm 33 with deflection to equal and counterbalance the weight of the roll 20 and its assembly. Thus, as the roll deflects further downwardly or approaches more closely to a horizontal position, the force of the counterbalancing spring 40 increases. As will be appreciated by those skilled in the art, this is achieved by proper design of the air spring which includes, as illustrated in FIGURE 4, end plates 40*a* and 40*b* with a bellows 40*c* extending therebetween. The counterbalancing spring is supported on an arm 42, which also supports the tensioning air spring 41, as will be described later in this disclosure.

Both the counterbalancing air spring 40 and the tensioning spring 41 with the tensioning torque arm 33 are carried in a substantially vertical position to nullify the effects of their weight on the system. As illustrated in FIGURES 4 and 5, the assemblies are positioned so that the center of gravity of the arm 33 with its air springs is substantially over the axis of the shaft 32.

The counterbalancing spring is illustrated as being formed with an end plate 41*a* and an opposing end plate 41*b* with the plates respectively carrying annular flanges 41*c* and 41*d*. Attached to the free edges of the flanges is an annular bellows 41*f*, and the design of the flanges and bellows is such that the desired load deflection characteristic will be obtained for the desired tension force of the roll 20 against the wire. Inasmuch as the counterbalancing roll 40 compensates for the weight of the roll assembly, the characteristic of the tensioning spring 41 can be designed solely to obtain a proper tensioning relationship. The air spring 41 is shown in the collapsed form in FIGURE 5 and is provided with means shown generally at 41*e* to inflate the spring with air. The spring 40 is provided with similar means for inflating the spring, shown generally at 40*e* and the elements 40*e* and 41*e* are conventional connections for air inflation lines or may incorporate a flow control valve, as will be fully appreciated by those skilled in the art. The spring 41 is so designed that varying air pressures will give varying tension forces against the wire. Thus, the operator may be provided with an indicating scale wherein the air pressure required for a given wire tension is indicated and the air spring can be inflated for obtaining the desired wire tension.

The air springs 40 and 41 are supported on the backing arm 42 which is mounted on an adjustable support shaft 43. As illustrated in FIGURE 3, the support arm or backing arm 42 includes a hub 44 keyed to the shaft 43 by a key 45 and the arm 43 has fabricated shaped bars 46, 47 and 48 joined at one end to the hub 44 and at the other end by a lateral bar 49 so as to provide a broad support for the air springs 40 and 41.

A stop device limits the separation of the arms 33 and 42 and includes a bolt 73 with an adjustable nut. The bolt passes through drilled holes in lugs 37*a* and 47*a* in bars 37 and 47.

Secured to the shaft 43 is a crank arm 50 carrying a segment gear 51 at its end which is in mesh with an adjusting pinion 52. The pinion is carried on a shaft 53 to which is secured a power means, such as a hand crank. The pinion shaft 53 is mounted in bearings 54 and 55 which are carried on support brackets 56 and 57, mounted on a frame piece 58. Also on the frame piece are bearings 59 and 60 which support the shaft 43. A similar frame piece 62 supports a bearing 63 for the shaft 32 which is carried coaxial with the shaft 43.

Rotation of the shaft 43 permits varying the rotational position of the support arm 42 and thus varies the operating position of the springs 40 and 41.

The support arm 42 for the springs has an indicating pointer 64 which moves along a scale 65. The scale is provided with positions 66 and 67 which indicate #1 and #2 operating the positions for the support arm and springs.

The expansion of the springs 40 and 41, or the distance between the arms 33 and 42 is shown by an indicator marker 68. The marker includes a bar 69 secured to the plate 40*a* of the air spring 40 and having a slot 70 in which slides a pin 71 secured to the upper plate 40*b* of the air spring.

Indicating marks may be carried on the bar 69 along the slot 70, if desired.

For rest position, or for replacing the wire loop in the machine, the roll assembly may be cranked down to a rest position.

To place the tensioning roll assembly into operation, the large counterbalancing air spring 40 is inflated to a predetermined supporting air pressure. The tensioning air spring 41 is then also inflated to a predetermined air pressure preferably to the pressure which will yield the wire tension which is desired. The roll assembly is then lifted by rotation of the pinion shaft 53 until the supporting arm 42 moves upwardly to the #1 position, as indicated by the pointer 64 on the scale 65.

The operator will then observe the indicator marker 68 to determine how far the bellows have expanded. If they have expanded beyond a predetermined limit, e.g., more than 8½° in a preferred construction of the mechanism, the supporting arm 42 is cranked up further to enable the pointer 64 to reach the #2 position. Depending upon the position in which the supporting arm 42 and the springs are operated, the operator will check the charts for the air pressure to be applied to the tensioning bellows 41 to achieve the wire tension desired. The air pressure required for the desired tension will be greater at the #2 position than at the #1 position of the support arm 42. A different air pressure may also be applied to spring 40, depending on whether operation is in the #1 or #2 position.

Thus, it will be seen that I have provided an improved tensioning roll assembly which meets the objectives and advantages hereinbefore set forth. The assembly is capable of applying a tensioning force to a run or span of a Fourdrinier wire, or a traveling web of similar nature in a manner which permits changes in length of the wire and applies a controlled tensioning force. The mechanism makes it possible to support a tensioning roll on pivotally mounted swing arms, while obtaining a desirable tension characteristic regardless of deflection of the tensioning roll. The air spring 41 is preferably designed to give a load deflection characteristic wherein a uniform tension is applied to the wire regardless of the wire length and independent of the position of the tensioning roll. The variations in torque effect of the roll assembly are automatically compensated for by the counterbalancing air spring 40 by its design characteristic.

I have, in the drawings and specification, presented a detailed disclosure of the preferred embodiments of my invention, and it is to be understood that I do not intend to limit the invention to the specific form disclosed, but intend to cover all modifications, changes and alternative constructions and methods falling within the scope of the principles taught by my invention.

I claim as my invention:

1. A wire control device for a Fourdrinier wire of a paper machine or the like comprising a looped forming wire, roll means for carrying and driving said wire with the tension varying with changes in drive conditions whereby the wire length changes, a tensioning roll positioned to engage the forming wire to establish a wire tension, a support for said tensioning roll, a first air spring positioned to carry said support with a lifting force to substantially balance the weight of the roll and support, and a second air spring positioned to urge the roll against the forming wire with a tensioning force whereby the tensioning force against the wire will be directly dependent on the force of said second spring.

2. In a paper making machine including a continuous looped Fourdrinier forming wire for supportingly carrying paper stock, a plurality of carrying rolls located within said forming wire loop, a driving means engaging the loop whereby varying tensions will occur in the wire with changes in driving forces, a tensioning roll positioned to engage the forming wire and apply a tensioning force thereagainst, a movable supporting guide for said tensioning roll, a first spring means positioned to carry said guide and tensioning roll and substantially balance the weight thereof, and a second spring means positioned to urge the roll with a tensioning force against the forming wire whereby the force received by the wire would be dependent solely upon the force of said second spring means.

3. A wire control device for a Fourdrinier wire in a paper machine or the like comprising a looped forming wire, roll means for carrying and driving said wire with the tension varying with changes in drive conditions whereby the wire length changes, a tensioning roll positioned to engage the forming wire to establish a wire tension, a support for said tensioning roll, a first spring positioned to carry said support with a lifting force to substantially balance the weight of the roll and support, an air spring positioned to urge the roll against the forming wire with a tensioning force whereby the tensioning force against the wire will be directly dependent on the force of said air spring, and means for inflating said air spring to varying pressures whereby the tension applied by said roll may be adjustably varied.

4. A wire control device for a Fourdrinier wire in a paper machine or the like comprising a looped forming wire, roll means for carrying and driving said wire with the tension varying with changes in drive conditions whereby the wire length changes, a tensioning roll positioned to engage the forming wire to establish a wire tension, a support for said tensioning roll, a first spring positioned to carry said support with a lifting force to substantially balance the weight of the roll support, an air spring positioned to urge the roll against the forming wire with a tensioning force whereby the tensioning force against the wire will be directly dependent on the force of said spring means, said air spring having a load deflection characteristic which will not increase the tensioning force applied with decrease in length of the wire, and means for inflating said air spring to varying pressures whereby the tension applied by said roll may be adjustably varied.

5. In a forming mechanism for a paper machine having a Fourdrinier wire including in combination a plurality of substantially parallel spaced carrying rolls, an endless looped Fourdrinier wire passed over said rolls, means for driving said wire, a tensioning roll engaging the wire, a support for carrying said tensioning roll, a rotating shaft connected to said support to rotate with variance in tensioning roll position, a first tensioning arm connected to said shaft, a second opposed tensioning arm mounted in a relatively fixed position, and air spring means between said tensioning arms whereby the tensioning roll is supported in position by said air spring, said first tensioning arm projecting substantially vertical with the center of gravity of the arm and the portion of the air spring supported by the arm substantially directly above the axis of said shaft, whereby the weight of the first tensioning arm will not have to be carried by said air spring to affect its performance.

6. In a paper making machine, means for supporting and driving a continuous looped forming wire, a tension roll positioned to engage the wire and movable to alter the path and control the tension of the wire, a pair

of supporting arms for carrying the tensioning roll, a pivotal shaft means supporting the weight of the tensioning roll and arms, a tensioning arm projecting from said shaft means, a tensioning air spring supportingly engaging said tensioning arm, a supporting air spring supportingly engaging said tensioning arm, said supporting air spring having a load deflection characteristic to support the weight of said tensioning roll, said shaft means and said roll supporting arms, said tensioning spring being inflatable to achieve a variable tension characteristic to apply a tensioning force to the roll independent of the weight of the roll, and means providing a support for said tensioning air spring and said support air spring.

7. In combination in a paper machine having an endless looped forming wire with means for supporting and driving the wire, a tensioning roll positioned to engage and apply a tensioning force to the wire and movable with variance in wire length due to changes in drive forces on the wire, a pivotal support member carrying the tensioning roll, shaft means connected to the pivotal support means, an inflatable tensioning air spring located to apply a tensioning torque to said shaft, counterbalancing spring means applying a balancing torque to said shaft to balance the weight of the support means and roll, means for backing said tensioning air spring and said counterbalancing spring, and adjustment means for said backing means to adjust the position of the backing means to a first or to a second position dependent on the overall length of the wire to bring the tensioning roll into the proper operating range for applying a desired tension, said air spring having a first air pressure to tension relationship for said first position of said backing means and having a second air pressure to tension relationship for said second position of the backing means.

8. In a paper making machine a member movable against a surface of a moving web to an operating position, first means for applying a positioning first force to said member just adequate for positioning said member in said operating position comprising an air spring, and

second means for applying an operating second force to said member for controlling the force between said member and said moving web comprising an air spring.

9. In a paper making machine a member movable against a surface of a moving web to an operating position, first means for applying a positioning first force to said member just adequate for positioning said member in said operating position comprising a closed flexible walled air spring, and second means for applying an operating second force to said member supplemental to said first force for controlling the force between said member and said moving web comprising a closed flexible walled air spring.

10. In a paper making machine a member movable against a surface of a moving web to an operating position, first means for applying a positioning first force to said member just adequate for positioning said member in said operating position comprising a closed flexible walled air spring, means for inflating said first air spring to apply said first force and position said member in said operating position, and second means for applying an operating second force to said member for controlling the force between said member and said moving web comprising a closed flexible walled air spring.

References Cited in the file of this patent

UNITED STATES PATENTS

1,582,322	Warren	Apr. 27, 1926
1,582,323	Warren	Apr. 27, 1926
2,392,150	Hornbostel et al.	Jan. 1, 1946
2,445,416	Baker et al.	July 20, 1948
2,694,345	Hornbostel	Nov. 16, 1954
2,760,411	Baxter	Aug. 28, 1956
2,907,450	Reid	Oct. 6, 1959
2,918,970	Printz	Dec. 29, 1959
2,976,924	Baxter	Mar. 28, 1961

FOREIGN PATENTS

168,152	Great Britain	Aug. 26, 1921