

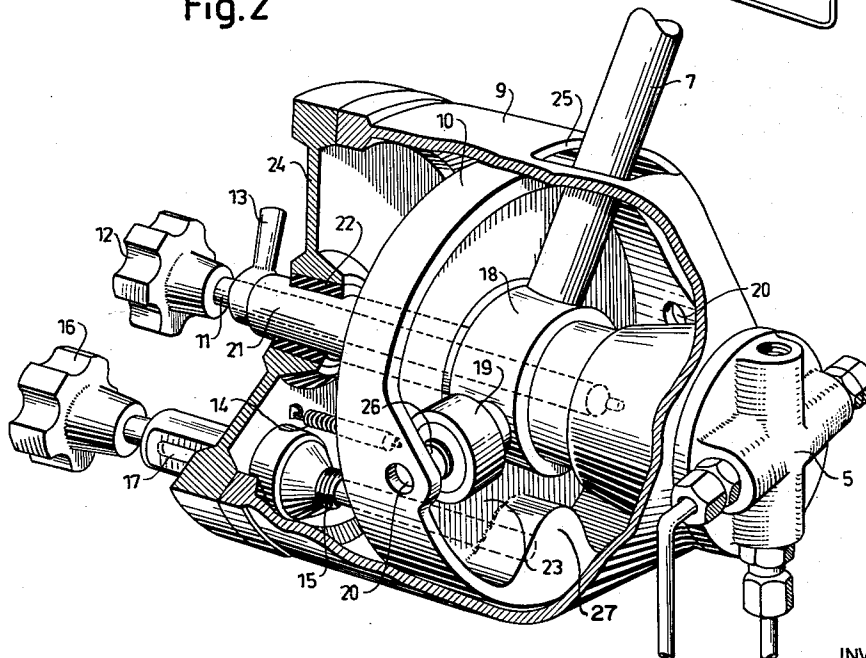
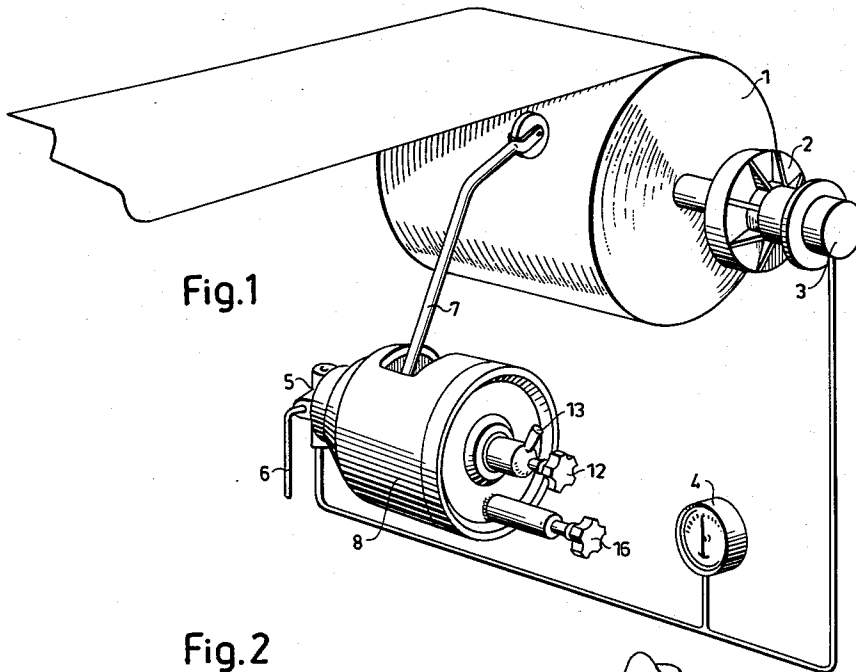
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TENSION CONTROL FOR WEB ROLL

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TENSION CONTROL FOR WEB ROLL

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The present invention relates to a device for controlling the web tension in a material web when it is being rolled off from or onto a storage roller disposed about a rotatable shaft.

Both when rolling off and rolling on material in the nature of a web it is important that the material web be tensioned to a certain degree, or else sudden pulls in the web may cause it to be torn off. It is further important that the web material, when being rolled onto a roller, be kept as stretched as possible, thus being rolled on evenly and tightly.

Even though it is desirable that the web be kept tensioned, it is, of course, necessary to pay attention to the strength of different web materials in order to obtain sufficient safety against the web being torn off.

As is evident from the above, the web both when being rolled off and when being rolled on, should be as tightly stretched as possible without the strength of the web material being exceeded.

The least complicated way of stretching the web is to let the roller from which the web is rolled off or rolled on be braked or driven e.g. by means of a friction clutch. By increasing or reducing the braking power or the driving power, the stretching of the web can be controlled to the desired degree. As the size of the roller on which the web is rolled on or from which it is rolled off will increase and decrease, respectively, during the rolling operation, the roller radius is not constant but will fluctuate between a minimum and a maximum value, for which reason the braking power or the driving power, applied to the shaft of the roller, has to be changed in dependence on changes in the size of the roller, if the web is to be kept constantly stretched. Thus, when the diameter of the roller is at its maximum the roller shaft has to be braked or driven with relatively large power, while a correspondingly reduced power is required when the radius of the roller is small.

As it is desirable to be able to keep the stretching of the web constant there is a need for a regulator, by means of which the stretching of the web can be controlled.

The problem has been known for a very long time and there have also appeared regulators, preferably of an electromechanical kind, by means of which the stretching of the web can be controlled. The usual way in which to control the stretching of the web in for instance printing machines is to provide the shaft of the roller with e.g. a block brake which is applied manually when the paper web tends to slacken. Although the said electromechanical regulators are effective and reliable, in most cases, for instance in printing presses, they are unnecessarily complicated and expensive, and consequently there is need for a simple and inexpensive regulator which will simultaneously satisfy the demands for control precision, for instance in printing presses.

The present invention relates to a web stretching regulator which is of relatively simple construction and is consequently inexpensive and easy to apply to existing roller frames. The regulator comprises on one hand a brake or clutch operated preferably by means of a pneumatic driving device, on the other hand a control device sensing the size of an object, and further a continuously adjustable pressure reducing valve, to whose low pressure side the said driving device is connected, and finally a necessary pressure fluid supplied to the high pressure side of the pressure reducing valve, and is characterized in that

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the control means is adapted, in dependence on the size of the sensed roller radius, to guide the setting of the pressure reducing valve and consequently of the static pressure prevailing at the low pressure side of the pressure reducing valve, in such a way that the pressure actuating the said brake or clutch driving device, and consequently the braking or clutching phase acting on the shaft of the storage roller, are caused to vary proportionally to a successive increase or decrease of the roller diameter when the web is being rolled onto or off from the storage roller.

Further particulars and advantages of the invention will be apparent from the accompanying drawings showing an embodiment of the invention chosen by way of example, and in which

FIG. 1 shows the web stretching regulator mounted on a roller frame, and,

FIG. 2 shows a control device with certain portions cut away.

FIG. 1 shows a roll 1 on whose shaft a brake or clutch 2 operated by means of a driving device 3 is disposed. The driving device 3, which consists of a pneumatically operated so called pressure box, receives pressure fluid, preferably compressed air, from the pressure reducing valve 5 via a pipe conduit, on which a manometer 4 is mounted. The pressure reducing valve 5, which is of the common standard type, is in turn supplied with pressure fluid from e.g. a pressure container or compressor (not shown) via the conduit 6. The pressure reducing valve 5 is disposed in such a way that its setting, and consequently the pressure acting on the driving device 3, is controlled by a regulator 8 which is provided with an arm 7 sensing the radius of the roll 1.

The regulator 8, which is shown in FIG. 2, consists of a casing 9, to which the pressure reducing valve 5 is attached. Furthermore, an essentially annular element 10, containing a guiding web 23 and the triangular projection 27, is rotatably disposed on shaft pins extending inwardly from the casing 9 into the holes 20. By means of a traction spring 14 attached to the wall 24 and to the web 23 the projection 27 is kept resting against the front portion of a rod 15 displaceable through the wall 24 by means of screw threads, said rod 15 being displaceable by means of the knob 16 in the axial direction of the rod 15 in such a way that the ring or disk 10 can obtain the desired inclination. The position of the rod 15 is indicated by the scale 17.

At the wall 24 of the casing 9 a pressure bar 21 is axially displaceable through the bushing 22. The pressure bar 21 is adapted to actuate a diaphragm in the pressure reducing valve 5 via a pressure spring (not shown here), the force of the pressure bar 21 acting on the said diaphragm determining the pressure prevailing at the low-pressure side of the reducing valve 5. The pressure bar 21 includes a threaded rod 11 passing through the bar 21, which may be rotated by means of the knob 12 and be displaced so that the pressure force applied to the said diaphragm in the pressure reducing valve 5 may be increased or reduced. After adjustment, the position of the rod 11 can be fixed by means of the locking nut 13 provided with a handle.

The regulator is further provided with an arm 7 sensing the size of the roll 1. The said arm is rotatably disposed around the pressure bar 21 by means of a bearing ring 18 or may possibly be unrotatably united with the said bar. The arm 7, which protrudes from the casing 9 through the opening 25, is furthermore rigidly connected with a shaft pin 26 on which there is disposed a roller 19, and is swingably movable about the centre axis of the pressure bar 21. The roller 19 normally bears against the web 23.

In order to describe the function of the web tensioning regulator, it is assumed that the roll 1 is to be rolled off and that the shaft of the roll is consequently to be braked during the rolling-off operation. Since the braking force acting on the roller shaft must fall toward zero when the radius of the roller is decreasing, the regulator is first set at zero by moving the arm 7 to a position corresponding to the centre axis of the roll 1, whereupon the rod 11 with the knob 12 is set in such a way that the manometer 4 will show the atmospheric pressure. After this pre-setting of the regulator, the rod 11 is locked by means of the nut 13, whereupon the roll 1 is disposed in the roller frame with the arm 7 resting against the roll surface. Depending on the quality of the material stored on the roll, the ring 10 is given an inclined position by means of the bar 15, in which case the inclined position of the ring can be read off on a scale 17. In the arrangement illustrated and hereinafter described the ring 10 and its web 23 are inclined downwardly and to the right as seen in FIG. 2.

When the arm 7 is disposed in such a way that its outer portion rests against the roller surface, the roller 19 will be swung together with the arm 7, the roller 19 rolling on the guiding member 23 of the inclined ring 10. Due to the inclined position of the ring 10, both the arm 7, the roller 19 and the pressure bar 21 will be displaced towards the pressure reducing valve 5 when the arm 7 is turned counter-clockwise. Through the displacement of the pressure bar 21 a pressure is exerted via a pressure spring device (not shown) against the diaphragm in the pressure reducing valve 5, said diaphragm being adapted, in a known manner, to maintain equilibrium between the pressure applied by the pressure bar and the reduced pressure prevailing in the valve and recorded on the manometer 4. The bearing ring 18 is immovable lengthwise of the pressure bar 21.

The pressure prevailing on the low-pressure side of the pressure reducing valve 5 actuates a driving member 3 connected with the pressure reducing valve via a pipe conduit. The said driving member 3 may preferably consist of a so-called pressure box. The driving member 3 is in turn coupled directly to a brake 2 acting on the shaft of the roller 1 with such a braking power that the web rolled off from the roller 1 is always kept stretched with preferably constant tension.

When the material begins to be rolled off from the roller 1, the radius of the roller 1 decreases, and consequently the arm 7 resting against the roller 1 is swung clockwise. The roller 19 running against the guiding web 23 of the ring 10 moves synchronously with the arm 7 since the shaft pin 26 of the roller 19 is rigidly connected therewith. The clockwise motion of the arm 7 consequently entails that the guiding roller 19 moves clockwise along the guiding web 23, the pressure bar 21 being displaced from the pressure reducing valve 5, whereby the spring pressure against its pressure controlling diaphragm decreases. When the spring pressure acting on the said diaphragm is not capable of compensating for the pressure above atmospheric prevailing in the pressure reducing valve 5, a valve is opened which lets out pressure fluid until there is once more equilibrium and the diaphragm has resumed its position of equilibrium. As the pressure in the pressure chamber of the pressure reducing valve 5 connected with the driving member 3 decreases when the arm 7 is swung clockwise, the braking power applied to the shaft of the roller 1 by the brake 2 will also decrease, whereby the tension in the web rolled off from the roller 1 may be kept constant despite the fact that the radius of the roller 1 has been reduced.

The controlling of the braking power acting on the roller 1 is of course entirely continuous, the regulator all the time sensing the radius of the roller 1 by means of the arm 7 and, in dependence on this sensed radius, controlling the pressure acting on the driving member 3

of the brake 2 in such a way that the web rolled off from the roller 1 always has a constant tension.

When rolling a web onto a roller, the shaft of the roller 1 is driven by a driving motor via a continuously adjustable clutch 2 controlled by a driving member 3, e.g. a dry disc clutch. In that case the regulator starts with the arm 7 in its neutral position, i.e. the centre axis of the shaft pin 26 of the guide roller 19 coincides with the axis of rotation of the ring 10 about the pins (not shown) which extend inwardly from the casing 9 into the holes 20. As the radius of the guiding roller 19 is as large as the perpendicular distance from the swinging axis of the ring 10 to the guiding member 23, an inclined position, if any, of the ring 10 does not affect the position of the bar 21 when the arm 7 occupies this position, since the ring 10 only moves about the guiding roller 19 without displacing it.

At the beginning of the rolling-on operation there is consequently a very small degree of coupling between the driving motor and the shaft of the roller 1, but accordingly as the radius of the roller 1 increases, the degree of coupling, and consequently the driving torque, will also increase, in such a way that the web tension of the rolled-on web will always be constant.

The inclined position of the ring 10, the pressure on the high-pressure side of the pressure reducing valve 5 and the rigidity of the pressure spring device disposed between the pressure bar 21 and the diaphragm of the pressure reducing valve 5 are factors which affect the pressure supplied to the driving device 3. With the guidance of these factors it is possible to place the ring in such an inclined position by means of the knob 16 and the scale 17, that the web tension desired for the web material in question is obtained. It has turned out that the regulator may be disposed in such a way that it will give an essentially linear control characteristic, i.e. the power which acts brakingly or rotatively on the shaft of the roller 1 varies linearly with the radius of the roller 1 from a maximum when the roller diameter is at its maximum to zero power when the arm 7 reaches the centre axis of the roller 1 in the theoretical case. The highest power value is preferably set by inclining the ring 10 to a degree which has been empirically tested for each material whereupon the inclination corresponding to the web tension is kept constant during the whole rolling-on or rolling-off operation.

An additional advantage of the regulator described here is not only that it is inexpensive and uncomplicated but also that it is relatively compact and very easy to apply to roller frames which were originally not provided with a web tension regulator. As the pressure fluid is not, on principle, consumed in the controlling operation, but the static pressure action of the pressure fluid is utilized, no compressor device is required but merely a pressure container. Of course, it should be seen to, however, that the pressure in the said container will not fall below the minimum pressure required for the controlling operation.

When the device to which the material rolled off from the storage roller is fed is stopped, it will often happen that the storage roller because of its large mass will not stop at once but will continue to rotate for several times. This is a manifest drawback, for it means that a certain quantity of the web material is wasted and that work is required in order to make the machine ready once more by removing material which has been discharged.

It is consequently desirable to be able to stop the rotational movement of the storage roller quickly, and this may of course be achieved by means of for instance a separate brake which is caused to act on the shaft of the storage roller as soon as the said device, to which the material web is fed, stops. By means of a web tensioning regulator in accordance with the invention the problem can, however, be solved in a simple and inexpensive manner without any separate brake by providing the pres-

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sure reducing valve with a preferably electromagnetically operated valve which is adapted, when the supply of current ceases or when the device fed with the web is intentionally stopped, to connect the chamber behind the pressure sensing diaphragm of the pressure reducing valve 5 with the surrounding atmosphere, the spring pressure applied by means of the pressure bar 21 against the diaphragm displacing the said diaphragm and the valve device connected with the diaphragm in such a way that pressure fluid may flow freely into the chamber connected with the driving member 3 through a conduit, thus actuating the driving member 3 in such a way that the maximum braking power against the shaft of the storage roller is created. Since a certain amount of pressure fluid will, of course, escape through the open valve connecting the pressure side of the diaphragm with the surrounding atmosphere, the valve has to be closed as soon as the storage roller 1 has been caused to stop and for that reason the contact means, which controls the current supply to the electromagnetic driving device of the valve should preferably be combined with that push-button control by means of which the device fed with the web is stopped so that the valve is closed as soon as the push-button control is allowed to return to the normal position.

What is claimed is:

1. A device for controlling the tension in a web of material being wound upon or unwound from a roll thereof comprising a rotatable shaft for supporting said roll, power transmission means connected to said shaft for controlling the rotation thereof, a pressure reducing valve having its low pressure side connected to control the operation of said power transmission means and a

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regulator connected to control the pressure applied to said power transmission means by said reducing valve, said regulator comprising a pressure bar connected to and movable endwise relative to said reducing valve for varying the pressure on the low pressure side of said valve, a disc surrounding said pressure bar and tiltable about a fixed axis perpendicular to the longitudinal axis of said bar, means for adjusting the angle of said disc relative to said bar, a bearing ring mounted to rotate around but being immovable endwise relative to the axis of said bar, an arm connected to said ring and positioned to engage the outer surface of said roll of web material on said shaft, and means rigidly connected to said bearing ring and positioned to engage the surface of said disc.

2. A device as defined in claim 1 comprising means for adjusting the position of said pressure bar relative to said valve.

3. A device as defined in claim 1 in which said means rigidly connected to said bearing ring consists of a pin connected to said ring and a roller on said pin.

4. A device as defined in claim 3 in which said disc is tiltable about an axis parallel to but spaced from the surface of said disc, the distance of said axis from said disc being substantially equal to the radius of said roller.

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