

[54] **DEVICE FOR REGULATING THE TENSION
IN WEBS OF MATERIAL**

[76] Inventor: **Louis Corse**, 6, rue Auguste Rodin,
La Source B.P. 6049-45018
Orleans-Cedex, France

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abandoned.

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242/75.2

[56] **References Cited**

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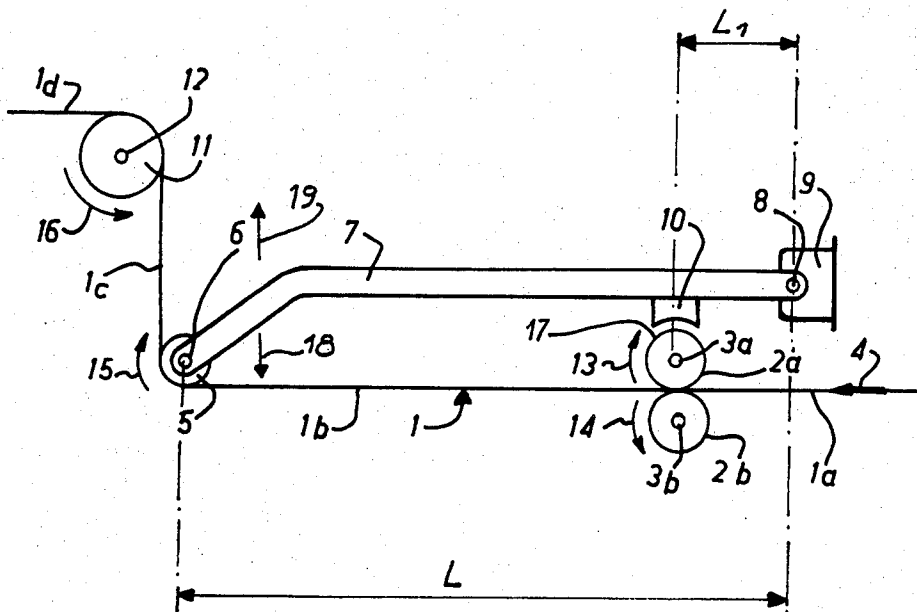
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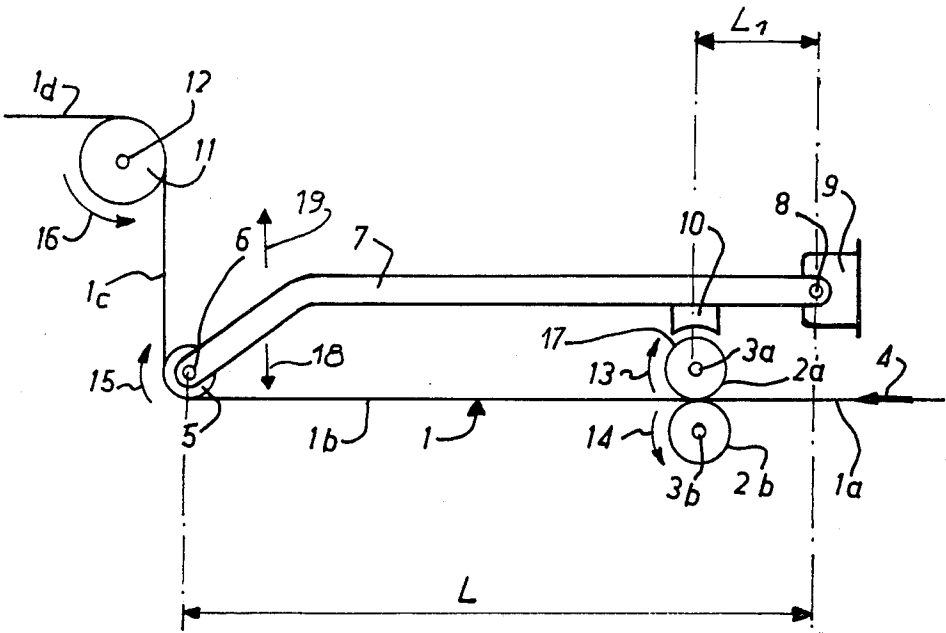
Primary Examiner—Richard A. Schacher
Attorney, Agent, or Firm—Robert E. Burns;
Emmanuel J. Lobato; Bruce L. Adams

[57] **ABSTRACT**

A device for regulating tension in a continuously moving web of paper consists of a third order lever having a tension sensing roller at the end remote from its pivot and a brake pad between the roller and pivot, the brake pad serving to resist rotation of a roll which frictionally engages the web.

2 Claims, 1 Drawing Figure





DEVICE FOR REGULATING THE TENSION IN WEBS OF MATERIAL

This is a continuation, of application Ser. No. 378,247, filed July 11, 1973 and now abandoned.

BACKGROUND OF THE INVENTION

In those industries, such as the printing industry, in which operations are performed by a machine on continuous webs of sheet material such as paper, it is necessary to maintain as constant as possible the tension in the web fed to the machine. Tensioning may be carried out by exerting a braking effect on the web by means of a servo-mechanism with a feed back loop.

A known device of this type includes a brake device which applies a braking force to the web, the magnitude of which force depends upon the tension determined downstream of the brake device by a sensor roller over which runs the web. This type of device is complicated and involves the use of spring means to urge the roller against the web in order to keep the roller in a balanced condition. Furthermore, the braking device is comparatively complicated.

SUMMARY OF THE INVENTION

The present invention has for its principal object the provision of a device for regulating the tension in web materials which is simple in construction, requires no springs or ancillary equipment, is easy to maintain and is reliable in operation.

The device provided by the invention consists of a third order lever which has a sensor roller at the end remote from the pivot and a brake pad or shoe disposed intermediate the roller and pivot. The device is so arranged that the roller is positioned downstream of the brake pad, considered in the direction of movement of the web and bears upon the web in the manner of a jockey roller. The brake pad is disposed so as to make contact with one of a pair of rolls through the nip of which passes the web. The roller and brake pad are urged towards their operative positions solely under the effect of gravity so that the device is purely mechanical in nature and requires no springs, fluid cylinders or electrical control devices.

In operation, the roller monitors the tension in the web and adjusts accordingly the position of the movable brake pad relative to the rolls. That is to say, as the tension in the web decreases, the web becomes slack and the roller allows the lever to fall, and with it the brake pad which applies a braking force to the rolls. These rolls resist the motion of the web so that the tension in the latter increases. The roller and lever are accordingly lifted and the braking force reduced. Eventually, the system settles down to run under a condition of equilibrium. The magnitude of the tension may be varied by weighting the lever to a greater or less extent.

DESCRIPTION OF DRAWING

The drawing shows a schematic side elevation of a preferred embodiment of a device for adjusting the tension in a continuous web of paper.

DESCRIPTION OF PREFERRED EMBODIMENT

As may be seen from the drawing, the device for regulating the tension of a web of paper 1 comprises two loose rolls 2a and 2b with parallel horizontal shafts 3a and 3b respectively, arranged perpendicularly to the

direction of movement of the web of paper, which passes between the two rolls and drives them rotationally by the friction which it exerts on them. The roll 2a constitutes a supporting roll for the web 1, and this roll is subjected to a greater or smaller degree of external braking, as will emerge in due course. Downstream of the rolls 2a and 2b are rollers 5 and 11.

At any instant the web of paper 1 can be regarded as subdivided into firstly an initial zone 1a, upstream of the rolls 2a and 2b, secondly an intermediate zone 1b, co-planar with the upstream zone and situated between the rolls 2a and 2b, and the roller 5, thirdly a return zone 1c, perpendicular to the intermediate zone 1b and to the initial zone 1a, delimited by the roller 5 and a return roll 11, and fourthly a terminal zone 1d, downstream of the roll 11.

The web of paper 1 is taken from a roller, not shown in the diagram, and situated upstream from the rolls 2a, 2b. Displacement of the web, obtained by drawing it downstream, in the direction of the arrow 4, rotates the rolls 2a and 2b, the roller 5 and the roll 11, in the directions indicated by the arrows 13, 14, 15 and 16 respectively.

The roller 5 is situated above the web which passes around the roller through an arc of about 90°, and the roller is constantly supported on the web 1 by reason of its own weight and that of a lever 7 on which the roller is carried, this lever being articulated about a horizontal shaft 8 parallel to the shafts 3a, 3b. The pivot lever 7, in fact, is in the form of a frame, and the roller 5 rotates about a horizontal shaft 6 journaled in the frame, the said shaft 6 being parallel to the shafts 8, 3a and 3b mentioned previously.

The pivot lever 7 is provided, between the shaft 6 and the shaft 8, with a braking device for the loose cylinder 2a, positioned above this latter. The said braking device may consist of a brake shoe 10 which rests more or less firmly on the peripheral surface 17 of the roll 2a. The lever 7 is thus a third order lever.

The invention will be understood more clearly from an explanation of the process by which the tension of the web is regulated. When, for example, the tension of the web decreases, the web tends to take on slack. This is reflected in a decrease in the reaction exerted upwards on the roller 5, under the effect of the web tension, and thus in a tendency of the roller 5 and of the lever 7 to move downwards, in the direction shown by the arrow 18. The brake shoe 10 likewise descends but through a distance less than that through which the roller moves. The force with which the brake shoe 10 is applied to the lateral surface 17 of the roll 2a thus increases, thereby braking the roll, which then slides, with friction, on the web 1, and increases the tension of the latter downstream from the rolls 2a and 2b, the roller 5 thus being returned to and held in a new position of equilibrium. If however, the roller passes through the equilibrium position, or for any other reason the tension in the web of paper increases, the web will become more taut and tend to increase the upward reaction exerted by the web 1 on the roller 5 and thus to cause the said roller 5 and the frame 7 to move upwards, in the direction shown by the arrow 19, opposite to that shown by the arrow 18. This displacement of the roller 5 is due to the fact that the said roller 5 constantly rests on the sheet 1. This leads to a shorter displacement of the brake shoe 10 in the same direction, i.e., the force with which the brake shoe 10 is applied to the surface 17 of the roll 2a decreases, whereby this roll is released

and the tension in the web downstream from the rolls is reduced, resulting in a re-descent of the roller 5 and in a return to the state of equilibrium.

In both cases, therefore, the tension of the web is regulated by a servo-mechanism with a feed back loop.

Needless to say, the effect obtained depends on physical magnitudes, these being the weight P of the roller 5 and of the frame 7, the lever arm L of the roller 5, the lever arm L_1 of the brake shoe 10, the frictional coefficient, f , of the brake shoe 10 on the surface 17 of the roll 2a, and the tension, t , of the web 1, upstream from the rolls 2a, 2b. For the sake of simplicity, the tension of the web 1 in the intermediate zone 1b will be termed T and the quotient L/L_1 will be termed K .

The calculations show that the tension T of the web of paper 1 in the intermediate zone 1b is a linear function of t and of P , of which the coefficients are hyperbolic functions of f and K . The tension T increases with t but far less than in proportion thereto, i.e., T varies less as a result of a given variation in t , and the device ensures more satisfactory regulation. It is possible to increase the product Kf by increasing either the ratio K of the length L to the length L_1 or the coefficient of friction f . Intuitively, moreover, it will be understood that better regulation is obtained by increasing the ratio of the two lever arms L and L_1 and the coefficient of friction, f , of the brake shoe 10 on the roll 2a.

An example given purely for information enables one to measure the amplitude of regulation obtainable with the use of the device covered by the invention. In this example the product Kf is assumed to be 100, with P equal to 10 kg. When t varies between 0 and 10 T varies between 9.9 and 19.8. In other words, when t is multiplied by 10, T is only multiplied by 2.

More generally, the regulating capacity of the device to which the invention relates can be formulated by stating that a variation Δt of the tension t upstream from the rolls 2a and 2b results in a variation ΔT of the tension T , in the intermediate zone 1b, equal to the variation t divided by $1 + Kf$.

Needless to say, the various physical parameters, i.e., P , L , L_1 and f , have to be adapted to each specific case. These adaptations, however, in no way effect the principle of the present invention.

To obtain a more satisfactory regulating effect, a number of regulating devices can be mounted in succession to one another. Each device in the series can have the same physical characteristics, in order to take account, in each device, of the other devices in the series, which are positioned upstream from it.

The brake shoe 10 which has been shown as the braking device naturally serves schematically for information and is in no way exclusive. Any other system fulfilling the same function would likewise be applicable.

The diagram shows a device in which the initial zone 1a and the intermediate zone 1b of the web 1 are horizontal, but it is clear that a similar device could be easily designed on the same principle as the invention but

with oblique initial and intermediate zones 1a and 1b of the web 1.

Furthermore, the device might be constructed with one supporting roll 2a only, the web of paper 1 then passing over a sufficient arc of its periphery to ensure that the braking force of this roll is transferred by friction to the web.

The supporting roll 2a could even be fitted with the delivery reel of the web of paper.

The brake pad may act on an altogether separate rotary member which is drivably connected, for example through gearing or a friction coupling with the roll 2a.

These and other modifications are intended to fall within the spirit and scope of the invention.

What is claimed is:

1. A device for regulating tension in a web of sheet material comprising:

a. a pair of opposed rolls making frictional contact with a web of sheet material traveling in a longitudinal direction thereof and passing between said pair of opposed rolls;

b. a pivoted lever having one end thereof disposed on a pivot axis, said pivot axis being disposed upstream of said pair of opposed rolls relative to the direction of travel of said web of sheet material, said pivoted lever extending in the direction of travel of said web of sheet material and having a bent end portion remote from said pivot axis and bent toward said web of sheet material whereby said pivoted lever remains in use substantially parallel to said web of sheet material;

c. a gravity-biased roller disposed on the bent end portion of said lever downstream from said pair of opposed rolls and bearing against said web of sheet material under the influence of gravity;

d. a brake shoe disposed on said pivoted lever adjacent an upper one of said opposed rolls for applying a braking force thereto, said braking force having a magnitude determined by said gravity-biased roller sensing tension in said web of sheet material and changing position in response to changes in said tension to change said braking force applied to said pair of opposed rolls thereby regulating said tension in said web; and

e. a third roll disposed to change the direction of advance of said web by about ninety degrees as it passes over said gravity-biased roller to maximize the change in braking force in response to a change in said tension.

2. A device for regulating tension in a web of sheet material according to claim 1, having a product Kf on the order of one hundred wherein f is the coefficient of friction between said brake shoe and said opposed rolls and K is the ratio of the distance between said pivot axis and said gravity-biased roller to the distance between said pivot axis and said brake shoe.

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