

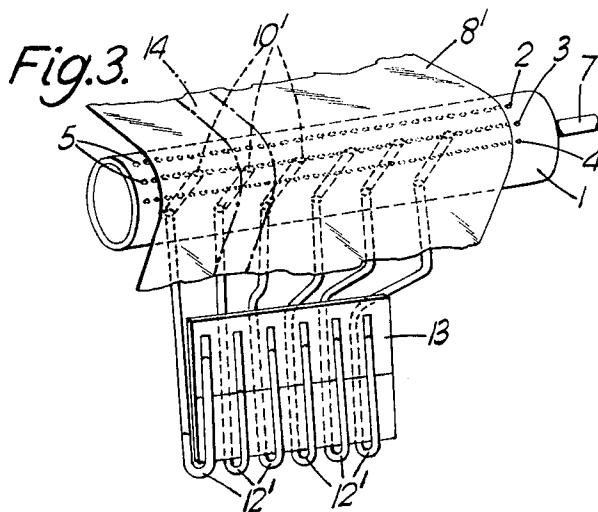
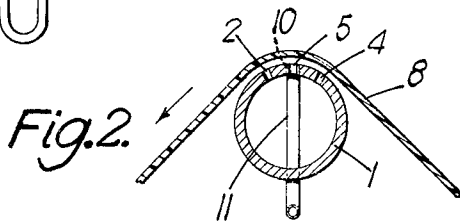
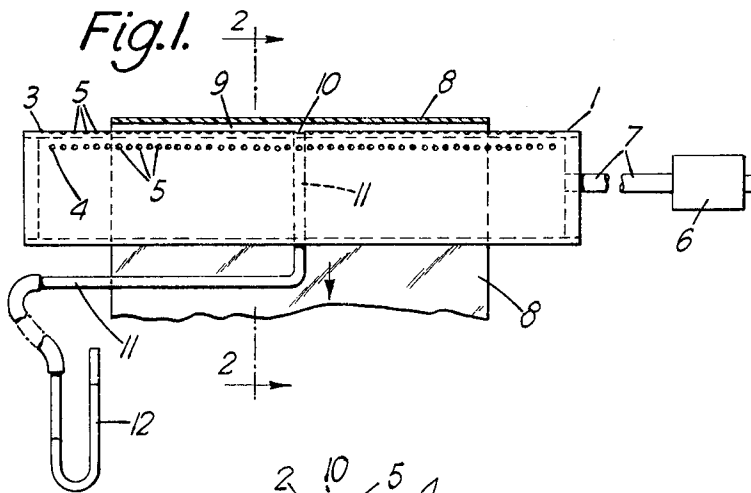
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K. S. WILLIAMS

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WEB TENSION MEASURING DEVICES

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INVENTOR

*Kenneth S. Williams*

By *Watson, Cole, Grindler & Watson*  
ATTORNEYS

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## WEB TENSION MEASURING DEVICES

Kenneth Sydney Williams, Bridgwater, Somerset, England, assignor to British Cellophane Limited, Bridgwater, Somerset, England, a British company

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4 Claims. (Cl. 73—143)

This invention relates to web tension measuring devices.

In a known device for measuring the tension in a stationary or travelling web stretched between two spaced supports, a movable member, for example a roller mounted at the end of a pivoted arm, is urged by weights or spring pressure against the web. At equilibrium, when the resistance offered by the web balances the force applied to the member, the position of the member with respect to a fixed datum point is a measure of the web tension. Such a device, however, requires the provision of moving mechanical linkage and accommodation for springs or weights and is a cumbersome mechanism to incorporate in web-handling machinery. Further, since positive contact by the member with the web is an essential feature of the operation of the device, it cannot readily be used with fragile webs or webs that are wet with ink or coating compositions.

The object of the present invention is to provide an improved web tension measuring device in which the tension of a web can be measured without contacting the web with a solid surface.

Accordingly, the present invention includes an apparatus for measuring the tension in a web which apparatus comprises an arcuate surface around which the web is passed, the arcuate surface having apertures through which a gaseous medium can be supplied under pressure to provide a supporting gaseous cushion between the under surface of the web and the arcuate surface, a supply means for continuously supplying the gaseous medium under pressure to the apertures and one or more pressure measuring devices for determining the pressure of the gaseous medium in the gaseous cushion at one or more selected points.

The arcuate surface should have sufficient surface area to permit of a change in direction of the web through an angle of at least 40° and up to 180° as it passes round the arcuate surface and the apertures are preferably arranged in two or more rows in a direction transverse to the path of the web.

In a preferred form of the apparatus, the arcuate surface is provided by a tubular member having a series of holes drilled through the tube wall in the area of the surface over which the web passes and gaseous medium, for example air, is supplied under pressure to the interior of the tube.

It is an essential feature of the invention that the web is entirely supported by the gaseous cushion as it passes round the arcuate surface. Under these circumstances, the pressure of gaseous medium (P) at a point in the gaseous cushion may, for practical purposes be related to the tension per unit width (T) in the web immediately above the point of pressure determination by the expression

$$P = \frac{T}{R}$$

where R is the radius of the arcuate surface.

A convenient method of determining the pressure of the gaseous medium at a selected point in the gaseous cushion is to provide a hole in the arcuate surface at a convenient point beneath the web and connect the hole

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by means of a pipe to a manometer or other conventional pressure measuring or indicating device when the pressure recorded will be a measure of the tension in the web immediately above the hole.

The apparatus is particularly useful for measuring the tension in a travelling web such as a sheet of cellulose film where the tension may vary at one or more points across the web due to tight or slack longitudinal lanes in the film. Such lanes are particularly troublesome in the manufacture of cellulose film as they prevent the film from lying flat in a transverse direction and cause creasing and other troubles when the film is fed to printing machines or converting machinery such as bag-making machines. They usually appear in the film during drying after wet processing when the drying apparatus is working inefficiently.

By employing the apparatus in accordance with the invention, it is possible to watch continuously the tension at a number of spaced points across a web of cellulose film leaving a drying apparatus by independently measuring the pressure of the gaseous medium in the gaseous cushion supporting the film at these points. Any slack or tight lanes are readily observed by comparison of the readings and appropriate adjustments can be made to the drying machine. The presence of a slack lane is indicated by a low pressure reading and a tight lane by a high pressure reading.

The apparatus according to the invention is capable of measuring the tension in any stationary or travelling web capable of being supported by the gaseous cushion out of contact with the arcuate surface. Solid webs such as cellulose film, films of plastic materials, paper, metallic foil and the like are readily supported by a gaseous cushion; so also are semi-porous webs such as bonded fibre fabrics or closely woven materials when the supply of gaseous medium through the apertures in the arcuate surface is far in excess of the loss of the medium through the web. However, the apparatus cannot be used for measuring the tension in open mesh webs such as loosely woven fabrics.

The web tension is measured without the web ever coming into contact with a solid surface thus avoiding scratching of the web which often occurs when conventional web tension measuring apparatus is employed. also the measurement of tension may be carried out on webs which are freshly printed or treated with a wet coating or sizing composition without the print, the coating or the sizing being smeared or otherwise affected.

The invention also includes a method for measuring the tension in a web which method comprises passing the web around an arcuate surface, maintaining the web out of contact with the arcuate surface by means of a gaseous cushion formed by continuously supplying a gaseous medium under pressure to the space between the web and the arcuate surface and measuring the pressure of the gaseous medium within the gaseous cushion at one or more selected points.

### Example

A specific example of an apparatus constructed and adapted to operate in accordance with the invention will now be described with reference to the accompanying drawings in which,

FIGURE 1 is a front elevation of one form of the apparatus.

FIGURE 2 is a section through line 2—2 of FIGURE 1, and

FIGURE 3 is a perspective view of a second form of the apparatus.

In FIGURES 1 and 2, a smooth-surfaced steel tube 1, seventy-two inches in length and six inches in diameter, is sealed at both ends and is drilled with three rows 2,

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3, 4 of holes 5 one millimetre in diameter and spaced one inch apart in each row 2, 3, 4. The rows 2, 3, 4 are spaced one and a half inches apart. Compressed air at a pressure of three pounds per square inch is supplied to the interior of the tube 1 by a pump 6 through a supply pipe 7 and on passing through the holes 5 supports a travelling cellulose film 8 forty eight inches in width on a cushion 9 of air out of contact with the tube 1. In passing round the tube 1 the film 8 changes direction through an angle of 90°.

At the centre of the tube 1 between the rows 2 and 4 of holes 5, and in line with the row 3, a test hole 10, one eighth of an inch in diameter, is drilled through the wall of the tube 1 and is connected by a pipe 11 to a manometer 12. The manometer 12 will measure the pressure of the air in the cushion 9 adjacent the test hole 10 and as this value is related to the tension in the film 8, the manometer 12 is, for convenience, calibrated in units of tension.

In FIGURE 3, the apparatus is identical with that shown in FIGURES 1 and 2 with the exception that a series of six test-holes 10<sup>1</sup> are provided at intervals of six inches. Each test-hole 10<sup>1</sup> is connected independently to one of six manometers 12<sup>1</sup> mounted side by side on a display panel 13. The reading of each manometer 12<sup>1</sup> will be a measure of the tension in the film 8<sup>1</sup> passing round the tube 1 at positions adjacent the test holes 10<sup>1</sup>. Thus, as shown in FIGURE 3, the presence and position of a slack longitudinal band or lane 14 in the film 8<sup>1</sup> will be indicated by a low reading on the corresponding manometer 12<sup>1</sup> when compared with the readings on the other manometers 12<sup>1</sup>. Similarly, a tight longitudinal band or lane in the film 8<sup>1</sup> will be indicated by a high reading on the corresponding manometer 12<sup>1</sup> and low readings on the remaining manometers 12<sup>1</sup>.

The apparatus may readily be incorporated in any web handling machinery and only requires a source of compressed air for its operation. The pressure of air employed must be sufficient to support the web out of contact with the tube but otherwise its value has substantially no effect upon the web tension measurements.

I claim:

1. An apparatus for measuring the tension in a web which apparatus comprises an arcuate surface around

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which the web is passed, the arcuate surface having apertures through which a gaseous medium can be supplied under pressure to provide a supporting gaseous cushion between the under surface of the web and the arcuate surface, a supply means for continuously supplying the gaseous medium under pressure to the apertures, the arcuate surface having at least two test-holes spaced apart generally transversely of the web for communicating with the gaseous cushion and a pressure measuring device connected with each test-hole for determining the pressure of the gaseous medium in the gaseous cushion in the vicinity of the test-hole.

2. An apparatus as claimed in claim 1 in which apparatus the apertures are arranged in at least two rows in a direction transverse to the path of the web.

3. An apparatus as claimed in claim 1 in which apparatus the pressure measuring device is a manometer.

4. An apparatus for measuring the tension in a web which apparatus comprises a tubular member having an arcuate surface around which the web is passed, the tubular member being closed at each end and having apertures in the arcuate surface through which a gaseous medium can pass from the interior of the tubular member to provide a supporting gaseous cushion between the under surface of the web and the arcuate surface, a supply means for continuously supplying the gaseous medium under pressure to the interior of the tubular member, the arcuate surface having at least two test-holes spaced apart generally transversely of the web for communicating with the gaseous cushion and a pressure measuring device connected with each test-hole for determining the pressure of the gaseous medium in the gaseous cushion in the vicinity of the test-hole.

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RICHARD C. QUEISSER, *Primary Examiner*.

JOSEPH P. STRIZAK, DAVID SCHONBERG,  
*Examiners.*