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Wentworth

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[54] **TENSIONING DEVICE**

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[51] **Int. Cl.**..... **B65h 25/22**, B65h 23/10

[58] **Field of Search**..... 242/75.43, 75.44, 75.45, 242/75.46, 75.51, 75.53, 75, 75.1, 75.2, 75.3, 75.4, 75.41, 75.42, 75.5, 189, 190; 226/38, 39, 42; 318/6, 7

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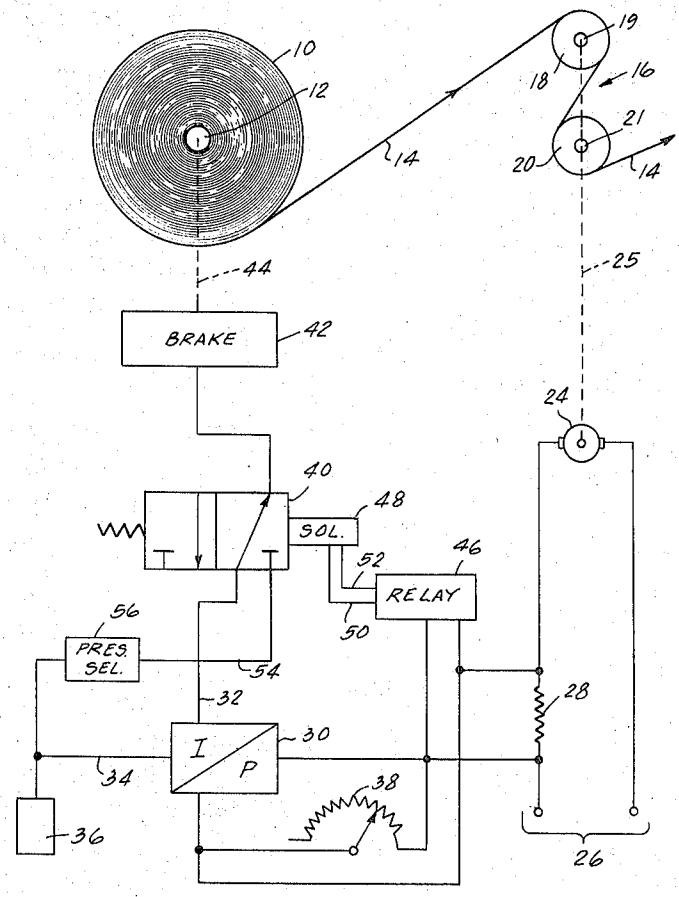
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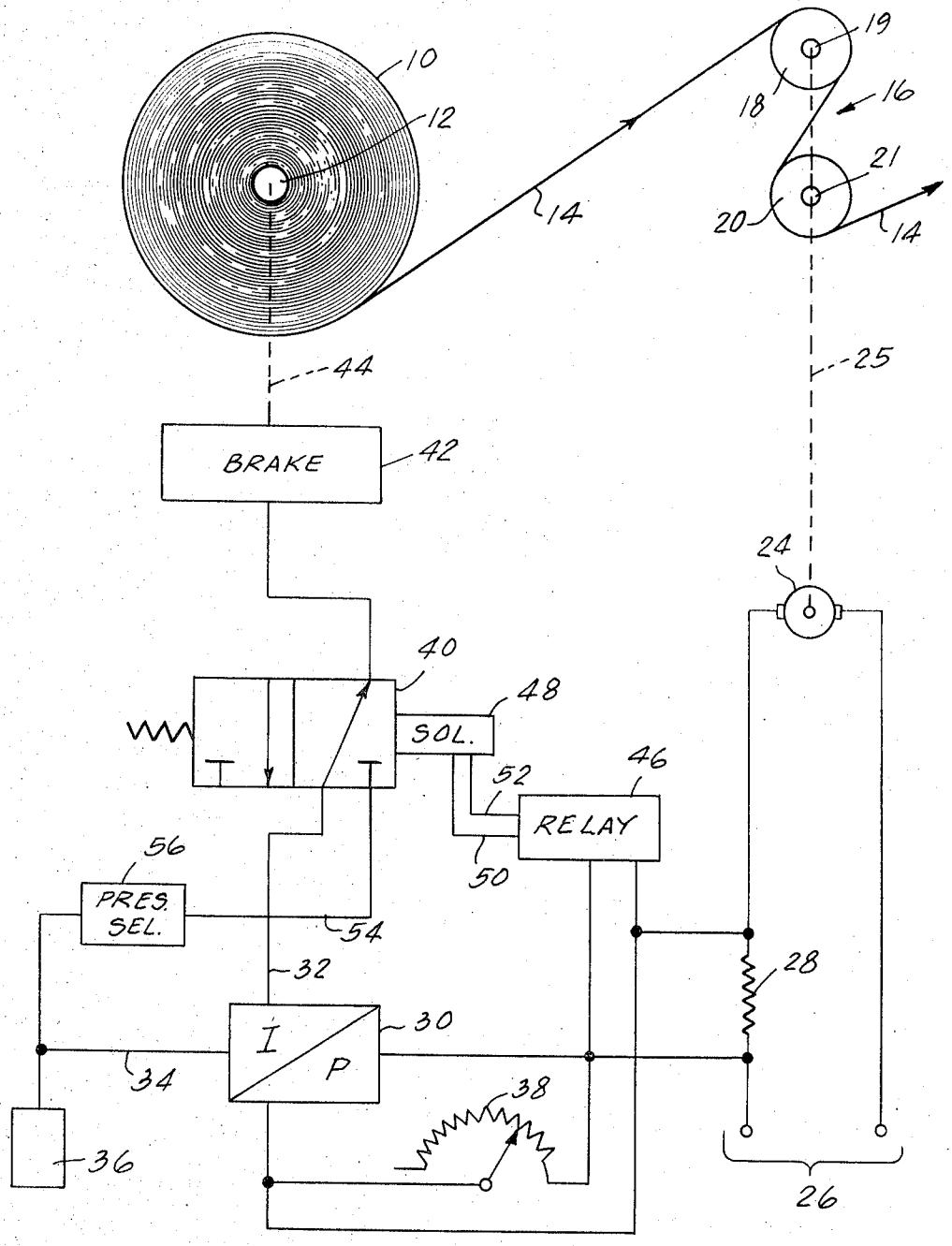
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[57] **ABSTRACT**

A tensioning device, adapted for use with a station in which web material is unwound from a roll, has a current-to-pneumatic pressure converter which is responsive to the current drawn by the armature of a motor associated with a tension multiplier connected in line with the web drawn from the roll. The pneumatic pressure determined by the current-to-pressure converter is adapted to control pneumatic brakes operative to brake the unwinding speed of the roll. A preset pressure operates the pneumatic brakes prior to initiation of the system, and this preset pressure is replaced by the pressure determined by the current-to-pressure converter, as soon as the motor current increases to a predetermined level.

10 Claims, 1 Drawing Figure




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12
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18
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BRAKE
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SOL.
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RELAY
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TENSIONING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a tensioning device, and more particularly to a tensioning device employed with a station at which web material is unwound from a relatively large diameter roll of such material.

2. The Prior Art

When web material is unwound from relatively large rolls, it is difficult to maintain a constant tension on the material as it is unwound, because the diameter of the roll changes as the material is unwound. The diameter is a maximum initially, and decreases to a minimum as the operation progresses. The torque, which acts on the core supporting the roll, and which is developed as a result of pulling the web material from the core, also changes as the operation progresses.

In the prior art, brake mechanisms have been employed for placing a predetermined braking torque on the roll-supporting core, and the amount of torque applied by such brake mechanism is reduced as the web material is withdrawn from the roll, in order to hold the tension constant. However, when the core which supports the roll is made of relatively light material such as cardboard, or the like, the amount of torque which must be used in order to achieve the desired web tension is sometimes greater than the core material can stand, so that the results are unsatisfactory. It is, therefore, desirable to provide a system for maintaining the web material under the proper tension as it is withdrawn from the roll, while applying a smaller torque to the core of the roll.

SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide apparatus for tensioning the web material as it is withdrawn from a supply roll, without applying large values of torque to the roll.

Another object of the present invention is to construct such apparatus of readily available components.

These and other objects and advantages of the present invention will become manifest upon an inspection of the following description and the accompanying drawings.

In one embodiment of the present invention there is provided a tension multiplier interposed in the path of the web from a supply roll to apparatus which pulls the web from the roll, a motor connected to said tension multiplier and adapted to urge the web toward the roll to increase the tension of the web downstream from said tension multiplier, a current-to-pressure converter connected with the motor and responsive to the current drawn thereby for producing a pneumatic pressure, and brake means connected with said supply roll, the brake means being connected with the converter for operation in response to the pressure produced thereby.

BRIEF DESCRIPTION OF THE DRAWING

Reference will now be made to the accompanying drawing, which illustrates, in functional block diagram form, an illustrative embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, a supply roll **10** is illustrated, which comprises a quantity of web material **14** supported on a core **12** and adapted for use in any process which employs web material. The web material **14** is withdrawn from the roll **10** and passed around a S-wrap tension multiplier **16** and then on to the processing apparatus (not shown). The function of the S-wrap tension multiplier **16** is to multiply the tension of the web so that the web **14** downstream from the tension multiplier has a greater value than that on the web **14** upstream therefrom. The processing apparatus contains as a part thereof a driven reel or the like for pulling the web **14** through the processing apparatus from the supply roll **10**, and it acts as a source of tension for the web **14**.

The tension multiplier **16** incorporates a pair of rollers **18** and **20** supported for rotation on shafts **19** and **21**, and geared together by gear means (not shown) so that both rotate together in unison. The shaft **21** of the roller **20** is connected to the shaft of a motor **24**, for rotation therewith, the connection being illustrated by the dashed line **25**. The geared connection between the rollers **18** and **20** causes the roller **18** to also rotate with the motor **24**. The motor **24** is energized in a direction so as to tend to turn the roller **20** in a direction opposite to the direction of movement of the web **14**. The connection between the rollers **18** and **20** causes the roller **18** to also be urged in the direction opposite to the direction of travel of the web. Thus, the current which flows through the armature winding of the motor is proportional to the torque on the motor shaft. As the torque on the motor shaft is directly proportional to the tension of the web **14**, the armature current of the motor **24** is a direct index of the tension of the web **14**.

The armature of the motor **24** is connected to a pair of terminals **26**, and a resistor **28** is connected in series with the armature winding and the terminals **26**. Accordingly, the armature current flows through the resistor **28**, and the voltage drop thereacross is proportional to the armature current. The terminals **26** may be connected to a resistance external to the circuit, or, alternatively, to a source of voltage. The external network connected to the terminals **26** is selected to give the desired performance of the motor **24** in conjunction with the resistor **28**. The resistor **28** is sized to produce a desired magnitude of voltage drop thereacross in response to the desired armature current, which of course depends upon the desired tension for the web **14**, and the particular characteristics of the motor **24**.

A transducer **30** has a pair of input terminals connected across the resistor **28** and is responsive to the voltage drop thereacross to regulate the value of pressure on a pneumatic output line **32**. An input line **34** is connected from the transducer **30** to a source **36** of air pressure. The pressure of the source **36** is greater than that desired on the output line **32**, so the transducer **30** functions as a variable pressure reducer.

The transducer **30** is preferably a commercially available type, known as a current-to-pneumatic pressure transducer. In one embodiment of the present invention the transducer is a model P2CP transducer marketed by the Barber Coleman Company.

A rheostat 38 is connected in parallel with the input terminals of the transducer 30, and is adjusted to select a given pressure output from the transducer 30 for a given value of armature current. Therefore, the rheostat 38 is conveniently employed to establish a scale factor between armature current and the pressure on the output line 32.

The output line 32 is connected through a valve 40 to an air brake 42 which is mechanically coupled to the shaft on which the core 12 is supported. The mechanical coupling is illustrated by means of a dashed line 44 which interconnects the brake 42 and the core 12. In operation, the valve 40 is normally in the condition schematically illustrated in the drawing, so that the pressure on the output line 32 is conveyed directly to the brake 42 to establish the torque supplied by the brake 42 on the core 12. The greater that this torque is, the greater is the tension of the web 14 as it is withdrawn from the roll 10. As already described, however, this tension is less than the tension on the web 14 downstream from the tension multiplier 16. Accordingly, a lesser value of torque is required to be produced by the brake 42 on the core 12 than would be necessary were it not for the tension multiplier 16.

A current sensing relay 46 is connected in parallel with the resistor 28 and responds to the voltage drop thereacross to control a solenoid 48 for operating the valve 40. When the voltage drop across the resistor 28 exceeds the threshold level of operation of the relay 46, it energizes the solenoid 48 via lines 50 and 52. The valve 40 is then operated to interconnect the line 32 and the brake 42.

During the initial period of operation, when the processing apparatus is starting up, there is substantially no tension on the web 14, and, accordingly, no current through the armature winding of the motor 24, so the relay 46 and the solenoid 48 are both unactuated. When the solenoid 48 is not actuated, the valve 40 connects the brake 42 to a line 54 which is connected to the pressure source 36 through a pressure reducer 56. The pressure reducer 56 is preferably a manually controlled pressure reduction valve which selects a predetermined constant pressure on the line 54, less than that produced by the source 36. Such valves are well known in the art and therefore need not be specifically described herein. This pressure is supplied to the brake 42, through the unoperated valve 40, so that the brake 42 applies a predetermined braking force to the core 12 during the initial period while the tension on the web 14 is building up from zero to its operating value. When the processing apparatus is started up, the tension of the web 14 increases, and armature current of the motor 24 increases, resulting in a voltage drop across the resistor 28. When this reaches a value just less than the value which corresponds to the working tension on the web 14, the relay is operated so as to connect the brake 42 to the regulated output 32 of the transducer 30. In this way the tension on the web 14 is caused to be raised quickly and smoothly to its operating value as the processing apparatus is started up, and the transducer 30 and the valve 40 thereafter control the brake 42 to thereafter control the tension on the web 14.

As the web material 14 is withdrawn from the roll 10, the necessary torque applied by the brake 42, in order to produce a predetermined tension on the web 14, decreases, because of the reducing diameter of the roll 10. The apparatus of the present invention is operative to sense, by means of the current flowing through the armature of the motor 24, the condition of the roll 10, and adjust the value of the pneumatic pressure supplied to the brake 42 accordingly.

The motor 24 is preferably a shunt motor, the field of which is constantly energized by means of a source of d.c. potential (not shown). Alternatively it may be a series or universal motor. An alternating current motor may alternatively be employed, and in that event, means for rectifying the a.c. armature current is employed.

It will be appreciated that it is necessary that the rollers 18 and 20 be equipped with a surface having a sufficiently large coefficient of friction when employed with the web material 14 so as to achieve the desired tension without the web material 14 slipping relative to the surface of the rollers.

What is claimed is:

1. A tensioning device for use with a process employing a quantity of web material drawn from a supply roll comprising, in combination, a roller mounted on a shaft, said web contacting the surface of said roller between said supply roll and said processing apparatus, a motor connected to said shaft, means for sensing the armature current of said motor and for regulating the pneumatic pressure on an output line in response thereto, brake means connected with said output line and adapted for impeding the rotating of said supply roll to control the tension on said web, and a source of potential connected to the motor to urge said motor to rotate in a direction opposite to the direction of travel of the web.

2. Apparatus according to claim 1, including manually operated means for controlling the scale factor between the armature current of said motor, and the pressure on said output line.

3. Apparatus according to claim 1 including means for establishing a predetermined pneumatic pressure, and means operative during an initial period of withdrawing said web from said roll while said tension is low for connecting said brake means to said predetermined pressure means.

4. Apparatus according to claim 1 wherein said brake means is operatively associated with the core upon which said supply roll is supported and is operative in response to the pressure on said output line to impede the rotation of said core when the tension of said web is less than a predetermined value.

5. Apparatus according to claim 1, wherein said roller guides said web around a turn, whereby said web is in frictional contact with the surface of said roller as it passes through said turn.

6. Apparatus according to claim 1, including a second roller connected to the first said roller for rotation therewith, said web contacting the surface of said second roller, whereby said first and second rollers are in frictional contact with said web.

7. Apparatus according to claim 6, including means for supporting said rollers to permit said web to define an S shape as it traverses said two rollers.

8. Apparatus according to claim 1, wherein said motor is a d.c. motor, and wherein said source of potential is connected in series with said armature to urge said motor to rotate in the direction opposite to the direction of travel of said web.

9. Apparatus according to claim **8**, including a resistor in series with the armature of said motor, and means for connecting said sensing means across said resistor.

10. Apparatus according to claim **3**, including relay means connected to said motor and responsive to the armature current thereof for operating a valve at the end of said initial period when said armature current exceeds a predetermined level, said valve being interposed in the path between said output line and said brake means and operable to disconnect said predetermined pressure means from said brake means and to connect said output line to said brake means.

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