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WEB TENSION APPARATUS

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2 Sheets-Sheet 1

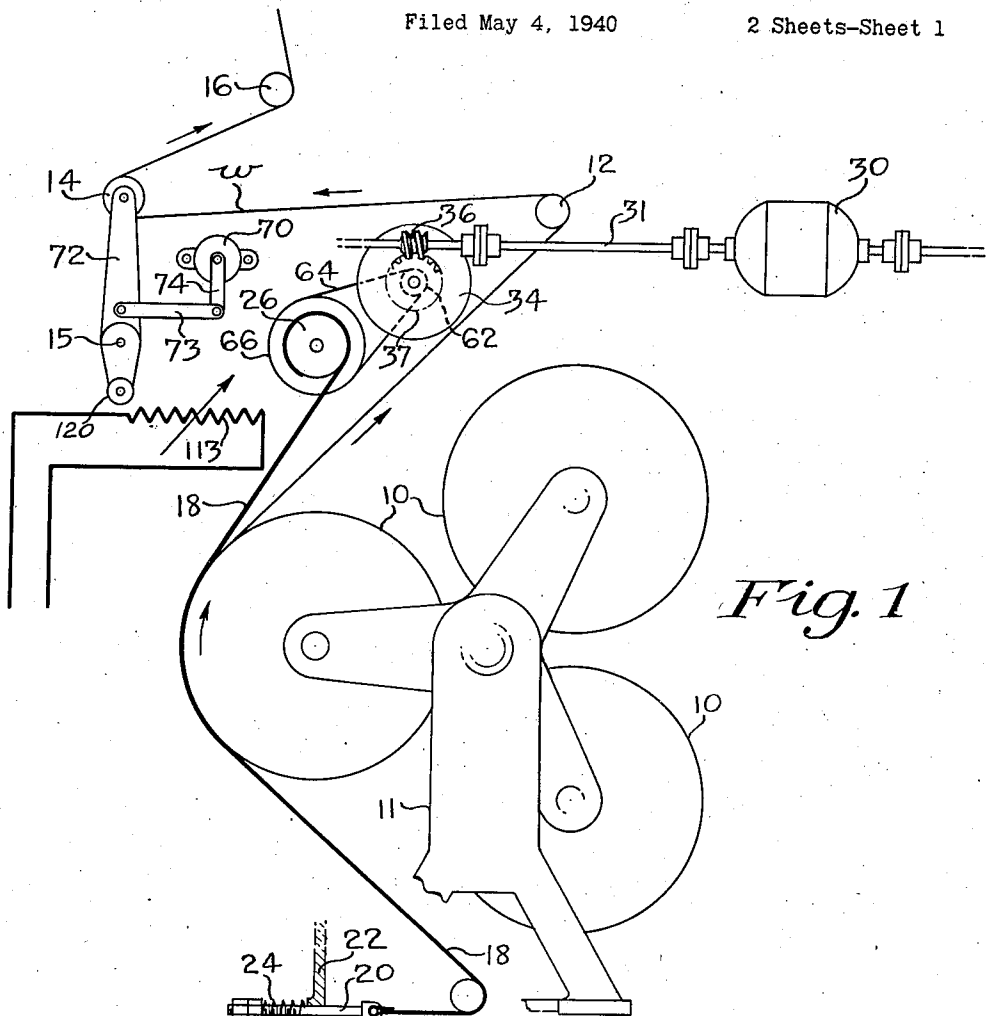


Fig. 1

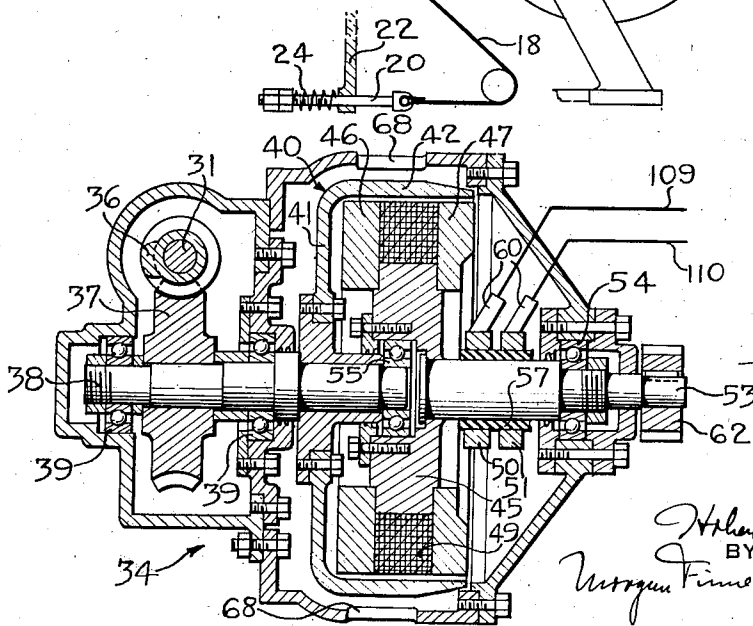


Fig. 2

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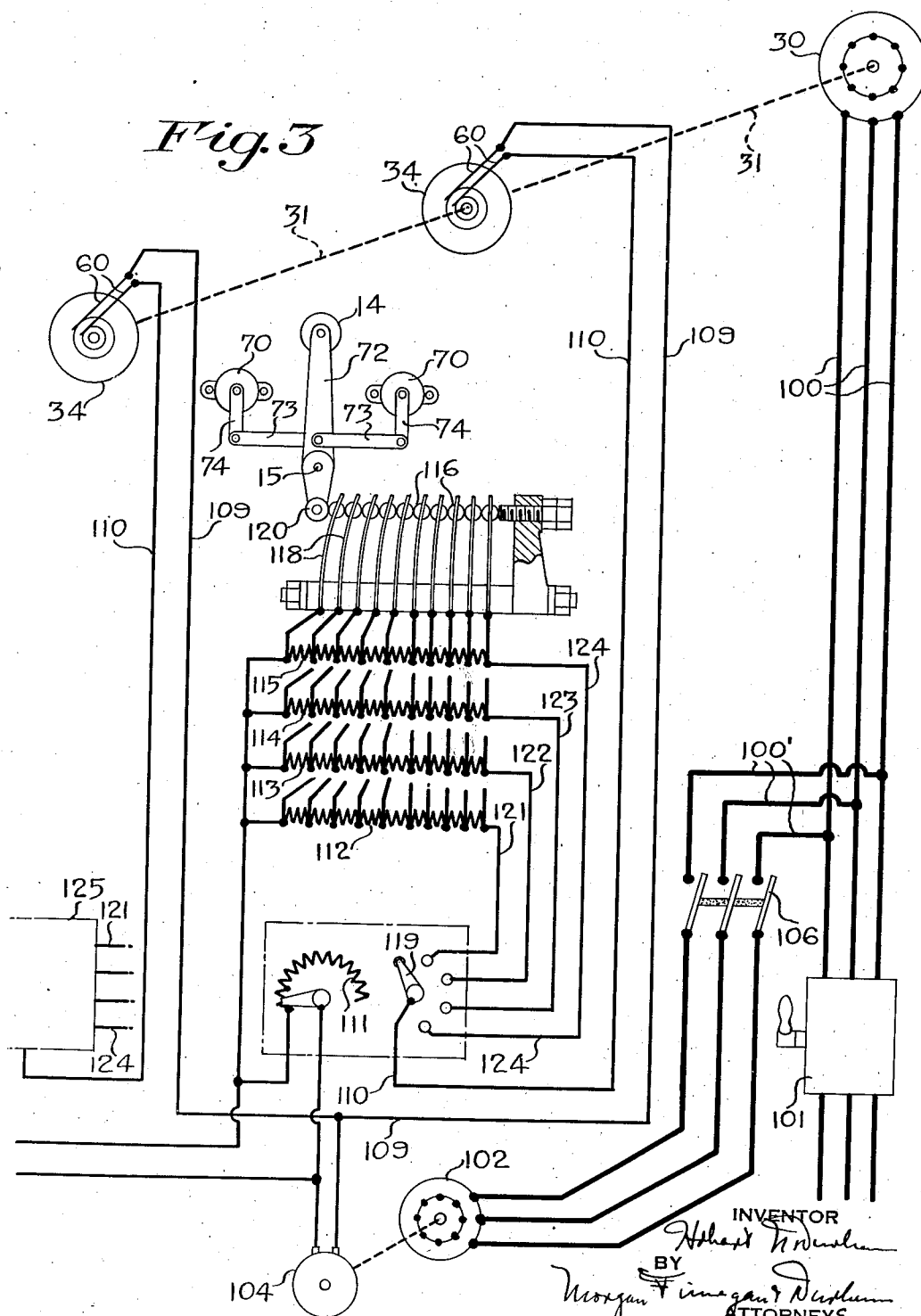
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

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WEB TENSION APPARATUS

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12 Claims. (Cl. 242—75)

The present invention relates to new and useful improvements in web tension apparatus and is particularly adapted for use in connection with the supply web to high speed rotary printing presses.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

The invention consists in the novel parts, constructions, arrangements, combinations and improvements herein shown and described.

The accompanying drawings, referred to herein and constituting a part hereof, illustrate one embodiment of the invention, and together with the description, serve to explain the principles of the invention.

Of the drawings:

Figure 1 is a diagrammatic side elevation of a typical and illustrative embodiment of the present invention;

Figure 2 is a vertical sectional view showing an eddy current clutch as used in connection with the present invention; and

Figure 3 is a circuit diagram of the present invention showing the various parts and their electrical interconnections.

The present invention has for its object the provision of a novel and improved web tensioning apparatus which is relatively simple in construction and provides a precise and minutely variable control of the tension of a web fed from a web roll to a printing press or other web consuming equipment. A further object of the invention is the provision of a novel and improved web controlling device in which friction is applied to the surface of a web roll from a source of power through a variable clutch so as to effect a continuous control of the web and maintain it constant regardless of the various other factors which may tend to cause a variation in the tension of the web. The invention also provides a web tensioning apparatus particularly adapted for use with high speed printing presses which can be operated from any prime mover such as an alternating current motor, and requires no relatively heavy direct current supply to effect the desired control. Still another object of the invention is the provision of an improved web tension device in which a constant tension is maintained by varying the pressure of a friction member against the surface of the web roll, the variation in pressure being induced by transmitting varying quantities of power from a constantly operating motor.

It has heretofore been proposed to employ a

torque motor or other form of stalled motor for pressing a friction member against a web roll, the pressure between the friction member and the web roll being varied in some cases to approximate a constant tension on the web. However, such installations have not only required

5 the provision of a relatively large source of direct current, but have failed to give accurate and precise control of the web tension by reason of the fact that the torque or other form of stalled motor moved by definite increments due to the fact that the current was supplied to it through a commutator. Furthermore, such motors have necessarily been of relatively large size in order to provide the proper heat dissipation as all of the excess power was converted into heat by parts which did not have any relative rotation. Purely mechanical systems have also been proposed which have failed to be satisfactory, due in part to the fact that they were slow to respond as their action was largely dependent upon the acceleration of gravity, and the systems employed had a relatively large inertia. Fluid pressure systems also have failed to be a success as they require not only a large amount of special power, but they are also subject to leakage and other factors which operate against their uniform and continued satisfactory performance.

30 In accordance with the present invention, the defects of the prior art are avoided and a highly satisfactory system is provided which is capable of regulating the tension of the web with any degree of precision. The parts have continuous relative rotation, are capable of being cooled satisfactorily and require only a minimum of direct current power for their control, at the same time responding quickly so as to maintain the tension of the web at a substantially constant value from the beginning to the end of the web roll.

45 It will be understood that the foregoing general description and the following detailed description as well, are exemplary and explanatory of the invention but are not restrictive thereof.

Referring now in detail to the illustrative embodiment of the invention as shown by the accompanying drawings, the web tension apparatus is shown as applied to the control of the tension of a web of paper being fed to the printing press from one of several web rolls 10 supported by a magazine reel 11, the web being led over a guide roller 12, a pilot roller 14 which is pivotally mounted to swing about shaft 15 and another guide roller 16 and thence to a high speed rotary printing press.

55 The tension of the web of paper being fed to the press is created by friction developed between one or more straps or other flexible friction elements 18 bearing against the outer sur-

face of the web roll 10, and these straps are preferably anchored to spring mounted rods 20 which have some movement in anchor brackets 22 securely fastened to the floor or machine frame, the rods being provided with compression springs 24 which resist the pull of the straps 18. The upper ends of straps 18 are connected to a roller or drum 26 which is adapted to be rotated and subjected to a continuous strain so as to keep the straps 18 pressed against the surface of roll 10 with the required degree of pressure. Thus, an increased force applied to the roller 26 causes an increased pull on the straps 18 to increase the pressure between the straps 18 and the roll 10, and thereby cause an increased tension in the web W being fed from the roll to the press. As the diameter of the web roll 10 decreases as the paper is used up, it is necessary that the pressure between the strap 18 and the web roll 10 be increased gradually to maintain a constant web tension, and this is accomplished by gradually increasing the force applied to and tending to rotate the roller 26.

In accordance with the present invention, the force applied to and tending to rotate the roller 26 is derived from a motor or other relatively high speed source of power, and while any rotating shaft may be used, I conveniently employ an electric motor 30 as the source of this power. Motor 30 drives a shaft 31 which extends along the printing press and over one or more of the web supply mechanisms, and this shaft drives one element of an electromagnetic clutch, such as an eddy current clutch 34 while the other element of the clutch is connected to rotate the roller 26. The power transmitted from shaft 31 to roller 26 is preferably varied so as to maintain the pull on the straps 18 substantially constant for any given web roll diameter, but is gradually increased as the web roll 10 diminishes in size, and is greatly and rapidly increased when the press is to be stopped or when a break occurs in the web.

Figure 2 of the drawings illustrates one form of electromagnetic clutch suitable for use in the present invention and as there shown shaft 31 is provided with a worm 36 meshing with worm gear 37 on shaft 38, shaft 38 being rotatably mounted in the clutch housing by bearings 39. On the inner end of shaft 38 is securely fastened a dished rotor 40 comprising a disc-like web 41 connected to a relatively wide cylindrical portion 42 formed with a plurality of circumferentially spaced poles. Within the rotor 40 is a rotatable annular field magnet 45 comprising a pair of spaced apart plates 46, 47 having short spoke-like polar projections, the space between plates 46 and 47 being substantially filled by a toroid winding 49 having its terminals connected to the slip rings 50 and 51. The rotatable field magnet 45 is mounted for rotation on shaft 53 which is rotatably supported in the clutch housing by bearing 54 near one of its ends and is supported near its other end on shaft 38 by bearing 55. Slip rings 50 and 51 are mounted on shaft 53 and insulated therefrom by insulating collar 57, and receive current supplied through brushes 60. On the outer end of shaft 53 is a sprocket or pinion 62.

The power and movement transmitted through the clutch from shaft 31 to sprocket 62 is applied to roller 26 through sprocket chain 64 which passes over a large sprocket 66 at one end of the strap roller 26 and thereby a variable portion of the power and rotation of shaft 31

is transmitted to the roller 26 to maintain the straps 18 in contact with the web roll 10 as well as to vary the pressure of these straps against the web roll. This portion of the power and rotation of the shafts 31 which is transmitted to the roller 26 can be widely, continuously and minutely varied by varying the current applied to the toroid winding 49 so as to cause the roller 26 to rotate in either direction, the tension of the straps 18 balancing the power applied to the roller 26.

The rotation of the shaft 31 causes the rotor 40 to be driven at a substantially constant speed, and this relatively high speed of rotation produces a continuous and rapid circulation of air through the ventilating openings 68 in the clutch housing, thereby preventing any overheating of the clutch even when it is operated for extremely long periods of time and without any substantial movement of the rotatable field coil 45. The polar nature of the drum-like rotor 40 tends to drag the rotatable field coil 45 along with it in the same direction of rotation, the strength of this drag being determined by the strength of the field produced by the winding 49 and the plates or pole pieces 46, 47, and this strength of field is substantially independent of the rotational position of the field magnet 45 as there is no variation in the field current as the magnet rotates.

In order to maintain a substantially constant tension on the web W during the normal operation of the web feeding apparatus and printing press, a variable resistance is provided in the power supply circuit for winding 49, and is under control of the position of the pilot roller 14, as will be described more in detail, in connection with the circuit diagram. As the web tension decreases the pilot roller is moved to supply additional power to the winding 49 to bring the tension back to normal, and similarly, the power supplied to winding 49 is decreased whenever the web tension increases. In order to prevent sudden fluctuations in the power transmitted through the eddy current clutch 34, shock absorbers or other damping arrangement 70 are connected to the pilot roller 14. As embodied, pilot roller 14 is mounted in pivoted arms 72 and is connected by links 73 to shock absorber arms 74, thereby slowing the movement of the pilot roller arms 72 with minor variations in web tension.

Referring now to the circuit diagram of Figure 3, the invention is illustrated as applied to a plurality of web tension units powered from a single motor 30. Motor 30 is illustratively shown as a polyphase induction motor receiving power from the mains 100 through a conventional starter box 101, and when starting switch 101 has been closed, the motor (running at a constant speed) drives shaft 31 and the parts 36, 38, 40, 41, 42 of each of the eddy current clutch units, but as their separate field coils 49 are not energized, no substantial amount of power is transmitted to the several rollers 26.

Power is supplied to the field coil 49 of the clutch units by individual circuits, and as shown branch lines 100' of mains 100 supply direct alternating current through a switch 106 to a motor 102 driving a generator 104 to provide direct current to the conductors 109, 110 of the individual circuit for each of the clutch units. Conductor 109 leads directly from the generator to one of the brushes 60 while conductor 110 is connected to the other brush 60 and supplies it

with power from the other terminal of generator 104 through variable resistance 111 and one of the several variable caterpillar resistances 112, 113, 114, 115. Resistance 111 is a manually operated variable resistance which can be adjusted to accommodate the tension apparatus to full or fractional width rolls of paper, a half roll requiring only half the tension of a full roll. The resistances 112, 113, 114, 115 are of the caterpillar type, each comprising a plurality of contacts 116 connected to taps on the resistance element, each contact being mounted upon its own individual conducting spring 118. Although only resistance element 115 is shown in Figure 3 as being supplied with such contacts 116 and conducting springs 118, it will be understood that the resistances 114, 113 and 112 are each supplied with similar caterpillar mechanism. The contact elements 116 of each of the several resistances are normally held in spaced apart relation by the action of their respective springs 118, but are sequentially pressed into contact with each other to short circuit more or less of the several resistance elements as these contacts are moved by the insulating member 120 carried by the lower extension of the pilot roller supporting arms 72, said insulating member operating to actuate simultaneously the contacts 116 and springs 118 of the caterpillar mechanism of each of the several resistance elements 112, 113, 114 and 115. Each of the resistance elements 112, 113, 114 and 115 are of a different ohmic value, and the particular resistance element to be in circuit at any particular time may be determined by the pressman by means of switch arm 119 which is connected to conductor 109 and adapted to selectively engage the conductors 121, 122, 123 and 124 leading to resistance elements 112, 113, 114, and 115 respectively.

A separate clutch unit and control is provided for each of the other web tensioning devices employed, and these parts are preferably duplicates of those described in connection with the first unit, the resistance 111 and selective switch 119 being located within a separate control box 125 with similar resistance elements 112, 113, 114 and 115, and a corresponding pilot roller 14 being provided for this unit, all units, however, receiving their requirements of direct current power from the same generator 104.

In the operation of the illustrative embodiment, web is fed from the web roll 10 over guide rollers 12 and 16 and is looped around pilot roller 14 in passing through the press. Pilot roller 14 is pivotally mounted on a shaft 15, and is spring biased so that it resiliently tends to enlarge the loop in the web against the tension of the web, being moved in a clockwise direction (Figure 1) by increased tension of the web, and in a counter-clockwise direction by decreased tension of the web. The shock absorbers 70 prevent sudden movements of the pilot roller 14, thereby rendering the mechanism more stable.

Before the printing press is started, starting switch 101 is closed to supply power to motor 30, and this motor is preferably of the conventional polyphase alternating current type and of sufficient power so as to enable it to rotate at a substantially constant speed under all types of operating conditions. Motor 30 drives shaft 31 and rotor 40 of the eddy current clutch of each of the web tension devices connected to and receiving power from shaft 31, and substantially

any number of such tension devices may be powered by a single motor 30.

The resistance 111 is regulated by the operator to correspond to the width of web roll being employed, one resistance value being customarily used for one quarter width web, another for half width, still another for three quarter width web, and the resistance 111 being substantially cut out for a full width web roll.

With the switch arm 119 the operator causes one of the resistance elements 112, 113, 114 or 115 to be placed in the circuit, the resistance chosen depending upon the particular type of operation being performed, and as the web is fed to the press, pilot roller 14 assumes a normal intermediate position, causing only the desired part of the particular resistance element in circuit to be used. Switch 106 is closed and current is supplied to motor 102 driving generator 104 from which a controlled amount of direct current is supplied to winding 49 through brushes 60.

The amount of power applied to the windings 49 under control of the resistance 111 and the particular caterpillar resistance in use, accurately determines the amount of power transmitted from the motor driven rotor 40 to the field coil 45, and thereby to the pinion 62, roller 26 and friction straps 18, causing these straps to be applied against the surface of the web roll 10 with a definite and substantially constant pressure to create a substantially constant web tension during the normal operation of the apparatus and the printing press. As the web roll 10 decreases in size, the pull on the straps 18 must be increased slightly to maintain a constant tension on the web, and this is taken care of by corresponding slight movement of the pilot roller 14 in a counter-clockwise direction, thereby increasing the power supplied to the clutch winding 49, causing a corresponding increase in the power transmitted from the motor 30 through the clutch to the straps 18.

During long continued periods of operation of the tension mechanism, the parts are maintained relatively cool due to the rapid relative rotation of elements 40 and 45, which causes a continuous circulation of air over these parts.

Unevenness in the web roll 10, or an out of round condition of the web roll does not cause an appreciable variation in the web tension, as the straps 18, roller 26 and clutch element 45 are free to move in either direction to maintain a constant pull on the straps 18, and thereby create a constant tension on the web W being fed from the web roll 10. There is no variation in the intensity of the force applied to the belts 18 which is at all dependent upon the position of the field element 45, as this field element and its slip rings 50, 51 have no commutator action, and as the rotor 40 is being revolved at a relative fast rate.

When the press is to be slowed down for normal stop, or for an emergency stop, as when the web breaks, the tension on the web W decreases, allowing pilot roller 14 to move counter-clockwise and short circuit more or all of the particular resistance element 112, 113, 114 or 115 in the circuit, thereby applying the full potential from the generator 104 through brushes 60 to the field winding 49 so as to cause a corresponding increase in the power transmitted by the clutch. This increased power transmission rotates roller 26 so as to tighten the straps 18 against the surface of the web roll 10, thereby creating a greatly increased braking force on the web roll to stop

the rotation of the web roll with the required degree of deceleration, the amount of force transmitted to the straps 18 being limited only by the strength of materials used, the power of the motor 30 and the power transmitting capacity of the clutch 34.

The apparatus of the present invention is particularly adapted for use in connection with the making of flying pasters in which the web from the new web roll is joined to the web being fed to the press from the active web roll without stopping the feeding of the web. In such an operation the magazine reel is rotated in a counterclockwise direction (Figure 1) so as to bring the new web roll firmly into contact with the running web from the expiring web roll, and this operation requires that the straps 18 be readily displaced, as by unwinding from the roller 26, without materially interfering with their degree of pressure against the web. This is ideally accomplished by the present invention due to the uniformity of power transmitted by the clutch regardless of the angular or rotational position of the field element 45.

The invention in its broader aspects is not limited to the specific mechanisms shown and described but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

What I claim is:

1. In a web tensioning device, a flexible friction member bearing against the surface of the web roll from which the web is fed, a continuously operating motor, an eddy current clutch in power transmitting relation between the motor and the friction member for transmitting power from the motor to vary the pressure of the friction member against the web roll, and means for varying the power transmission of the eddy current clutch.

2. In a web tensioning device, a flexible friction member bearing against the surface of the web roll from which the web is fed, a continuously operating motor, an electric clutch in power transmitting relation between the motor and the friction member for transmitting power from the motor to the friction member to press the friction member against the web roll, and means controlled by the tension of the web fed from the roll for varying the power transmission of the clutch.

3. In a web tensioning device, a strap bearing against a rotatable web roll, a roller to which the strap is connected to pull the strap into contact with the web roll, a continuously rotating motor, and an electric clutch connecting the motor with the roller.

4. In a web tensioning device, a strap bearing against a rotatable web roll, a roller to which the strap is connected to pull the strap into contact with the web roll, a continuously rotating motor, an electric clutch connecting the motor with the roller, and means for varying the power transmitted by the clutch for varying the pressure of the strap bearing against the roll.

5. In a web tensioning device, a strap bearing against a rotatable web roll, a roller to which the strap is connected to pull the strap into contact with the web roll, a continuously rotating motor, an electric clutch connecting the motor with the roller, and an electric control for the clutch controlled by the tension of the web fed from the

roll for varying the pressure of the strap against the web roll by variation of the power transmitted through the clutch to maintain a constant web tension.

6. In a web tensioning device, a strap bearing against a rotatable web roll, a roller to which the strap is connected to pull the strap into contact with the web roll, a continuously rotating motor, an electric clutch connecting the motor with the roller, a resistance in the clutch circuit, and means controlled by the tension of the web fed from the roll for varying the resistance.

7. In a web tensioning device, a strap bearing against a rotatable web roll, a roller to which the strap is connected to pull the strap into contact with the web roll, a continuously rotating motor, an electric clutch connecting the motor with the roller, and a resistance in the clutch circuit for varying the power transmitted by the clutch from the motor.

8. In a web tensioning device, a strap bearing against a rotatable web roll, a roller to which the strap is connected to pull the strap into contact with the web roll, a continuously rotating motor, an eddy current clutch having a variable power transmission, a pilot roller controlled by the tension of the web fed from the roll, a resistance controlled by the pilot roller and in the clutch circuit, and means interconnecting the motor and strap roller so that an increase in power transmitted through the clutch presses the straps against the roll with increased pressure.

9. In a web tensioning device, a flexible friction element bearing against a rotatable web roll, rotary means connected to one end of the friction element to pull the friction element into contact with the web roll, a rotary motor, a pair of relatively rotatable members connecting the motor to the rotary means, and means for electrically energizing one of the relatively rotatable members to cause said one of the relatively rotatable members to be rotated by the motor.

10. In a web tensioning device, a flexible friction element bearing against a rotatable web roll, rotary means connected to one end of the friction element to pull the friction element into contact with the web roll, a rotary motor, a pair of relatively rotatable members connecting the motor to the rotary means, means for electrically energizing one of the relatively rotatable members to cause said one of the relatively rotatable members to be rotated by the motor, and means for varying the energization of the energized rotatable member in accordance with the tension of the web fed from the roll.

11. In a web tension device to act on a web roll, a brake acting on the web roll, a rotary motor, an eddy current clutch interconnecting the web roll brake and motor to vary the force applied by the motor to the brake through the clutch, and a variable resistance in circuit with the clutch and controlling the variation in the force applied through the clutch.

12. In a web tension device to act on a web roll, a brake acting on the web roll, a rotary motor, and an eddy current clutch interconnecting the web roll brake and motor to vary the force applied by the motor to the brake through the clutch, a pilot roller to be moved by changes in the tension of the web fed from the web roll, and a resistance in circuit with the clutch and controlled by the pilot roller.

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