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WEB TENSION CONTROL MECHANISM

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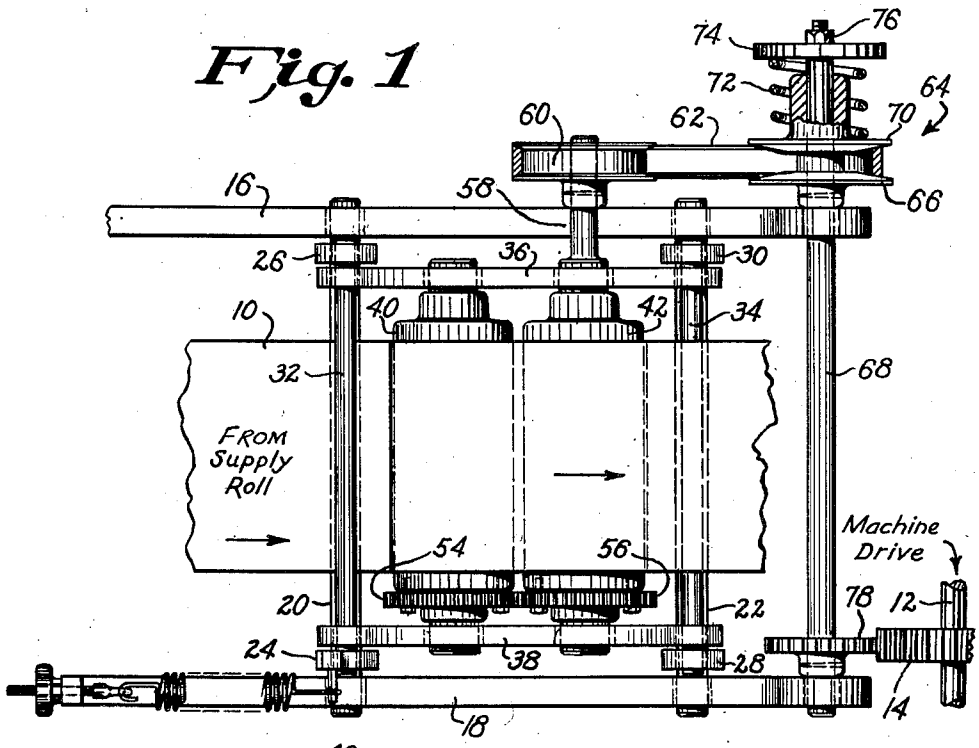
Fig. 1



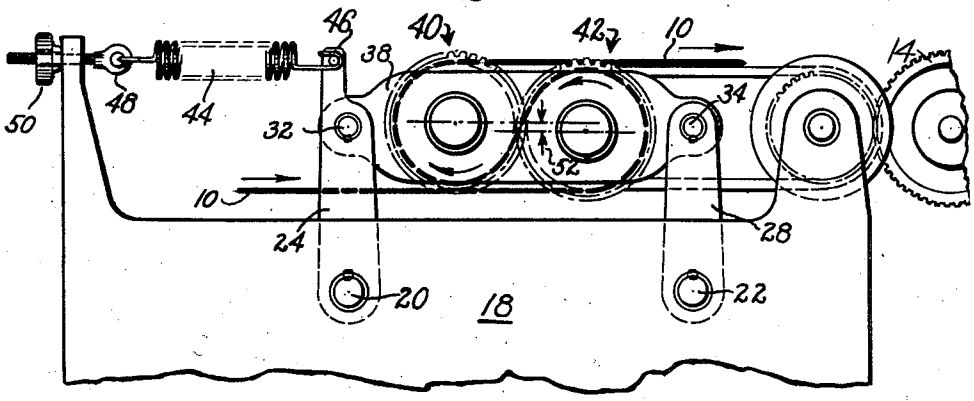


Fig. 2

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WEB TENSION CONTROL MECHANISM

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9 Claims. (Cl. 271—2.3)

This invention relates to an arrangement for accurate control of the tension of moving webs of paper or other flexible material which are being supplied to (or withdrawn from) printing machines or the like which perform operations on such webs.

A principal object of the invention is to provide an arrangement or mechanism of the above type in which the state of tension of the moving web is precisely and, in effect, instantaneously regulated to a predetermined constant value which is independent of the variations in the travel speed of the web.

Another very important object of the invention is to provide a tension control mechanism having the characteristic that a uniform distance is maintained between any two points on the web lying on opposite sides of the mechanism, regardless of the tension-controlling movements of such mechanism. That is, the present invention exercises control of web tension without any variable "take-up" in the web such as is required in conventional tension control devices. This feature is of great importance in certain applications of the device, such as where the tension control mechanism is disposed between two printing units, or between a printing unit and a cutting cylinder or the like.

The above mentioned feature of the present invention enables tension control to be exercised without in any way disturbing the accuracy of register as between successive operations on the same web.

A further object of the invention is to provide a mechanism of the above type whose design is such that it may readily and economically be applied to an existing web handling, printing or treating machine, without major modifications therein.

Still another object of the invention is to provide a design of the above type in which the essential parts are arranged in a generally straight-line configuration, with the directions of arrival and departure of the tension-control web nearly coincident, or at least parallel to one another, so that the arrangement may be introduced into existing web handling equipment without major changes such as might be involved if the entering and leaving web portions were required to be travelling in different directions.

Still another object of the invention is to provide an arrangement of the above type in which automatic control of web tension, to compensate for speed variations, is accomplished simply and economically with a minimum number of mechanical parts.

In general, the above and other object and advantages of the invention are realized by a structure which includes a pair of parallel and adjacent web-carrying rollers carried by a carriage which is movably mounted upon the machine frame by sets of parallel arms constituting a parallelogram linkage, and in which a balance is automatically maintained among three sets of forces acting upon the carriage. Obviously, equivalent motions, such as a purely rectilinear movement of the carriage, could also be employed, but since the maximum carriage travel will be

relatively small, the parallelogram linkage provides a simpler arrangement almost wholly free from friction. A variable ratio V-belt drive is utilized to regulate accurately the rotatable speeds of the web rollers in accordance with the speed of operation of the associated web handling or treating apparatus.

A preferred form of the invention will be described in detail herein in connection with the accompanying drawings, in which:

Fig. 1 is a plan view (with parts in section) of a preferred tension controlling device following the principles of the invention, and

Fig. 2 is a side elevational view of the same.

In order to simplify the present disclosure, associated conventional devices not forming a part of the present invention have been omitted. Thus, it is to be understood that the invention may be applied to either the supply of web material to a machine such as a printing machine or the like, or it may be applied to the withdrawal of partially or completely treated web material from such apparatus. In the drawings, the arrangement is illustrated as controlling the tension in web material **10**, such as paper, from a supply roll (not shown) to a printing machine or the like which includes a shaft **12** rotating in accordance with the speed of such printing machine. This shaft **12** may be a main drive shaft of the printing machine, or it may be any subsidiary shaft rotating in synchronism therewith, so that the drive gear **14**, secured to shaft **12** may be utilized to control the web tension device of the invention. The direction of travel of web **10** is indicated in Figs. 1 and 2 by directional arrows, and is generally from left to right of the drawings, although this direction is reversed during a part of the travel through the web tensioning device.

The main support for the web tensioning elements is represented by a pair of stationary side frames **16** and **18**, and these may, in some case, be the already existing side frames of conventional web handling apparatus. Extending between the side frames **16** and **18** are a pair of cross shafts **20** and **22** which are rotatable in the side frames, and each carries just within the respective side frames a pair of upstanding arms which are keyed on the respective cross shafts. Cross shaft **20** is shown as carrying upstanding arms **24** and **26**, and cross shaft **22** has keyed thereon the upstanding arms **28** and **30**. The upper portions of arms **24** and **26** are connected by a cross shaft **32** which may be keyed to the respective arms, and likewise the upper portions of arms **28** and **30** are connected by a cross shaft **34** which may also be keyed to these arms.

A pair of parallel side plates **36** and **38** have their respective ends journalled upon the cross shafts **32** and **34**, and between these side plates are journalled, a pair of parallel web guiding rollers **40** and **42**.

It will be seen from the above that the rollers **40** and **42** may move as a unit, to the left or right as viewed in Fig. 2, with the upstanding arms such as **24** and **28** remaining parallel to one another during such movements of the rollers. A tension spring **44** is connected from one of the upstanding arms, shown as arm **24**, an upward extension of which carries a pin **46** about which one end of the spring is hooked. The other end of the spring **44** is connected to a fixed part of the side frame **18** as by an eye bolt **48** passing through an aperture in the frame **18** and threadedly engaging in adjusting nut **50** so that the tension of spring **44** tends to move the assembly of web guiding rollers to the left.

The rollers **40** and **42** are spaced apart a sufficient amount so that web **10** (Fig. 2) may pass upwardly around roller **42** and thence downwardly and then upwardly around roller **40**, in a serpentine fashion, leaving

roller 40 to the right in a direction parallel to the direction from which it approached roller 42 from the left. Preferably, rollers 40 and 42 have identical diameters at their web-carrying portions, and to avoid frictional contact between the portions of web material moving adjacent one another in opposite directions, the center lines of rollers 40 and 42 may be slightly offset in the vertical direction. This offset is indicated in Fig. 2 by arrows 52, the roller 42 in this instance having its center line slightly below the center line of roller 40.

Rollers 40 and 42 are geared to one another as by spur gears 54 and 56, so that they rotate at equal speeds in opposite senses. Roller 42 has its shaft extended as at 58, and this extension carries a pulley 60 for a V-belt 62 which passes around a variable diameter V-belt pulley 64 of generally known type. Thus, the variable diameter pulley 64 may comprise a portion 66 secured to a drive shaft 68 journalled between side frames 16 and 18. The other portion 70 of pulley 64 is keyed to shaft 68 but may slide axially therealong, and is urged toward portion 66 by a spiral compression spring 72 whose outer end bears against a plate 74 also fixedly secured to the shaft 68 as by a nut 76.

Shaft 68 is driven in synchronism from the associated web handling or treating machine, such as a printing machine, by any desired means. Conveniently, and for simplicity, this connection may comprise a gear 78 secured to shaft 68 and meshing with the gear 14 already described above as moving in synchronism with the operation of the web treating or handling machine with which the present invention cooperates. Obviously, any other direct drive for shaft 68 from the printing machine could be utilized, it being understood that the transmission ratio required can readily be calculated from a knowledge of the speed of such machine, and the effective diameters of tension control rollers 40 and 42.

The operation of the invention will now be described. Suppose gear 78 is given a counterclockwise rotation by gear 14 and shaft 12, rotating shaft 68 and thereby the pulley 64, belt 62 and pulley 60, so that roller 42 will rotate in the direction indicated by curved arrow thereon in Fig. 2. Because of the gears 54 and 56, roller 40 will be driven clockwise. This will produce travel of web 10 from left to right in the drawings, so as to feed such web to the printing machine, or other following apparatus.

It will be obvious that the carriage comprising side plates 36 and 48, and the rollers 40 and 42, will be urged to the left by the adjusted tension of spring 44 and will be urged to the right by the tensional force in V-belt 62, since the spiral compression spring 72 normally urges the sheave portions 66 and 70 towards one another to provide a maximum effective diameter for the variable pulley 64. In addition, the carriage is subjected to a further force contributed by web 10, which may urge it in either direction depending upon whether the web is being supplied momentarily too fast or too slowly from the supply roll to the printing machine.

The adjustment of spring 44 is made so that during normal running conditions the above three forces are in equilibrium. However, if the tension of web 10 exceeds the predetermined nominal value as set by the adjustment of spring 44, the carriage for rollers 40 and 42 will move to the right. This will decrease the center-to-center distance from pulley 60 to pulley 64, and compression spring 72 will cause the belt 62 to run on a larger effective diameter at pulley 64. Since pulley 64 is the driving pulley of the two, this will increase the speed at which pulley 60 is driven and hence increase the speed of rollers 40 and 42 to cause the web 10 to be fed into the printing unit at a faster rate, thereby reducing the web tension.

The reverse action will occur in the event that web tension falls below the predetermined value so that variations in web tension in either direction will be corrected instantaneously and regardless of changes in the operating speed of the following web receiving unit to which shaft 12 is connected.

From the above description it will be clearly seen that movements of the carriage carrying rollers 40 and 42 accomplish the desired control of web tension without any variation in the distance, measured along the web, between points of the web lying on opposite sides of the mechanism. By "opposite sides" is meant the entering portion of the web and the leaving portion of the web. This is because the distance between the centers of the rollers 40 and 42 is fixed. The accomplishment of this feature makes the present invention particularly valuable where the tension control device is installed between two web-treating devices between whose operations exact registry must be maintained.

A further major advantage of the described arrangement over prior systems of this general type will now be described. Only two web guiding rollers (40 and 42) are required, but the serpentine fashion in which the web passes around these rollers permits the entrance and exit paths to be parallel to one another and separated only by approximately the diameter of one of the rollers. There is no separate web tension sensing means such as required in many previous constructions, because the function of tension sensing is in effect performed by the some rollers 40 and 42 which may undergo tension correcting movements without substantially altering their positions other than in the general direction of web travel. The arrangement is extremely simple, free from maintenance difficulties, and can readily be incorporated into existing web handling apparatus without major changes therein.

It will be seen that in the preferred embodiment illustrated and described herein, the use of a variable pulley and V-belt type of drive has the advantage that a single element, the V-belt 62, operates to transmit the rotating force to the rolls 40 and 42, and also serves as means for automatically adjusting the variable speed drive in accordance with movements of the carriage in response to changes in web tension. While this is the preferred arrangement, it is apparent that other kinds of variable speed drives could be employed, and that the translation of carriage movement into compensating speed changes of such drive could be accomplished by a wholly different element. It will also be realized that the tension-transmitting V-belt 62 could be replaced by a compressive-force transmitting element so placed as to urge the roller carriage in the direction opposite to the action of the force provided by spring 44.

While the invention has been disclosed herein in connection with one preferred embodiment, it is to be understood that many modifications can be made therein without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. Web tension control mechanism comprising a framework, a carriage, a pair of parallel web-guiding rollers rotatably mounted on said carriage on fixed parallel axes and geared together for rotation in opposite directions, the web under control being wrapped in a serpentine manner around the rollers, means mounting said carriage for movement substantially in the direction of a line perpendicular to said axes, means biasing said carriage to move toward one extremity of its movement, a variable speed drive for driving one of said rollers, a force-transmitting element for biasing said carriage toward the other extremity of its movement, and means for adjusting the output speed of said drive in response to movement of said carriage resulting from changes in web tension.

2. Web tension control mechanism comprising a framework, a carriage, a pair of parallel web-guiding rollers rotatably mounted on said carriage on fixed parallel axes and geared together for rotation in opposite directions,

the web under control being wrapped in a serpentine manner around the rollers, means mounting said carriage for movement substantially in the direction of a line perpendicular to said axes, means biasing said carriage to move toward one extremity of its movement, a variable speed drive for driving one of said rollers, and a force-transmitting element for biasing said carriage toward the other extremity of its movement and for adjusting the output speed of said drive in response to movement of said carriage resulting from changes in web tension.

3. Web tension control mechanism comprising a framework, a carriage, a pair of parallel web-guiding rollers rotatably mounted on said carriage on fixed parallel axes and geared together for rotation in opposite directions, the web under control being wrapped in a serpentine manner around the rollers, means mounting said carriage for movement substantially in the direction of a line perpendicular to said axes, means biasing said carriage to move toward one extremity of its movement, a variable speed drive for driving one of said rollers, including a tension-transmitting element for biasing said carriage toward the other extremity of its movement and for adjusting the output speed of said drive in response to movement of said carriage resulting from changes in web tension.

4. Web tension control mechanism in accordance with claim 3, in which said variable speed drive comprises a pulley in driving relation to one of said rollers and a second pulley driven from a power shaft, one of said pulleys having an adjustable effective diameter, and a belt connected about said pulleys and operative to alter said adjustable pulley in accordance with the tension of said belt.

5. Web tension control mechanism in accordance with claim 3, in which the means mounting said carriage comprises a parallelogram linkage extending between said carriage and said framework.

6. Web tension control mechanism in accordance with claim 3, in which said first mentioned biasing means comprises a spring connected between said carriage and said framework.

7. Web tension control mechanism in accordance with claim 6, and manual means for adjusting the force exerted by said spring.

8. Web tension control mechanism comprising a framework, a carriage, a pair of parallel web-guiding rollers rotatably mounted on said carriage on fixed parallel axes and geared together for rotation in opposite directions, means mounting said carriage for movement substantially in the direction of a line perpendicular to said axes, means biasing said carriage to move toward one extremity of its movement, and means for driving one of said rollers at a speed controlled by the tension of a web wrapped about said rollers in serpentine fashion, said driving means including a variable speed drive having a tensioned belt biasing the carriage in the opposite direction.

9. Web tension control mechanism comprising a framework, a carriage, a pair of parallel web-guiding rollers rotatably mounted on said carriage on fixed parallel axes and geared together for rotation in opposite directions, the web under control being wrapped in a serpentine manner around the rollers, means mounting said carriage for movement substantially in the direction of a line perpendicular to said axes, means biasing said carriage to move toward one extremity of its movement, and means including a variable speed V-belt drive for biasing said carriage toward the other extremity of its movement, said V-belt drive extending between pulleys one of which is secured to one of said rollers to rotate the same, and the other of which is secured to a power shaft mounted in a fixed position with reference to said framework.

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