

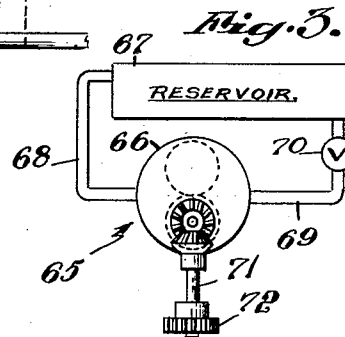
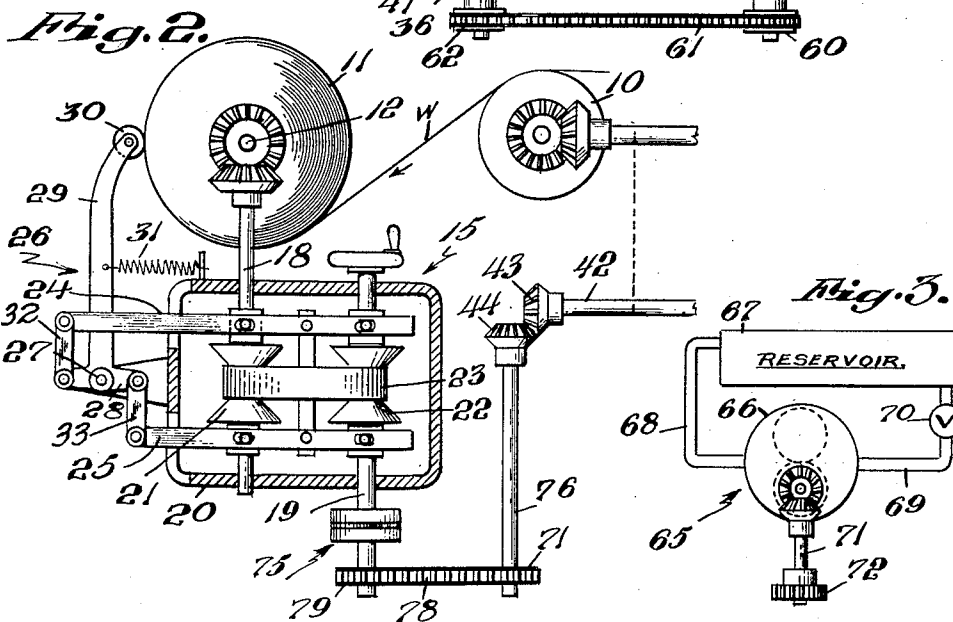
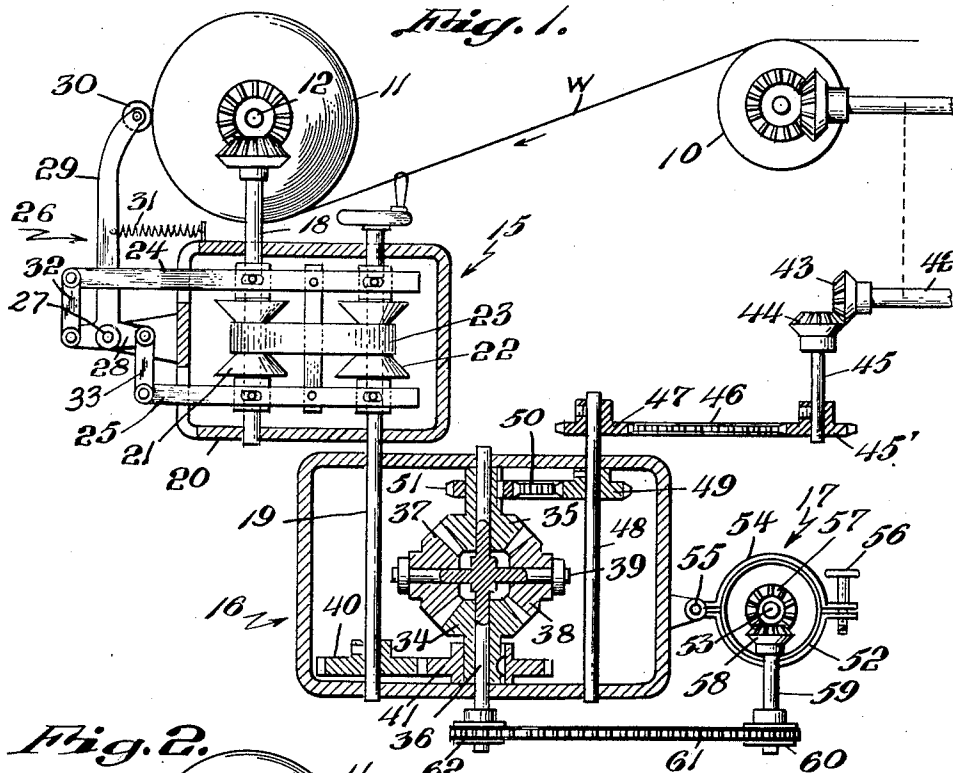
Dec. 8, 1959

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2,916,227

CONSTANT TENSION UNWINDING CONTROL

Original Filed Dec. 19, 1952



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1

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CONSTANT TENSION UNWINDING CONTROL

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Original application December 19, 1952, Serial No. 327,003, now Patent No. 2,883,122, dated April 21, 1959. Divided and this application April 3, 1958, Serial No. 726,180

8 Claims. (Cl. 242—75.5)

This invention relates to constant tension unwinding and/or winding control and is a division of application Ser. No. 327,003, filed December 19, 1952, now Patent No. 2,883,122.

A primary object of the present invention is to provide a control mechanism which will maintain uniform tension on a strip which is being processed.

Another object of the present invention is to provide a relatively inexpensive constant tension control mechanism which is easy to maintain.

And still another object of the present invention is to provide a velocity control on the rewind shaft and compensate for the increasing linear speed of the web as the roll increases in diameter.

Other objects of the present invention will be pointed out in part and become apparent in part in the following specification and claims.

Uniform tension is a prerequisite to uniformity of product in many strip processing machines such as textiles, paper, imitation leather, aluminum foil, printing and the like. Especially is this true in coating machinery where the tension on the web or strip effects the nature of the application of the coating being applied to the cloth.

In the past constant tension control mechanisms have been of the so-called "on-off" type. This type of control mechanism inherently produces "hunting," that is, the tension would build up gradually to some predetermined value above an arbitrary average, when the control mechanism would correct the tension to some predetermined value below the arbitrary average. A graph representation of this type of control would produce a zig-zag curve of tension against time.

The present invention overcomes this irregularity of tension control by correcting any deviation in the tension instantaneously. The rate of correction is in direct proportion to the error of tension. A graph of the present control mechanism would tend to produce a straight line for tension against time.

Referring to the drawings in which similar characters of reference indicate corresponding parts in the figures:

Figure 1 shows an embodiment of the present invention in diagrammatic form;

Figure 2 is a diagrammatic representation of a modified form of Figure 1;

Figure 3 is a diagrammatic form of a gear pump.

Referring to the drawing in more detail, particularly Figure 1, W designates a strip or web of material which is fed or advanced from a drum 10 to a beam 11 at a constant velocity, the beam being mounted on an axle 12 for rotation thereby. Inasmuch as the problem is to maintain the tension on the web constant as the web is wound on the beam 11, it follows that the power applied to axle 12 must be maintained constant as the diameter of the beam increases. To that end three separate mechanical units are employed: a variable speed transmission 15, a differential gear train 16, and a brake mechanism 17. These units are well known and may be

2

interconnected by well-known power transmitting means such as belt drives, gear drives and the like. In the present instance these units and the connecting drives therefore are shown as by way of example more or less diagrammatic.

The variable speed transmission 15 as shown comprises a pair of parallel shafts 18, 19 which are rotatably mounted in a housing 20. Each shaft 18, 19 carries respectively, a pair of expansive pulleys 21, 22 which are splined to said shafts for rotational movement thereto. Pulleys 21, 22 are operatively connected for rotation, one from the other, by an edge active belt 23 and may be simultaneously and oppositely adjusted to provide variable speeds.

The adjustment is accomplished by a mechanism including a pair of levers 24 and 25 which are positioned one on one side of said pulleys 21, 22 and the other of said levers positioned on the opposite side of said pulleys. Each lever is similarly pivotally mounted intermediate the ends thereof for rocking movement with the portion of the lever at one side of the pivot operatively connected to the pulley 21, while the portion of the lever on the other side of the pivot is operatively connected to the pulley 22. The levers are rocked in unison about the pivots thereof by a bell crank 26 which is arranged to sense an increase or decrease in the diameter of beam 11. The bell crank 26 is a double bell crank of general T-shape being pivotally mounted on a bracket as at 27 intermediate the ends of the short arm 28 thereof. The long arm 29 of the bell crank carries a roller 30 which is urged against the periphery of beam 11 by a pull spring 31. Thus an increase in the diameter of the beam 11 will cause the lever 26 to be rocked in one direction and a decrease in the diameter of the beam 11 will cause the said lever to be rocked in the other direction. One end of the short arm 28 is pivotally connected to lever 24 by means of a link 32, and the other end of the short arm 28 is similarly connected to the lever 25 by means of a link 33.

From the above it will be apparent that as the beam 11 increases in diameter, the lever 26 will be rocked about the pivot 27 counterclockwise and rock or shift levers 24, 25 toward each other at the free end thereof. This movement will axially move each half of pulley 22 toward the other so as to increase the effective diameter thereof, and simultaneously will axially move each half of pulley 21 away from the other so as to decrease the effective diameter thereof.

The differential gear train 16 comprises a pair of oppositely disposed bevel gears 34 and 35 which are rotatably mounted on the reduced portions of a shaft 36, and a pair of oppositely disposed bevel gears 37, 38 which engage with gears 34, 35 and are rotatably mounted on a shaft 39 which extends at right angles to shaft 36 and is secured thereto to revolve about the axis of shaft 36 as the same is rotated. The bevel gear 34 is rotated from shaft 19 which carries a spur gear wheel 40 which engages a spur gear wheel 41 secured to bevel gear 34. Bevel gear 35 is rotated from a power shaft 42 which is driven from the drive mechanism (not shown) which mechanism rotates drum 10 so that the speeds of rotation of both drum 10 and shaft 42 are constant at all times. The drive from shaft 42 to bevel gear 35 is through a pair of miter bevel gears 43, 44; shaft 45; sprocket wheel 45'; sprocket chain 46 to sprocket wheel 47, secured to shaft 43, and from shaft 48 by means of sprocket wheel 49 fixed thereto and sprocket chain 50 to sprocket wheel 51 fixed to said bevel gear 35.

The above differential gear train operates in the known manner. When bevel gears 34, 35 are rotated in the opposite direction and at the same speed, shaft 36 is idle, that is, it has zero speed. Any difference in speed

of rotation of bevel gears 34, 35 when turning in the opposite direction will produce rotation of shaft 36 and the speed of this rotation will be proportional to the difference in the speed of rotation between bevel gears 34, 35.

The brake mechanism 17 is of well-known construction and comprises a brake drum 52 secured to a shaft 53. A pair of brake shoes 54 which are pivotally mounted as at 55 embrace the drum 52 with a gripping action which is adjustable by a brake adjusting screw 56. A bevel gear 57 is secured to shaft 53 and engages a bevel pinion 58 which is carried on shaft 59. A chain sprocket wheel 60 is fixed to shaft 59 and is connected by a sprocket chain 61 to sprocket wheel 62 secured to shaft 36 of differential gear train 16. It will be apparent that if shaft 36 is held against rotation, power will be transmitted from shaft 42 to bevel gear 35. Bevel gears 37, 38 which in the above condition function as stationary idlers will transmit rotation to bevel gear 34 and through spur gears 40, 41 to shaft 19. Now assume that shaft 36 is allowed free rotation in which case power will be transmitted from shaft 42 to bevel gear 35 and to bevel gears 37, 38. Since shaft 36 is free to rotate, bevel gears 37, 38 will be carried about axis of shaft 36 and no power will be transmitted to shaft 19, this depending, of course, upon there being more resistance offered to the rotation of the connecting drive portion from bevel gear 34 to the beam 11 than to rotation of shaft 36. Thus it will be apparent that the drag on the shaft 36 may be chosen in between these two extreme conditions and determine the power transmitted from shaft 42 to shaft 19.

In operation, let it be assumed that the beam 11 is just beginning to take up web W. In this condition the axle 12 will be rotated at its maximum revolutions per minute. Drum 10 advances the web W at a constant and predetermined linear speed to beam 11. Drum 10 and shaft 42 are rotated at constant speed from the same power source. Shaft 42 rotates shaft 19 through the drive connection previously described to rotate axle 12 at the maximum speed at which the diameter of beam 11 will allow itself to be driven, that is, the speed of rotation of beam 11 is dependent upon the speed of travel of web W and will not allow itself to be rotated any faster than required to take up the web advanced thereto. Thus, as the diameter of the beam increases, the speed of shaft 19 would tend to decrease and if the diameter of beam 11 doubles during the winding, the speed of rotation of axle 12 will be reduced to one half. It may be said therefore that the speed of rotation of axle 12 varies inversely with the diameter of beam 11.

Thus, it follows that as the diameter of the beam 11 increases, the speed of rotation of shaft 19 would decrease. Since the speed of rotation of shaft 42 is constant, the decrease in speed of rotation of shaft 19 would result in an increase in the speed of rotation of shaft 36 and in the speed of rotation in brake 17 thereby decreasing the power transmitted from shaft 42 to shaft 19. This decrease in power is reflected directly by a decrease in tension on the web W since predetermined power is a prerequisite for constant tension. In the present instance as the diameter of the beam 11 increases, the lever 26 will be rocked counter-clockwise about pivot 27. This in turn will shift levers 24, 25 about their pivots to decrease the effective diameters of pulleys 22 and increase the effective diameters of pulleys 21 so as to compensate for the decrease in speed of rotation required for beam 11 to take up the web W. Thus the speed of rotation of shaft 19 will remain constant as the diameter of beam 11 increases. Since the speed of rotation of shafts 19 and 48 remain constant, the speed of shafts 36 and 59 likewise remains constant. It will be apparent therefore that constant predetermined power is transmitted or applied to shaft 19 and thus to beam 11 at all times, which maintains a constant tension on web W. At the start of

the operation, the brake is adjusted to a setting which will result in a desired predetermined tension on web W.

In some instances, a gear pump designated generally 65 may be substituted for the brake mechanism 17 (see Figure 3). The pump mechanism 65 comprises a pump 66 operatively connected to a reservoir 67 by means of a suction line 68 on one side of the pump and a return line 69 on the other side thereof. A discharge valve 70 is provided for controlling the torque exerted by the pump. The pump is operated through a pump shaft 71 having a sprocket wheel 72 secured thereto which may be connected to be driven by the shaft 36 through the sprocket chain 61 being trained over sprocket wheel 72.

It will be apparent that the resistance to rotation of the pump shaft 71 may be controlled by the valve 70 so that a predetermined drag may be placed in shaft 36 and thereby control the power transmitted to shaft 18.

In Figure 2 I have shown a modified construction in which a slip clutch 75 replaces the differential gear train 16 and brake mechanism 17 of Figure 1. The variable speed transmission and control therefore remains the same as previously described.

In the structure disclosed in Figure 2, power is transmitted from a suitable power source (not shown) to shaft 76, sprocket wheel 77 and sprocket chain 78 to sprocket wheel 79 carried in the input shaft 80 of slip clutch 75, the other side of said clutch being connected to shaft 19 of the variable transmission 15.

In operation the slip clutch is adjusted to transmit a predetermined torque to shaft 19. Thus the torque transmitted from shaft 76 through the slip clutch 19 will remain constant at all speeds of rotation of shaft 19, thereby maintaining constant predetermined tension on the web W being wound on beam 11.

Having shown and described preferred embodiments of the present invention, by way of example, it should be realized that structural changes may be made without departing from the spirit or scope of the invention.

I claim:

1. In a mechanism for winding web materials, a drive shaft, a beam, a variable speed transmission comprising a first shaft, a second shaft, and a member shiftable to vary the speed ratio between said first shaft and said second shaft, a driving connection between said beam and said first shaft, a differential gear train comprising three rotatable power transmitting elements, a driving connection between said second shaft and the first of said three elements, a driving connection between said drive shaft and the second of said three elements, a braking means, a driving connection between said braking means and the third of said three elements, and means responsive to the diameter of said beam for shifting said member.

2. In a mechanism for winding web materials, a drive shaft, a beam, a variable speed transmission comprising a first shaft, a second shaft, and a member shiftable to vary the speed ratio between said first shaft and said second shaft, a driving connection between said beam and said first shaft, a differential gear train comprising three rotatable power transmitting elements, a driving connection between said second shaft and the first of said three elements, a driving connection between said drive shaft and the second of said three elements, a braking means, a driving connection between said braking means and the third of said three elements, a bell crank arm operatively connected to said member for shifting said transmission, a follower roller rotatably mounted at the end of said arm, and means for urging said roller against said beam and shifting said member as the diameter of the beam changes.

3. In a mechanism for winding web materials, a drive shaft, a beam, a differential gear train comprising three rotatable power transmitting elements, a driving connection between one of said three elements and said drive shaft, a braking mechanism, a driving connection be-

5

tween said braking mechanism and the second of said three elements, a variable speed transmission comprising two power transmitting shafts each having a pair of cone disks splined thereon, two levers controlling said cone disks, a driving connection between one of said transmission shafts and the third of said three elements, a driving connection between the second of said transmission shafts and said beam, a mechanism for controlling the two levers of said variable speed transmission comprising a bell crank arm, a bracket secured to said variable speed transmission, said bell crank arm being pivotally mounted in said bracket, a link pivotally mounted to said bell crank arm and one of said levers, a second link pivotally mounted to said bell crank arm and the second of said levers, a follower roller at the end of said bell crank arm, said roller being urged against said beam by resilient means.

4. In a mechanism for winding web materials, a drive shaft, a beam, a variable speed transmission comprising a first shaft, a second shaft, and a member shiftable to vary the speed ratio between said first shaft and said second shaft, a driving connection between said beam and said first shaft, a slip clutch, a driving connection between said second shaft and one side of said slip clutch, a driving connection between the other side of said slip clutch and said drive shaft, and means responsive to the diameter of said beam for shifting said member.

5. In a mechanism for winding web materials, a drive shaft, a beam, a variable speed transmission comprising a first shaft, a second shaft, and a member shiftable to vary the speed ratio between said first and said second shafts, a driving connection between said beam and said first shaft, a slip clutch, a driving connection between said second shaft and one side of said slip clutch, a driving connection between the other side of said slip clutch and said drive shaft, a bell crank arm operatively connected to said member for shifting said transmission, a follower roller rotatably mounted at the end of said arm, and means for urging said roller against said beam and shifting said member as the diameter of the beam changes.

6. In a mechanism for winding web materials, a drive shaft, a beam, a variable speed transmission comprising two power transmitting shafts each having a pair of cone disks splined thereon, two levers controlling said cone disks, a driving connection between one of said transmission shafts and said beam, a slip clutch, a driving con-

6

nection between one side of said slip clutch and the second of said transmission shafts, a driving connection between the other side of said slip clutch and said drive shaft, a mechanism for controlling the two levers of said variable speed transmission comprising a bell crank arm, a bracket secured to said variable speed transmission, said bell crank arm being pivotally mounted in said bracket, a link pivotally mounted to said bell crank arm and one of said levers, a second link pivotally mounted to said bell crank arm and the second of said levers, a follower roller at the end of said bell crank arm, said roller being urged against said beam by resilient means.

7. In a mechanism for winding web materials, a drive shaft, a beam, a variable speed transmission comprising a first shaft, a second shaft, and a speed changing mechanism shiftable to vary the speed ratio between said first shaft and said second shaft, a positive driving connection between said beam and said first shaft, a slipping drive connection between said drive shaft and said second shaft, a pivoted bell crank arm, a linkage connecting said arm to said speed changing mechanism, and a roller carried by the said arm engaged against said beam and responsive to the diameter of the beam for rocking said bell crank for shifting said speed changing mechanism.

8. In a mechanism for winding web materials, a drive shaft, a beam, a variable speed transmission comprising a first shaft, a second shaft, and a speed changing mechanism shiftable to vary the speed ratio between said first shaft and said second shaft, a positive driving connection between said beam and said first shaft, a slipping drive connection between said drive shaft and said second shaft having constant torque transmitting characteristics, a pivoted bell crank arm, a linkage connecting said arm to said speed changing mechanism, a follower roller rotatably mounted at the end of said arm and means for urging said roller against said beam thereby rocking said crank for shifting said speed changing mechanism as the diameter of the beam changes.

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