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TENSION-DOMINATED CONTROL

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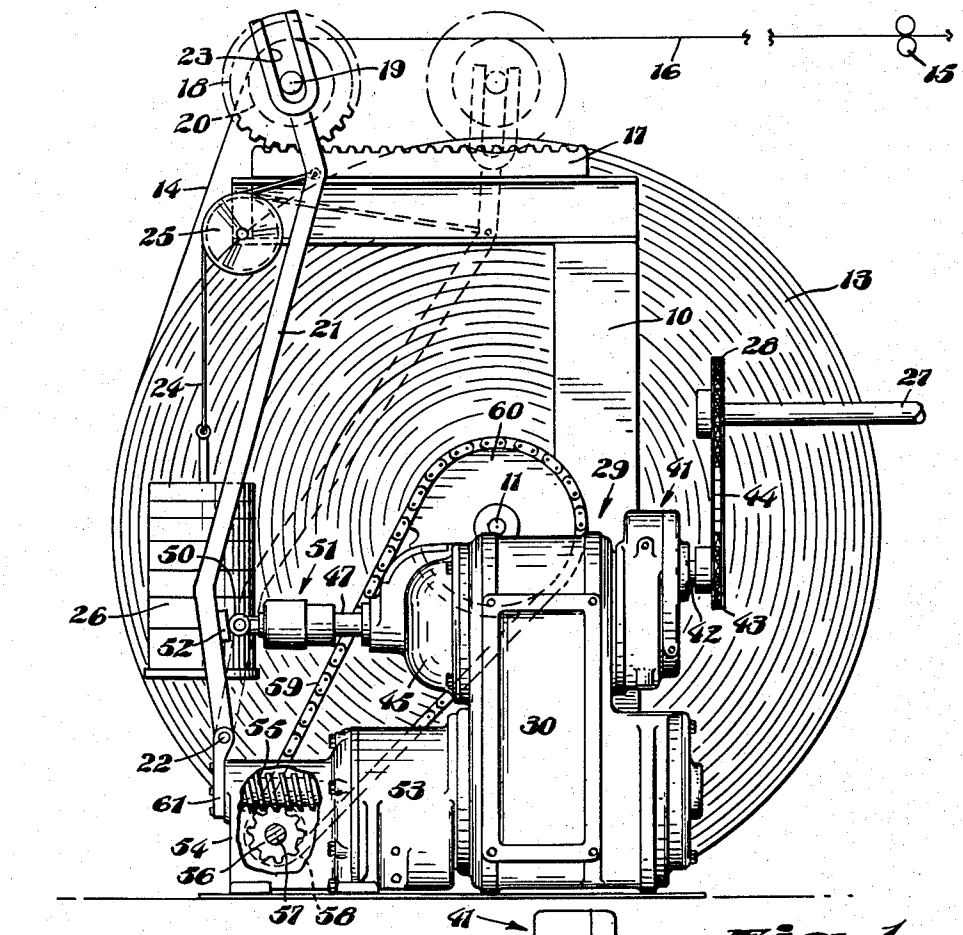


Fig. 1.

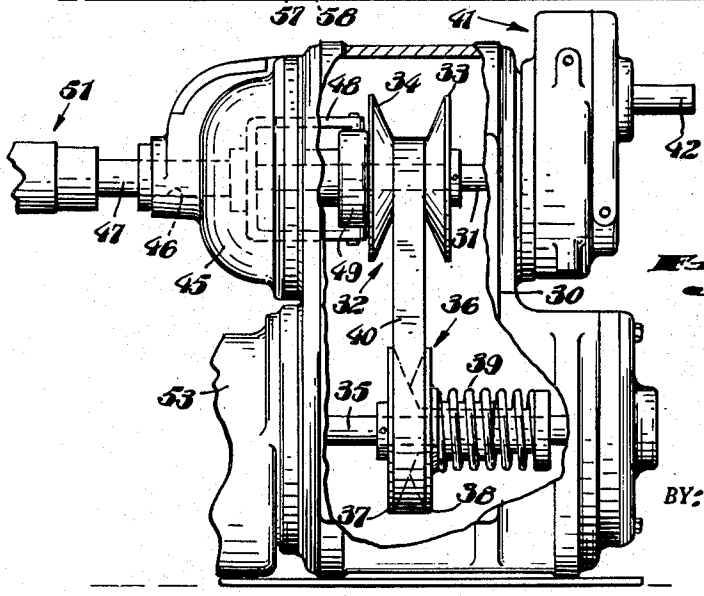


Fig. 2.

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TENSION-DOMINATED CONTROL

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9 Claims. (Cl. 242—75)

The present invention relates to a tension-dominated control or drive for a storage roll for flexible material, and the primary object of the invention is to provide a mechanism which, in response to tendencies toward variation in a condition in a length of such material, such as, for instance, tension, will automatically vary the speed at which such a storage roll is driven in order to maintain such condition against substantial effective variation. A further object of the invention is to include, in the drive train between the power source and the storage roll, an irreversible gear such, for instance, a worm drive, in order more effectively to control accurately the speed of rotation of the storage roll throughout an unwinding cycle.

The invention may be used with a loom beam let-off drive.

To the accomplishment of the above and related objects, our invention may be embodied in the form illustrated in the accompanying drawings, attention being called to the fact, however, that the drawings are illustrative only, and that change may be made in the specific construction illustrated and described, so long as the scope of the appended claims is not violated.

Fig. 1 is a side elevation of a control constructed in accordance with the present invention, assembled with a beam let-off mechanism, fragmentarily and somewhat diagrammatically illustrated, and

Fig. 2 is an enlarged elevation of a variable speed transmission which constitutes an element of the control, parts of the casing of such transmission being broken away for clarity of illustration.

Referring more particularly to the drawings, it will be seen that I have shown a frame **10** in which is journalled a shaft **11** upon which is carried the conventional unwind roll familiarly found in loom constructions. A mass **13** of flexible material is shown wound upon the roll, and the parts are shown, in solid lines, at a time in the cycle of the suggested machine, very shortly after the initiation of an unwinding operation. It will be seen that the material is led from the mass **13** in a section **14** which is always tangent to the effective surface of the mass **13** (sometimes referred to as the effective surface of the storage or unwind roll) and, after passing over the whip roll, later to be described in detail, extends in a run **16** to mechanism, suggested at **15**, through which the material is forwarded at a constant lineal velocity to a point of use (not shown).

A trackway **17** which may, as shown, take the form of a pair of parallel, horizontal racks, is supported upon the frame **10** (which may be a part of a conventional loom frame) above the axis of the shaft **11**, said trackway extending in a direction transverse to the axis. Wheels **18**, which may be cogs, as shown, support an axle **19** upon said trackway **17** for movement therealong; and a roller **20** is supported upon the axle **19** for free rotation about the axis thereof. The assembly **18**, **19**, **20** corresponds to the conventional whip roll.

An arm **21** is mounted for oscillation about a fixed axis **22** which will later be described in detail. The free end of said arm is bifurcated to provide a notch **23** in which the projecting end of the axle **19** is operatively engaged, so that the whip roll and the free end of the arm **21** will move together. A cable **24** has one end anchored to the arm **21**, passes over a pulley **25**, and supports a weight **26**, whereby said arm is yieldably biased to hold the roller **20** at the left-hand end of the trackway **17**, as viewed in Fig. 1.

It will be seen that the roller **20** bears against the inner surface of tfhe section **14** within that sector which is defined between the current point of tangency of section **14** with the effective surface of the unwind roll, and a vertical plane including the axis of the shaft **11**.

A shaft, indicated at **27**, is driven through suitable means (not shown) at a constant ratio with respect to the forwarding means; and said shaft carries a sprocket **28**.

A variable speed transmission, indicated generally by the reference numeral **29**, comprises a case or housing **30** in which is journalled a shaft **31** carrying an expansible pulley indicated generally by the reference numeral **32**. Said pulley comprises a coned disc **33** fixed to the shaft **31** and a mating coned disc **34** supported from said shaft for axial movement toward and away from its fellow, **33**. A second shaft **35** is likewise journalled in the casing **30** and carries a resiliently-expansible V-pulley indicated generally by the reference numeral **36**. The pulley **36** comprises a coned disc **37** fixed to the shaft **35** and a mating coned disc **38** supported from said shaft for axial movement toward and away from the disc **37**, together with a spring **39** constantly urging the disc **38** toward the disc **37**. A belt **40** provides a driving connection between the pulleys **32** and **36**.

In the illustrated embodiment of the invention, the shaft **31** is driven from the output shaft of a reduction gear, indicated generally by the reference numeral **41**, whose input shaft **42** carries a sprocket **43** driven, by means of a chain **44**, from the sprocket **28**.

A removable bell **45**, forming a closure for the casing **30**, is formed to provide a bearing **46** in which is reciprocably mounted a rod **47** carrying, at its inner end, a yoke **48** operatively engaging a housing **49** for a thrust bearing operatively engaged with the disc **34**. A roller **50** is carried at the outer end of the rod **47**, and preferably, a telescopic spring unit, indicated generally by the reference numeral **51**, is interposed between the roller **50** and the rod **47**. A pressure pad **52**, preferably carried on the arm **21**, is positioned for operative engagement with the roller **50**.

In the illustrated embodiment of the invention, a reduction gear **53** is driven by the shaft **35** and, in turn, drives a worm **55** which is an element of a worm gear **54**. A worm wheel **56**, mounted on a shaft **57** within the unit **54**, meshes with the worm **55** and carries, exteriorly, a sprocket **58** which is drivingly connected, by a chain **59**, with a sprocket **60** fixed to the shaft **11**.

When a loaded storage roll is mounted in the frame **10** upon the shaft **11**, the arm **21**, under the influence of the weight **26**, will be in its extreme counter-clockwise position, in which the roller **20** on the axle **19** will be at the extreme left-hand end of the track **17**. The free end of the material on the roll will be carried over the whip roll **20** and to the forwarding means **15**, and thence to a point of use. When the forwarding means **15** is energized, the shaft **27** will likewise be driven. The parts are so proportioned and designed that, under these conditions, the roll **12** will be driven at an angular velocity such as to maintain a predetermined degree of tension in the run **16**.

As material is withdrawn from the mass 13, the effective diameter of the unwind roll is decreased. Since the roll is turning at a constant angular velocity under the driving influence of the shaft 27 through the variable speed transmission 29, there is a tendency for the tension in the run 16 of the material to increase. At the same time, the point of tangency of the section 14 with the effective surface of the mass 13 moves gradually toward the right, as viewed in Fig. 1. The combined effect of these two tendencies will be to increase the horizontal component of the force exerted upon the roller 20 by the material; whereby the tendency of the weight 26 is overcome, and the whip roll 20 will be moved toward the right on the trackway 17. Thereby, the arm 21 will be swung in a clockwise direction about its pivotal support 22 on the bracket 61 to shift the rod 47 toward the right, thereby forcing the disc 34 to move toward the disc 33.

Such movement of the disc 34 will crowd the belt 40 outwardly between the discs 33 and 34, pulling the belt more deeply into the groove between the discs 37 and 38 and shifting the disc 38 toward the right against the tendency of the spring 39. Thus, the effective diameter of the pulley 32 is increased and the effective diameter of the pulley 36 is decreased, to increase the speed at which the shaft 35, and consequently the shaft 11, will be driven. Thus, as the whip roll 20 moves gradually toward the right, as viewed in Fig. 1, the speed of the shaft 11 will be correspondingly gradually increased. Obviously, the proportions of the several parts will be so arranged that the increase in the speed of the shaft 11 will precisely compensate for the diminution in the effective diameter of the mass 13, to maintain constant tension upon the run 16, which is continuously forwarded, at a constant lineal speed, by the forwarding means 15.

We claim as our invention:

1. Means for automatically controlling the rate of rotation of a storage roll for flexible material comprising, in combination with such a roll, a length of flexible material wound on said roll, means for forwarding said material relative to said roll, rotary means driven at a constant ratio with respect to said forwarding means, a variable-speed transmission driven by said rotary means, said transmission comprising an input shaft connected to be driven from said rotary means, an output shaft, a pulley on each of said shafts, belt means providing a driving connection between said pulleys, at least one of said pulleys being an expansible V-pulley, and an element shiftable oppositely to vary oppositely the effective diameter of said V-pulley and thus to vary oppositely the output speed of said transmission, a worm driven from said transmission output shaft, a worm wheel driven by said worm and connected to drive said roll, an arm mounted for oscillation about a fixed axis in a common plane with the axis of said roll, means operatively engaging said arm and bearing against the inner surface of said material at a point within the sector defined between the current point of tangency of such material with the effective surface of said roll and a plane including the axis of said roll and normal to the plane of movement of said material, means yieldingly resisting movement of said arm in response to an increase in the tension in that reach of the material between the forwarding means and said means bearing against the material, and means connecting said arm to shift said shiftable element.

2. Means for automatically controlling the rate of rotation of a storage roll for flexible material comprising, in combination with such roll, a length of flexible material wound on said roll, means for forwarding said material at constant lineal velocity, rotary means driven at a constant ratio with respect to said forwarding means, a variable-speed transmission driven by said rotary means, said transmission including an element shiftable oppositely to vary oppositely the output speed of said transmission, a worm driven by said transmission, a worm wheel driven by said worm and connected to drive said roll, an arm mounted for oscillation about a fixed axis in a common plane with the axis of said roll, a trackway spaced from said axis, disposed in a plane substantially parallel with said axis and extending in a direction transverse to the direction of length of said axis, a bearing member operatively engaging said arm and supported on said trackway for movement therealong, bearing against the inner surface of said material at a point within the sector defined between the current point of tangency of said material with the effective surface of said roll and a plane including the axis of said roll and normal to the plane of movement of said material, said bearing member being yieldably biased away from said normal plane and toward said current point of tangency, and means connecting said arm to shift said shiftable element.

3. Means for automatically controlling the rate of rotation of a storage roll for flexible material comprising, in combination with such a roll, a length of flexible material wound on said roll, means for forwarding said material at constant lineal velocity, rotary means driven at a constant ratio with respect to said forwarding means, a first shaft driven from said rotary means, a pulley on said shaft and comprising a coned disc fixed to said shaft and a mating coned disc supported from said shaft and axially shiftable toward and away from its fellow, a second shaft parallel with said first shaft, a second pulley on said second shaft and comprising a coned disc fixed to said second shaft, a mating coned disc supported from said second shaft and axially shiftable toward and away from its fellow, and spring means urging said last-named disc toward its fellow, a belt providing a driving connection between said pulleys, a shiftable element operatively engaging said first-named mating disc, a worm drivingly connected to said second shaft, a worm wheel meshing with said worm and connected to drive said roll, an arm mounted for oscillation about a fixed axis, a trackway spaced from said axis, disposed in a plane substantially parallel with said axis and extending in a direction transverse to the direction of length of said axis, a bearing member operatively engaging said arm and supported on said trackway for movement therealong, bearing against the inner surface of said material at a point within the sector defined between the current point of tangency of said material with the effective surface of said roll and a plane including the axis of said roll and normal to the plane of movement of said material, said bearing member being yieldably biased away from said normal plane and toward said current point of tangency, said arm operatively engaging said shiftable element to control movement thereof.

4. The combination with a let-off including an unwind roll, a substantially horizontal trackway, a whip roll supported to travel on said trackway, a length of flexible material wound on said unwind roll, and means for withdrawing said material from said unwind roll, said material extending from said unwind roll over said whip roll and thence to said withdrawing means and said whip roll having its axis always within the sector between the current point of tangency of said material with the effective surface of said unwind roll and a substantially vertical plane including the axis of said unwind roll, of a tension-responsive drive for said unwind roll comprising rotary means driven at a constant ratio with respect to said withdrawing means, variable-speed transmission means driven by said rotary means and including an element shiftable oppositely to vary oppositely the output speed of said transmission means, a worm driven by said transmission means, a worm wheel meshing with said worm, means connecting said worm wheel to drive said unwind roll, and means connecting said whip roll to shift said shiftable element to increase the output speed of said transmission means as said whip roll travels toward said vertical plane.

5. The combination of claim 4 in which said means connecting said whip roll to shift said shiftable element comprises an arm mounted for oscillation about a fixed axis, and means yieldably biasing said arm toward said

current point of tangency and away from said vertical plane, said whip roll having a driving connection with said arm, and said shiftable element being positioned in the path of movement of said arm toward said vertical plane.

6. The combination of claim 5 in which said variable-speed transmission means comprises a first shaft driven from said rotary means, a pulley on said first shaft and comprising a coned disc fixed to said shaft and a mating coned disc supported from said shaft and axially shiftable toward and away from its fellow, a second shaft parallel with said first shaft, a second pulley on said second shaft and comprising a coned disc fixed to said second shaft, a mating coned disc supported from said second shaft and axially shiftable toward and away from its fellow, spring means urging said last-named disc toward its fellow, and a belt providing a driving connection between said first pulley and said second pulley, said shiftable element operatively engaging said first-named mating disc.

7. The combination of claim 6 in which said shiftable element is a rod terminating at one end in a yoke, a thrust bearing operatively engaged with the outer side of said first-named mating disc, means providing an operative connection between said yoke and said thrust bearing, and roller means at the other end of said rod positioned for operative engagement by said arm.

8. The combination of claim 4 in which said variable-speed transmission means comprises a first shaft driven from said rotary means, a pulley on said first shaft and comprising a coned disc fixed to said shaft and a mating coned disc supported from said shaft and axially shiftable toward and away from its fellow, a second shaft parallel with said first shaft, a second pulley on said second shaft and comprising a coned disc fixed to said second shaft, a mating coned disc supported from said second shaft and axially shiftable toward and away from its fellow, spring means urging said last-named disc toward its fellow, and a belt providing a driving connection between said first pulley and said second pulley, said shiftable element operatively engaging said first-named mating disc.

9. The combination of claim 8 in which said shiftable element is a rod terminating at one end in a yoke, a thrust bearing operatively engaged with the outer side of said first-named mating disc, means providing an operative connection between said yoke and said thrust bearing, roller means at the other end of said rod, and means moving with said whip roll and operatively engaging said roller means to control the position of said rod.

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