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TENSION-RESPONSIVE CONTROL

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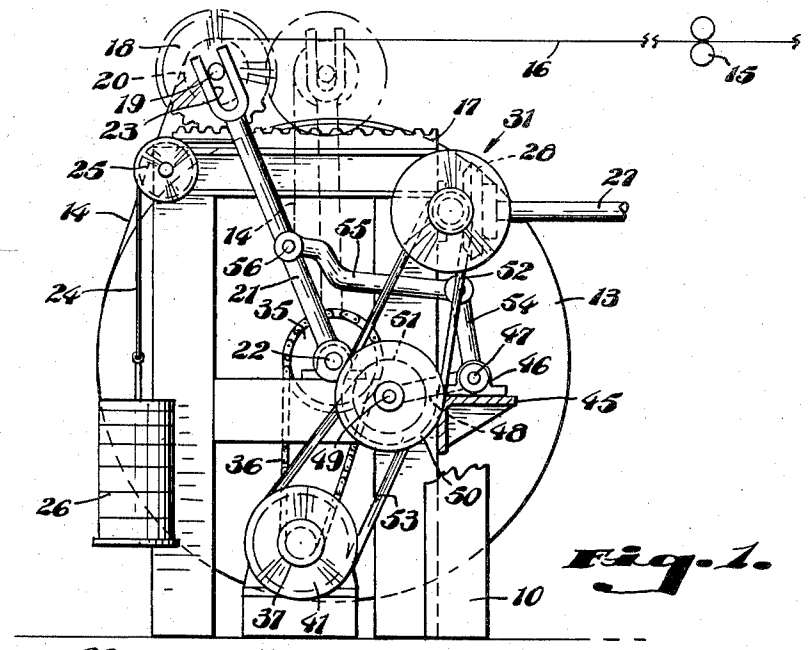


Fig. 1.

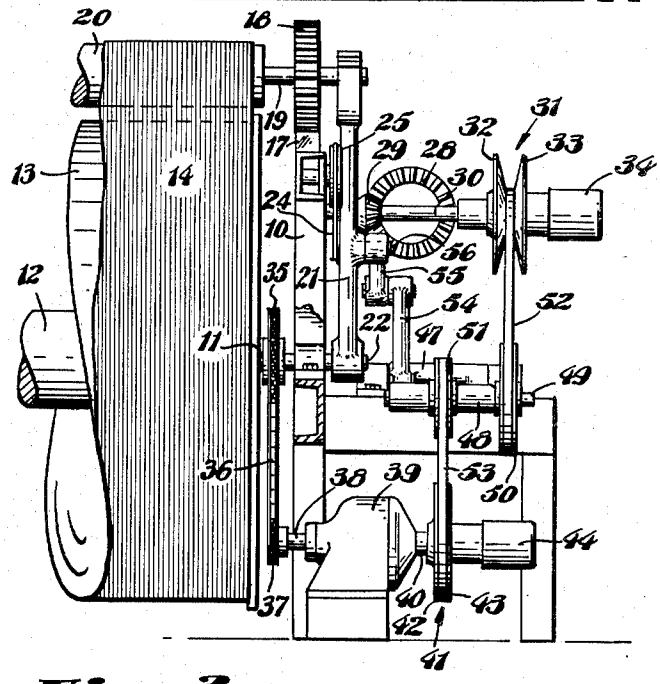


Fig. 2.

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TENSION-RESPONSIVE CONTROL

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16 Claims. (Cl. 139—110)

The present invention relates to a 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, either for winding or unwinding of the material, in order to maintain such condition against substantial effective variation.

The invention is particularly designed for use, and has been illustrated and will be described in connection, with a loom beam let-off drive; and particularly it is an object of the invention to place the shiftable element of a variable-speed transmission, connected to drive the unwind roll of a loom, under the domination of the conventional whip roll of a loom.

To the accomplishment of the above and related objects, my 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 end elevation thereof.

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 **12**, familiarly found in loom construction. A mass **13** of flexible material such as, for instance, warp yarns is shown wound upon the roll **12**; 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 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 take the form of a pair of parallel, horizontal racks, is supported upon the frame **10** (which may be a part of the conventional loom frame) above the axis of the roll **12**, 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** comprises, of course, the conventional whip roll.

An arm **21** is mounted for oscillation about a fixed axis **22** which preferably coincides with the axis of the shaft **11**. In the illustrated embodiment of the invention, said arm is actually mounted upon a projection of said

shaft; the arm being free, however, for oscillation with said shaft. The arm **21** projects into proximity with the trackway **17** and, at its outer end, is bifurcated to define a slot **23**, elongated in the direction of length of the arm, and freely receiving a projecting end of the axle **19**. Thus, the roll **20** is operatively connected to the arm **21**, whereby movement of said roller along the trackway **17** will be accompanied by oscillation of the arm **21** about its journal axis **22**. 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 the material **14** within that sector which is defined between the current point of tangency of section **14** with the effective surface of the roll, and a vertical plane including the axis of the roll **12**.

A shaft, indicated at **27**, is driven through suitable means (not shown) at a constant ratio with respect to the material-forwarding means **15**. A bevelled gear **28** on the shaft **27** meshes with a bevelled gear **29** on a shaft **30** suitably supported upon an axis parallel with the axis of the shaft **11**; and a first resiliently expansible V-pulley, indicated generally by the reference numeral **31**, is mounted to rotate upon the axis of the shaft **30**.

The pulley **31** comprises a coned disc **32** axially fixed with respect to the shaft **30** and a mating coned disc **33** mounted for axial reciprocation relative to the shaft **30**, and resiliently urged toward the disc **32** by a conventional spring unit **34**.

A sprocket **35** is fixed to the shaft **11** and is drivingly connected by a chain **36**, with a sprocket **37** on the output shaft **38** of reducing gear **39**. The input shaft **40** of the gear **39** carries a resiliently expansible V-pulley, indicated generally by the reference numeral **41**, and comprising a coned disc **42** fixed to the shaft **40** and a mating coned disc **43** axially shiftable relative to the shaft **40** and resiliently urged toward the disc **42** by a conventional spring unit **44**.

Upon a bracket **45**, mounted in a horizontal plane between the axes of the pulleys **31** and **41**, a bearing **46** pivotally supports the intermediate portion of a bell-crank lever **47** for oscillation about an axis parallel with, but offset from, the plane common to the axes of the pulleys **31** and **41**. One arm **48** of the lever **47** supports a jack-shaft **49** upon which are mounted two fixed-diameter pulleys **50** and **51**. The pulleys **50** and **51** are connected to rotate together; and this connection is most conveniently provided by drivingly connecting both pulleys to the jack-shaft **49**. A belt **52** provides a driving connection between the pulley **31** and the pulley **50**, while a belt **53** provides a driving connection between the pulleys **51** and **41**.

To the other arm **54** of the bell-crank lever **47** is connected one end of a link **55**, the other end of which is pivotally connected, as at **56**, at an intermediate point in the arm **21**.

When a loaded storage roll **12** is mounted in the frame **10**, 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 end of the material on the roll will now 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 **12** is decreased. Since the roll is turning at a con-

stant angular velocity under the driving influence of the shaft **27** through the variable speed transmission comprising the pulley **21**, the pulleys **50** and **51** and the pulley **41**, 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 along the trackway **17**. Thereby, through the link **55**, the bell-crank lever **47** will be turned in a clockwise direction. Such movement of the lever will tend to move the jack-shaft **49** toward the pulley **31** and away from the pulley **41**. This will tend to produce slack in the belt **52**; but the spring unit **34** will, of course, move the disc **33** toward the disc **32**, thus squeezing the belt **52** outwardly between the discs **32** and **33**, to increase the effective diameter of the pulley **31**. At the same time, as the pulley **51** moves away from the pulley **41**, the belt **53** will be pulled more deeply into the groove between the discs **42** and **43**, forcing the disc **43** away from the disc **42**, against the tendency of the unit **44**, and decreasing the effective diameter of the pulley **41**. The increase in the effective diameter of the pulley **31** will, of course, result in increasing the speed at which the jack shaft **49** will be driven; and the decrease in the effective diameter of the pulley **41** will result in increasing the speed of the shaft **40** relative to the speed of the jack-shaft **49**. Thus, as the whip roll **20** moves gradually toward the right, as viewed in Fig. 1, the speed of the shaft **11** will be gradually increased. Obviously, the proportions of the several parts can be so constructed 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**.

It will be clear that the illustrated mechanism could be used, also, in a winding operation. In such case, the material-forwarding means **15** would, of course, move the material toward, instead of away from, the storage roll **12** at constant velocity; and the control mechanism would operate to reduce the angular velocity of the roll **12**, progressively, under the domination of variation, or rather tendencies toward variation, in the tension in the section **16** of the material. The whip roll **20** would move progressively from its dotted line position toward its solid line position, as viewed in Fig. 1, to move the arm **21** progressively in a counter-clockwise direction, during such winding operation. Thereby, the lever **47** would be progressively moved in a counter-clockwise direction to shift the jack-shaft **49** away from the pulley **31** and toward the pulley **41**, to reduce, progressively, the effective diameter of the pulley **31** and to increase, progressively, the effective diameter of the pulley **41**.

I claim as my 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, variable-speed transmission means connecting said rotary means to drive said roll and comprising an input shaft connected to be driven from said rotary means, an output shaft connected to drive said roll, an expansible V-pulley on each of said shafts, edge-active belt means providing a driving connection between said pulleys, and an element shiftable to vary inversely the effective diameters of said pulleys, 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 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, means yieldingly resisting movement of the arm in response to an increase in the tension on 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 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, variable-speed transmission means connecting said rotary means to drive said roll, said transmission means including an element shiftable oppositely to vary oppositely the output speed of said transmission means, an arm mounted for oscillation about 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 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 operatively connected with said arm, said arm 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 pulley driven by said rotary means, a second pulley spaced from said first-named pulley and mounted on an axis parallel with the axis of said first pulley, a jack shaft, means supporting said jack shaft between said first and second pulleys upon an axis parallel with the axes of said pulleys for bodily movement toward and away from said first pulley, a third pulley and a fourth pulley drivingly mounted on said jack shaft, a first belt trained over said first pulley and over said third pulley, a second belt trained over said second pulley and over said fourth pulley, one of the pulleys engaged by each of said belts being an expansible V-pulley, means connecting said second pulley to drive said roll, an arm mounted for oscillation about 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 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 operatively connected with said arm, said arm being yieldably biased away from said normal plane and toward said current point of tangency, and means connecting said arm to shift said jack shaft.

4. The control means of claim 3 in which said means supporting said jack shaft comprises a lever mounted to swing upon an axis parallel with said pulley axes and eccentric with respect to said jack shaft axis.

5. The control means of claim 3 in which said first pulley and said second pulley are resiliently-expansible V-pulleys and said third and fourth pulleys are fixed-diameter V-pulleys.

6. Means for automatically controlling the rate of rota-

tion 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 resiliently-expansible V-pulley driven by said rotary means, a second resiliently-expansible V-pulley spaced from said first-named pulley and mounted on an axis parallel with the axis of said first pulley, a jack shaft positioned between said first and second pulleys upon an axis parallel to the axes of said pulleys, a third pulley and a fourth pulley drivingly mounted on said jack shaft, a first belt trained over said first pulley and over said third pulley, a second belt trained over said second pulley and over said fourth pulley, an arm mounted for oscillation about 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 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 operatively connected with said arm, said arm being yieldably biased away from said normal plane and toward said current point of tangency, means shiftable oppositely to expand one or the other of said resiliently-expansible V-pulleys selectively while permitting contraction of the other, means connecting said arm to shift said shiftable means, and means connecting said second pulley to drive said roll.

7. The combination with a loom beam let-off including an unwind roll, a whip roll supported to travel on a substantially horizontal 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 connecting said rotary means to drive said unwind roll and comprising an input shaft connected to be driven from said rotary means, an output shaft connected to drive said roll, an expansible V-pulley on each of said shafts, edge-active belt means providing a driving connection between said pulleys, and an element shiftable to vary inversely the effective diameters of said pulleys, 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.

8. The combination of claim 7 in which said means connecting said whip roll to shift said shiftable element comprises an arm mounted for oscillation about the axis of said unwind roll, 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 means providing a driving connection between said arm and said shiftable element.

9. The combination with a loom beam let-off including an unwind roll, a whip roll supported to travel on a substantially horizontal 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 comprising a pulley driven by said rotary means, a second pulley spaced from said first-named pulley and mounted on an axis parallel with the axis of said first pulley, a jack shaft, means supporting said jack shaft between said first and second pulleys upon an axis parallel with the axes of said pulleys for bodily movement toward and away from said first pulley, a third pulley and a fourth pulley drivingly mounted on said jack shaft, a first belt trained over said first pulley and over said third pulley, a second belt trained over said second pulley and over said fourth pulley, one of the pulleys engaged by each of said belts being an expansible V-pulley, an element shiftable oppositely to vary oppositely the output speed of said transmission means, an arm mounted for oscillation about the axis of said unwind roll, 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, means providing a driving connection between said arm and said shiftable element, means connecting said shiftable element to shift said jack shaft toward and away from said first pulley, 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, and means connecting said second pulley to drive said unwind roll.

10. The combination of claim 9 in which said means supporting said jack shaft comprises a lever mounted to swing upon an axis parallel with said pulley axes and eccentric with respect to said jack shaft axis.

11. The combination of claim 9 in which said first pulley and said second pulley are resiliently-expansible V-pulleys and said third and fourth pulleys are fixed-diameter V-pulleys.

12. The combination with a loom beam let-off including an unwind roll, a whip roll supported to travel on a substantially horizontal 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 comprising a pulley driven by said rotary means, a second pulley spaced from said first-named pulley and mounted on an axis parallel with the axis of said first pulley, a jack shaft, means supporting said jack shaft between said first and second pulleys upon an axis parallel with the axes of said pulleys for bodily movement toward and away from said first pulley, a third pulley and a fourth pulley drivingly mounted on said jack shaft, a first belt trained over said first pulley and over said third pulley, a second belt trained over said second pulley and over said fourth pulley, one of the pulleys engaged by each of said belts being an expansible V-pulley, an element shiftable oppositely to vary oppositely the output speed of said transmission means, means connecting said shiftable element to shift said jack shaft toward and away from said first pulley, 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, and means connecting said second pulley to drive said unwind roll.

13. The combination of claim 12 in which said means supporting said jack shaft comprises a lever mounted to swing upon an axis parallel with said pulley axes and eccentric with respect to said jack shaft axis.

14. The combination of claim 12 in which said first

pulley and said second pulley are resiliently-expansible V-pulleys and said third and fourth pulleys are fixed-diameter V-pulleys.

15. The combination with a loom beam let-off including an unwind roll, a whip roll supported to travel on a substantially horizontal 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, a first resiliently-expansible V-pulley driven by said rotary means, a second resiliently-expansible V-pulley spaced from said first pulley and mounted on an axis parallel with the axis of said first pulley, a bell-crank lever intermediately supported to swing about an axis parallel with, but offset from the plane common to the axes of said pulleys, a jack shaft carried by one arm of said lever for rotation about an axis disposed between the axes of said pulleys and parallel therewith, two fixed diameter pulleys, mounted on said jack shaft and connected for joint rotation, a belt providing a driving connection between said first pulley and one of said jack shaft pulleys, a second belt providing a driving connection between the other of said jack shaft pulleys and said second pulley, means providing a driving connection between said second pulley and said unwind roll, and means providing a driving connection between said whip roll and the other arm of said lever to shift said jack shaft toward said first pulley as said whip roll travels toward said vertical plane.

16. The combination with a loom beam let-off including an unwind roll, a whip roll supported to travel on a substantially horizontal 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, a first resiliently-expansible V-pulley driven by said rotary means, a second resiliently-expansible V-pulley spaced from said first pulley and mounted on an axis parallel with the axis of said first pulley, a bell-crank lever intermediately supported to swing about an axis parallel with, but offset from the plane common to the axes of said pulleys, a jack shaft carried by one arm of said lever for rotation about an axis disposed between the axes of said pulleys and parallel therewith, two fixed-diameter pulleys, mounted on said jack shaft and connected for joint rotation, a belt providing a driving connection between said first pulley and one of said jack shaft pulleys, a second belt providing a driving connection between the other of said jack shaft pulleys and said second pulley, means providing a driving connection between said second pulley and said unwind roll, an arm mounted for oscillation about the axis of said unwind roll, said whip roll being operatively connected to said arm to shift the same as said whip roll travels on said trackway, means yieldably biasing said arm toward said current point of tangency and away from said vertical plane, and a link connecting the other arm of said lever with an intermediate point on said oscillable arm.

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