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TENSION CONTROL DEVICE
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Fig. 1 is a schematic diagram of a mechanical device, likely a pump or valve. It features a large circular component (2) with a central shaft (1) passing through it. The shaft is connected to a lever arm (5) which has a pivot point (1) and a curved end (5a). A spring (10) is attached to the lever arm. A piston rod (8) is connected to the lever arm and a piston (6) inside a cylinder (9). The piston rod has a seal (8a) and a guide (8b). A valve (11) is shown at the top left, connected to the cylinder. Various other parts are labeled with numbers 3 through 11.

Fig. 1. A schematic diagram of a mechanical device, likely a pump or engine component. The diagram shows a large circular disk (2) with a central shaft (1) and various connecting rods and valves (3, 4, 4a, 5, 5a, 5b, 5c, 5d, 5e, 5f, 5g, 5h, 5i, 5j, 5k, 5l, 5m, 5n, 5o, 5p, 5q, 5r, 5s, 5t, 5u, 5v, 5w, 5x, 5y, 5z). The diagram includes numbered labels 1 through 20, indicating specific parts and components.

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TENSION CONTROL DEVICE

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This invention relates to arrangements for automatically maintaining constant tension on yarn or other filamentary material which is being unwound from a beam or other rotary package.

While my invention is especially useful as applied to the unwinding of warp from a beam in a slasher or in a loom, it is not limited in its use to the textile field and may be used in other situations where material is to be unwound from a beam, reel or other rotary package.

A broad object of the invention is to devise an arrangement for maintaining a constant tension upon yarn or warp which is being pulled from a beam.

Various types of brake devices have been applied to warp beams to prevent overrunning of the beam and to maintain tension on the warp while it is being unwound from the beam. One common form of brake device involves a rope or cable fixed at one end and arranged within a groove formed in the periphery of one end flange or head of the beam and having a weight attached to the free end. With a device of this kind, unless the brake is released in advance, the initial pull upon the warp must be sufficiently great to overcome the static friction of the beam shaft in its bearings, as well as to overcome the inertia of the loaded beam, in order to set the beam into rotation. The force necessary to overcome the inertia of the loaded beam and to keep it in rotation increases greatly as the outside diameter of the warp package decreases.

A specific object of the present invention is to devise a tension control device in which the beam is initially set into rotation by pull or tension exerted by the yarn or warp applied at constant distance from the center of the beam.

Another object is to devise a tension control arrangement wherein the tension of the warp is maintained substantially constant independently of the diameter of the package on the beam.

A characteristic feature of my invention is that the warp is taken off from the beam over a whip roll which is mounted upon a supporting frame pivoted for angular movement about the axis of the beam. A releasable brake device is arranged to interlock the frame with the beam, whereby a pull on the warp passing over the whip roll will turn the frame about the axis of the beam and thus will start the beam rotating about its axis. The brake device includes suitable means controlled by the movement of the pivoted frame for variably releasing the brake as the frame moves away from its locked or biased position.

Four different forms of my invention are illustrated in the accompanying drawing, in which:

Figure 1 is an end view of a warp beam showing a tension control device using a brake formed of a cable arranged within a groove in the end flange of the beam;

Figure 2 shows a modified form of brake device in which a brake shoe is arranged to engage the periphery of the beam flange;

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Figure 3 shows a modified form of the invention in which the brake is in the form of a rotary disk having a brake shoe engaging its peripheral edge and being coupled to the beam by a flexible belt; and

Figure 4 is a view showing a modification in which the brake device is formed of a spring element coiled about the periphery of one end flange of the beam.

Referring to the drawing, in all four arrangements the warp-loaded beam is shown in end view, the beam shaft being shown at 1 and one end flange at 2. The ends of shaft 1 are supported in suitable bearings, not shown. The warp 3 extends from the package on the beam and passes over a whip-roll 4 arranged substantially vertically about the axis of the beam. This roll is supported upon a pivoted frame formed of two bell-crank members 5 arranged at opposite ends of the beam and being journaled upon the end sections of shaft 1 for limited turning about the axis of the shaft. Only one bell-crank member is shown in the drawing, but an identical one is mounted at the opposite end of the beam. The roll 4 is mounted for rotation on a shaft 4a which joins the upper ends of the vertical arms 5a of the bell-crank members and holds them in fixed spaced relation. The horizontal arms 5b are joined near their outer ends by a bracing member 5c. The pivoted frame formed of members 5 is biased for rotation in an anti-clockwise direction by means of a weight 6 attached to each horizontal arm 5b near the outer end thereof. The frame is held in a normal or biased position by means of a fixed stop 7 arranged to engage a part of the frame, such as the horizontal arm 5b.

The beam is releasably locked or secured to the pivoted frame by means of a releasable clutch or friction brake device. In Fig. 1 the brake device is formed of a flexible band 8, such as a rope or cable, having one end secured at 8a to the arm 5b of the pivoted frame and passing round the end flange 2 in a groove formed in the flange. The other end of the band 8 is secured at 8b to a lever 9 which is pivoted at 9a to the horizontal arm 5b. A spring 10 is connected between the bell-crank member 5 and a portion of the lever 9 at a point removed from the pivotal axis 9a so that the spring 10 tends to rotate the lever 9 in a direction to take up the slack in the band 8 and thereby lock or frictionally clamp the flange to the pivoted frame. A fixed stop 11 is arranged in the path of movement of the lever 9 so as to prevent clockwise movement of the lever after the pivoted frame has rotated clockwise through a small angle from its zero or biased position.

Fig. 1 shows the arrangement in the shut-down or non-operating state. When warp is to be withdrawn from the beam, it is pulled in the direction of the arrow, and as soon as the pull becomes sufficient to overcome the biasing force applied by the weight 6, the pivoted frame begins to turn around the axis of the shaft 1. Since the beam is mechanically coupled to the frame through the brake device, the beam turns with the frame. After the frame has rotated through a small angle, the end of lever 9 engages the stop 11 and prevents further clockwise movement of the free end of the lever, thereby causing relative anti-clockwise movement between the lever 9 and the arm 5b upon any further clockwise movement of the pivoted frame. This results in the gradual release in the tension on band 8, and as soon as the tension on the cable is reduced to a certain point, the frictional braking action of the cable on the beam is insufficient to prevent the beam from rotating with respect to the pivoted frame.

The action of the arrangement in maintaining a constant tension on the warp is as follows: If the pull on the warp increases for any reason, the pivoted frame turns in the clockwise direction, thereby increasing the relative anti-clockwise movement of the lever 9 with respect to the arm 5b and thereby further reducing the tension on the

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band 8 and reducing the braking action. In case the tension on the warp 3 should decrease, the pivoted frame will turn in an anti-clockwise direction by a small amount, thus effecting a relative clockwise movement of the lever 9 with respect to the arm 5b and thereby increasing the tension on band 8 and increasing the braking action on the beam.

In the arrangement shown in Fig. 2, the pivoted frame for supporting the whip roll 4 is of substantially the same construction as that of Fig. 1, but the brake device is of a different construction. In this arrangement, the brake device includes a brake shoe arranged to engage the peripheral edge of the end flange 2 of the beam and being mounted pivotally upon an arm 13 of a bell-crank member which is pivoted to the arm 5b on an axis 13a. The second arm 13b of the bell-crank extends outwardly beyond the end of arm 5b in a position to engage the stop 11 after a small clockwise movement of arm 5b from its zero position. Brake shoe 12 normally is held into locking engagement with the flange 2 by means of the biasing spring 10 connected between the bell-crank 5 and the pivot pin 12a of the brake shoe.

The mode of operation of Fig. 2 is believed to be obvious from the foregoing description of Fig. 1. The beam normally is coupled to the pivoted frame for turning with the frame by means of the brake shoe 12, but, after a limited clockwise rotation of the pivoted frame, the arm 13b engages the stop 11 and operates the bell-crank lever 13 in a direction to partially relieve the pressure on the brake shoe 12. The regulating action of this arrangement is essentially the same as that in Fig. 1. By forming stop 11 as a yieldable stop, such as a coiled spring or a block of rubber, the release of the braking action of the shoe can be made more gradual, that is, it will require a greater angular movement of the pivoted frame to fully release the brake. The same result may be obtained by forming arm 13b as a leaf spring.

The arrangement shown in Fig. 3 is the same as that shown in Fig. 1 except for the brake device which couples the pivoted frame to the beam. In this case, the brake device is formed of a disk or wheel 14 mounted upon a rotary shaft carried by arm 5b of the pivoted frame. The disk 14 is coupled to the flange 2 by means of a suitable speed-multiplying driving connection comprising belt 15 mounted in a groove formed in flange 2 and passing over a suitable pulley 16 secured to the mounting shaft of the disk 14. The disk 14 is held against rotation by means of a brake shoe 17 pressed yieldably against the edge of disk 14 by a suitable spring 18, one end of which is secured to the end of the brake shoe 17, the other end of which engages fixed stop 19. The brake shoe is pivoted at 17a to an extension 5b' on the arm 5b. The arrangement is such that with the device in shut-down position as shown in the drawing, reaction of the spring 18 from the stop 19, acting through the brake shoe 17, holds the disk 14 against rotation and thereby locks the beam for turning with the pivoted frame. After the pivoted frame begins to rotate in a clockwise direction, the spring 18 tends to move away from the stop 19 and thereby reduces the pressure exerted by the brake shoe 17 on the wheel 14. Eventually, the pressure is reduced to a point where the disk 14 begins to rotate, and this permits the beam to rotate in a clockwise direction with respect to the pivoted frame. Increased pull on warp 3 results in greater clockwise angular movement of the pivoted frame and thereby reduces still further the pressure on the brake shoe 17 and thus further reduces the braking action on the beam. Decreased pull on the warp has the opposite effect.

The arrangement shown in Fig. 4 is the same as that shown in Fig. 1 except for the brake device. In this case, the brake device is formed of a resilient spring element 20, such as a rod of spring brass or steel having one end secured to the arm 5b at 20a and being located within a groove formed in the peripheral edge of the flange 2.

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The other end of the spring element 20 is provided with an outwardly extending portion 20b arranged below a fixed stop 21. The spring element 20 is formed so that it normally grips the flange 20 with sufficient force to lock the beam for movement with the pivoted frame when the frame is turned by a pull on the warp 3. After the frame is turned through a small angular movement, the projection 20b on spring 20 engages the fixed stop 21 and thus prevents further movement of the free end of the spring. Any further clockwise movement of the pivoted frame results in the spreading of the two ends of the spring member, thereby reducing the gripping action of the spring on the beam flange and thereby partially releasing the braking action. The degree to which the brake is released depends upon the extent of turning of the pivoted frame. While the spring member 20 is shown as formed of only one turn, it may be formed of two or more complete turns if desired. Also, by forming stop 21 as a yieldable stop, as explained above in connection with Fig. 2, the releasing action will be less sensitive to movement of the pivoted frame.

In all forms of my invention the necessary regulating action is obtained in a relatively small angular turning of the pivoted frame so that the movement arm extending vertically from the axis of shaft 1 to the axis of shaft 4a remains substantially unchanged. Thus, the pull on the warp 3 necessary to start the beam moving will be the same when the beam is nearly empty as when it is full. Also, in all forms of the invention illustrated, the beam initially is locked or clamped to the pivoted frame carrying the whip roll 4 by a releasable friction clutch or brake, and the brake is variably released in response to movement of the pivoted frame away from its zero or biased position.

In the annexed claims, the term "beam" is used in a generic sense to apply to the conventional warp beam as well as to equivalent structures, referred to as reels, spools, etc. Also, the term "warp" is used in a broad sense to apply to either filamentary material or strip material, such as a web of cloth.

What I claim is:

1. A tension control device comprising a beam having warp wound thereon and mounted for rotation on its axis, a rigid frame pivoted for turning about the axis of said beam, a whip roll carried by said frame for guiding said warp away from said beam substantially at right angles to the plane passing through the axis of the beam and the axis of the whip roll, a brake device for frictionally coupling said beam to said frame to effect turning of the beam with said frame about the beam axis, said brake device comprising two brake parts arranged in frictional engagement with each other, one of said parts being connected to said frame and the other part to said beam to slide relative to said one part when said beam rotates relative to said frame, means normally biasing said frame for turning in a direction opposite to the take-off direction of the warp, a stop for holding said frame in a zero position, resilient means normally pressing said brake parts together with sufficient force to prevent relative turning between said beam and said frame, and means controlled by movement of said frame away from its zero position for reducing the pressure between said brake parts in accordance with the extent of movement of the frame from said zero position.

2. A tension control device according to claim 1 wherein one part of said brake device comprises an end flange of said beam and the other brake part is connected with said frame and has frictional engagement with the periphery of said flange.

3. A tension control device according to claim 2 wherein said brake part connected with said frame comprises a brake band encircling said end flange.

4. A tension control device according to claim 3 wherein said brake band comprises at least one convolution of a resilient wire or rod having an unflexed diameter less

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than the diameter of said end flange and being outwardly flexed when mounted on said end flange, whereby said band is held in locking frictional engagement with said flange by its own resilient force.

5. A tension control device according to claim 1 wherein one of said brake parts comprises an end flange of said beam and the other brake part comprises a flexible brake band encircling said flange and having one end thereof secured to said pivoted frame, and said resilient means being connected to exert a pull on the other end of said band.

6. A tension control device according to claim 1 wherein one of said brake parts comprises an end flange of said beam and the other brake part comprises a brake shoe, and including a bell-crank member pivotally supported upon said frame, means pivotally supporting said brake shoe on one arm of said bell-crank, the second arm of said bell-crank extending radially outward beyond said frame, said resilient means being connected to said bell-crank and pressing said brake shoe against said flange, and a fixed stop in the path of said second crank arm whereby, when said pivoted frame turns about the axis of said drum said second crank arm engages said stop and continued turning of said frame effects rotation of said crank in a direction to release the pressure on said brake shoe.

7. A tension control device according to claim 1 wherein said resilient means comprises a spring carried by said one brake part and engaging a fixed stop to apply pressure to said one part when said pivoted frame is in its zero position, whereby movement of said frame away from said zero position releases the pressure on said one brake part.

8. A tension control device according to claim 1 wherein said other brake part comprises a brake wheel carried

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by said frame and mounted to rotate on an axis parallel with the axis of said beam, a speed-multiplying driving connection between said beam and said wheel, and said one brake part comprises a brake shoe engaging the periphery of said wheel.

9. A warp tension control device comprising a beam mounted for rotation on its axis, a rigid frame pivoted for turning about the axis of said beam, a whip roll carried by said frame, means comprising a brake element providing a frictional driving connection between said frame and said beam for rotation of said beam about its axis by the turning of said frame about the same axis, means normally biasing said frame for turning in a direction opposite to the take-off direction of rotation of said beam, a stop for holding said frame in a zero position, and means controlled by movement of said frame away from its zero position for reducing the pressure between said brake element and said beam in accordance with the extent of movement of the frame from said zero position.

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