Aug. 9, 1949. F. G. LAKE ET AL 2,478,283

FRICTION LETOFF

Filed Oct. 4, 1946 4 Sheets-Sheet 1

Fig. 1:

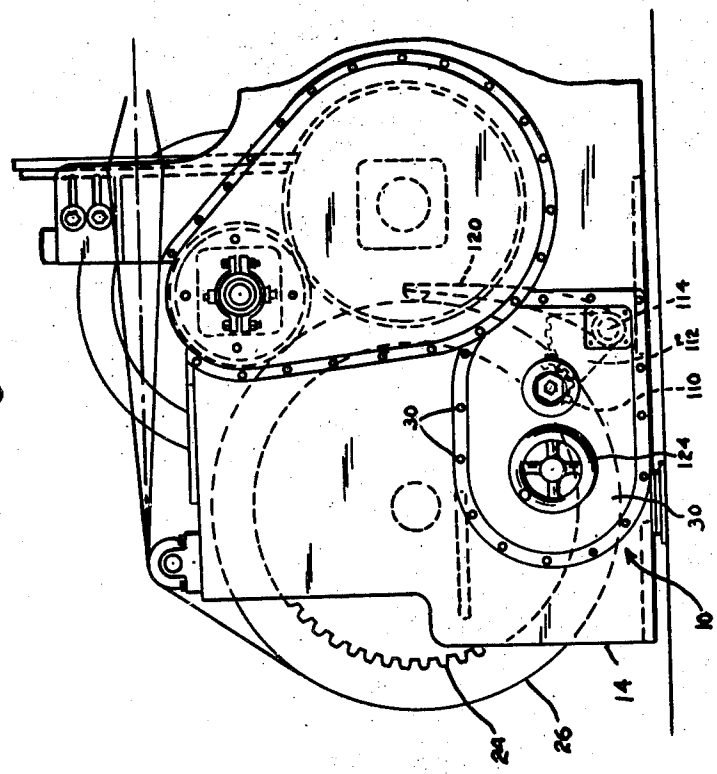
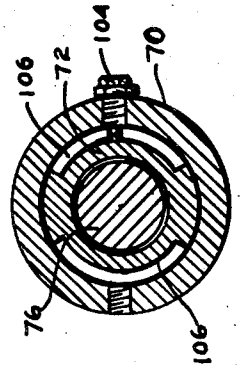


Fig. 4:



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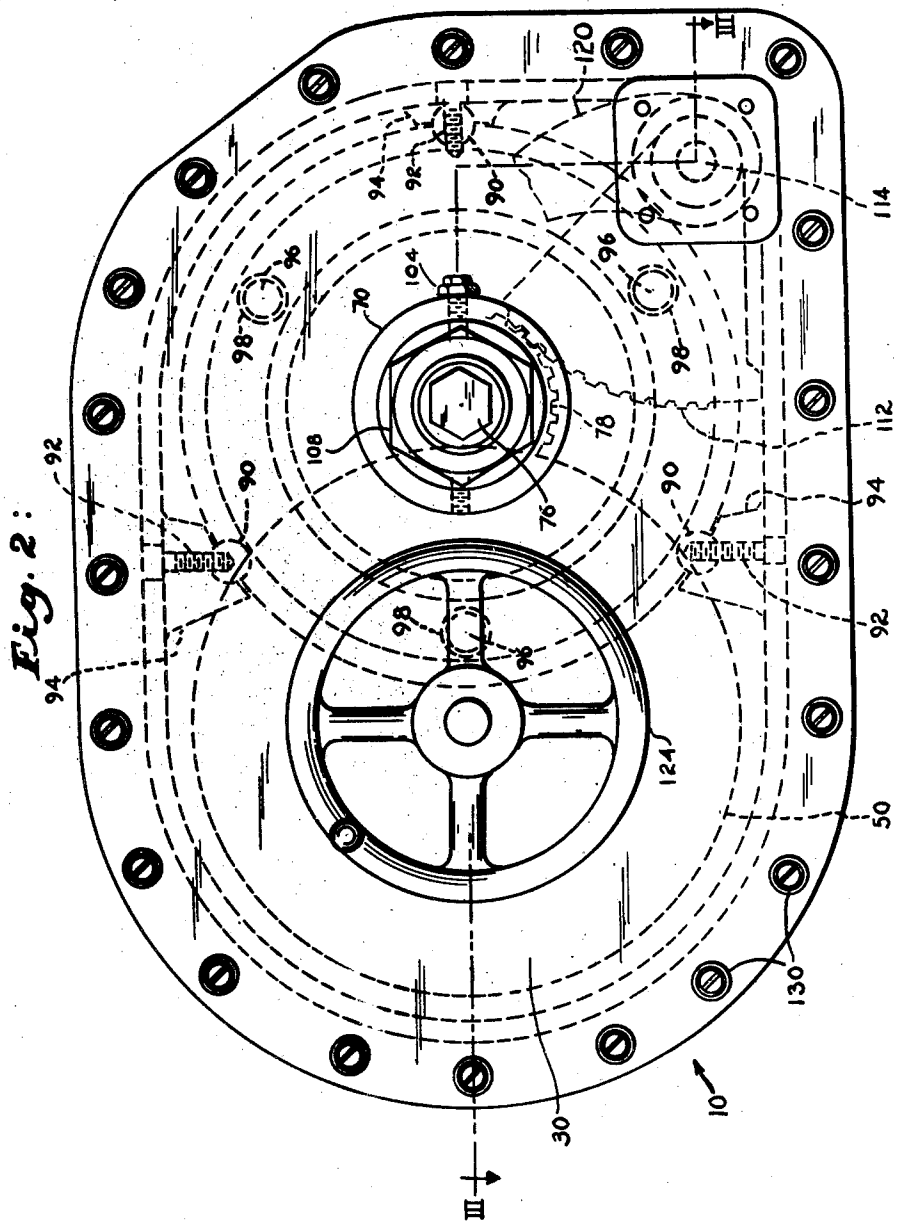


Fig. 2.

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FRICTION LETOFF

Filed Oct. 4, 1946 4 Sheets-Sheet 3

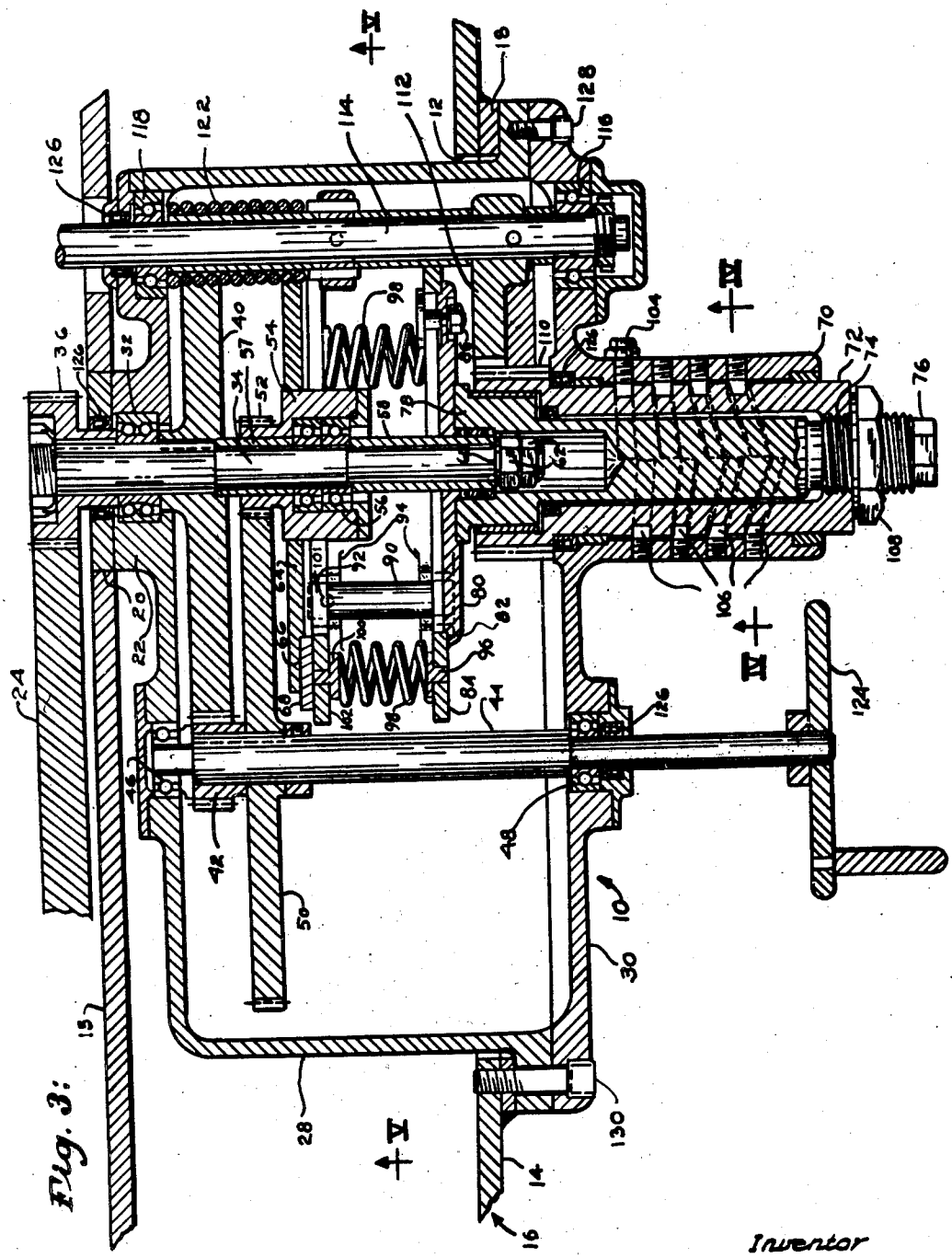


Fig. 3.

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FRICTION LETOFF

Filed Oct. 4, 1946 4 Sheets-Sheet 4

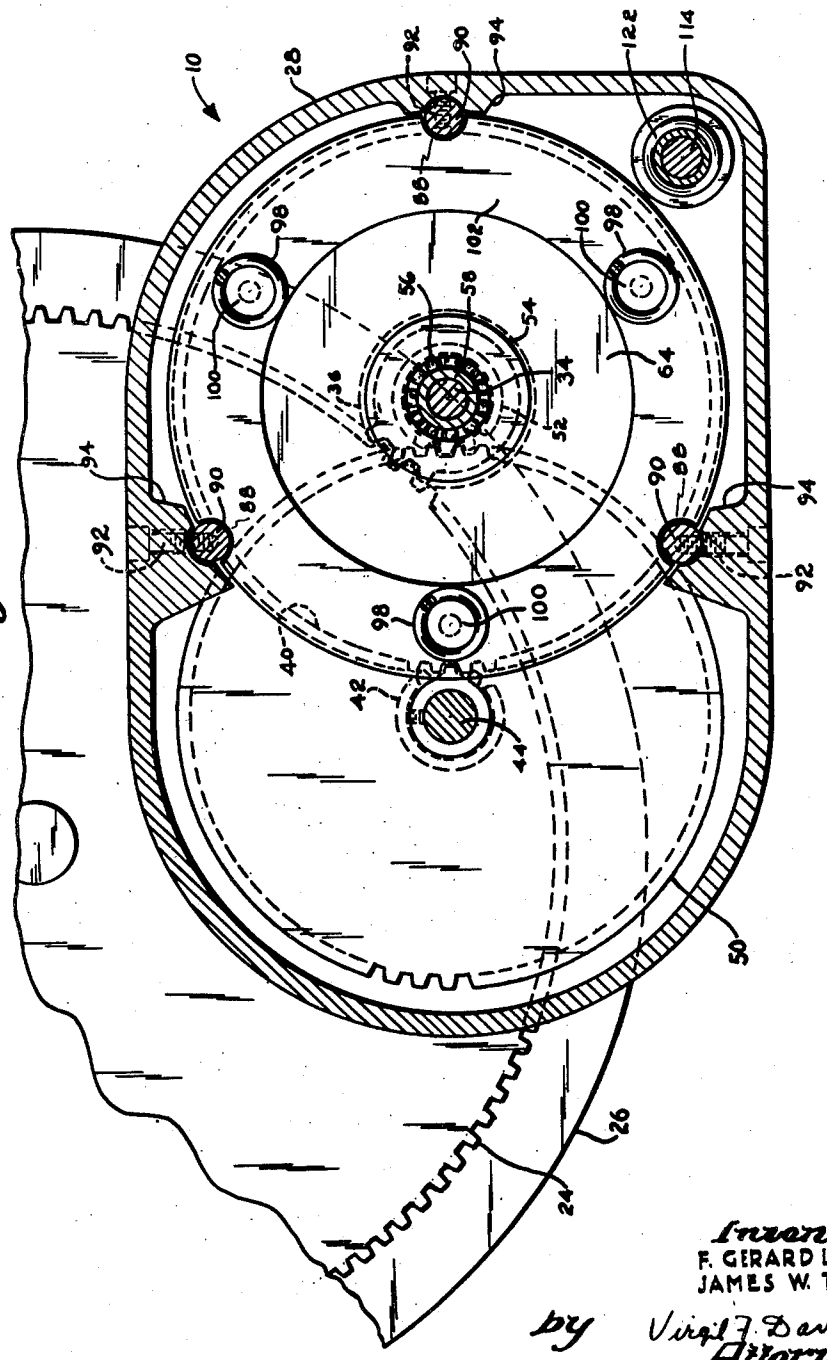


Fig. 5:

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UNITED STATES PATENT OFFICE

2,478,283

FRICTION LETOFF

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10 Claims. (Cl. 139—107)

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The present invention relates generally to improvements in textile looms and, as illustrated herein, relates more particularly to improvements in constant tension friction let-offs.

Positive let-offs of the Bartlett or the Roper types which employ positive actuating means acting through a braking member to cause the warp beam to rotate and thus pay off the warp are most commonly used today in high speed looms. Such let-offs, however, are not entirely satisfactory since they operate intermittently and hence permit periodic variations in tension of the warp threads. In many cases, such variation is objectionable since the woven cloth will be streaky or uneven which results in production of "seconds" with consequent loss to the textile mill operator.

Friction let-offs are more satisfactory from at least one aspect since warp is let-off uniformly and constantly. Friction let-offs, however, have not been satisfactory since they are affected by changes in atmospheric conditions. Friction between the friction surfaces varies according to temperature and humidity conditions and adjustments to compensate for such change are not adequate to insure that constant tension will be maintained on the warp sheet. It has not been possible, as a practical matter, to provide friction let-offs with any satisfactory means for compensating for the decrease in diameter of the warp beam.

Present commercial let-offs, either positive or friction type, are difficult to service and maintain; and, since the repair or adjustment of such let-offs involves the removal and replacement of many individual parts, the idle periods and loss of production of the machine due to such repairs or adjustments are excessive.

One object of the invention is to provide an improved friction let-off by the use of which the above-mentioned difficulties will be overcome. To this end and in accordance with one feature of the invention, the present friction let-off is provided with means for reducing the effects of temperature and humidity on the friction surfaces thereof.

Another object of the invention is to provide improved means for compensating for the decrease in diameter of the warp on the warp beam. To this end, means are provided for accurately varying the pressure between the friction surfaces of the let-off.

A still further object of the invention is to provide an improved friction let-off which will maintain a constant tension on the warp by developing a braking effect which, at any operating pressure between the friction surfaces of the let-off, is predictable and substantially constant. To accomplish this end, the novel friction let-off is so constructed and arranged that in operation a relatively high rubbing velocity is produced between the rotor and stator friction elements whereby variations in said rubbing velocity do not result in large or unpredictable variations in braking effect.

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A still further object of the invention is to provide a let-off mechanism which will reduce substantially the time necessary for repair and replacement thereof. To this end, the let-off mechanism is enclosed in a casing which permits the entire let-off mechanism to be removed as a unit.

A still further object of the invention is to improve generally upon the construction and operation of loom let-offs.

With the above and other objects and features in view, the invention will now be described with particular reference to the accompanying drawings in which

Fig. 1 is a view in side elevation of the portion of the left hand side of the loom to which the present let-off is applied.

Fig. 2 is an enlarged side elevation of the let-off of Fig. 1.

Fig. 3 is a sectional view taken along the line III—III of Fig. 2.

Fig. 4 is a sectional view taken along line IV—IV of Fig. 3; and

Fig. 5 is a sectional view taken along line V—V of Fig. 3.

The present let-off illustrating a preferred embodiment of the invention may be applied to any present commercial type of loom having conventional cast iron side frames if so desired, but is preferably applied to a loom having double web side frames. The drawings show only a portion of a textile loom since a description of the remaining parts of the loom is not necessary for a complete understanding of the present invention.

The let-off mechanism, as shown most clearly in Fig. 1, is enclosed in a casing 10 which is inserted in an opening 12 in the outer web 14 of the loom side frame 16. The opening 12 is surrounded by a pad 18, welded to the web 14, which provides a seat for the casing 10. The frame 16 is provided with an inner web 15 having an opening 20 arranged to receive a boss 22 on the inner side of the casing 10 and which acts to position the casing 10, and the let-off mechanism contained therein, in proper operative relation to a gear 24 on the warp beam end 26.

The casing 10 comprises a body portion 28 and a cover member 30. The portion 28 is provided with the boss 22, above referred to, which is provided with a bearing 32 for a main shaft 34 to which is keyed a spur gear 36. The gear 24 on the beam end 26 meshes with the gear 36 and forms the operating connection between the warp beam and the let-off mechanism.

Rotation of the shaft 34 and the warp beam is controlled by a friction clutch or brake as will now be described. A spur gear 40 is located within the casing 10 and is keyed to the shaft 34. The gear 40 meshes with a gear 42 fixed to a countershaft 44 which is rotatably mounted at one end in a bearing 46 supported in the body portion of the casing 10 and at its other end in a bearing 48 in the cover 30. The shaft 44 has keyed thereto a second spur gear 50 which meshes with a spur gear 52.

In order to obtain a sufficiently high rubbing velocity between the rotor and the stator elements of the let-off mechanism and a smooth control effect, the angular velocity of gear 24 is multiplied through gears 36, 40, 42, 50 and 52. The multiplication ratio chosen is best determined in each particular case.

The spur gear 52 is rotatable on the shaft 34. The spur gear 52 is provided with a hub 54 which is recessed, as shown best in Fig. 3, to receive bearings 56 on which the gear 52 rotates. The gear 40 and the gear 52 are spaced by a spacer 57 and the bearings 56 are maintained in predetermined axial position by a spacer member 58 which is maintained in position by a washer 60 and nuts 62 threaded on the end of the shaft 34. The hub 54 of the gear 52 has welded thereto a disc 64 which is provided with a circumferential recess 66. An annulus 68 of suitable friction material is supported in the recess 66, as will later be described.

The cover 30 of the casing 10 is provided with a cylindrical projection 70 in which a sleeve 72 is mounted in alinement with the shaft 34 for angular and axial movement. This sleeve 72 at its outer end is provided with a threaded opening 74 into which is threaded a thrust member 76 which is arranged to move axially relatively the sleeve 72. The thrust member 76 at its inner end is provided with a bore for receiving the end of the shaft 34 so that the inner enlarged end 78 thereof projects beyond the end of the spacing sleeve 58. The end 78 carries a disc 80 which is provided with a shouldered circumferential portion 82 for receiving a ring 84. The ring 84 is maintained in position on the disc 80 by means of spaced shouldered bolts 86. The ring 84 is provided with a plurality of spaced notches 88 for receiving rods 90 which are maintained in position within the casing 10 by cap screws 92 extending through inwardly extending brackets 94 formed as a part of the casing 10 and supporting the rods 90. Thus, the ring 84 is movable axially but is held from rotation. The thrust member 76 and the sleeve 72 are mounted for limited rotation relatively to the ring 84 as will later become apparent.

The ring 84 has fixed thereto a plurality of members 96, each having a circular projection thereon for receiving one end of a compression spring 98. The other end of each of said springs 98 is received in a similar circular projection 100 fixed to annulus 102. The annulus 102 is substantially identical with the ring 84 and is provided with recesses 101 for receiving the rods 90. Thus, rotation of the annulus 102 is prevented

although it may move axially relatively to the rods 90. The friction ring 68 is maintained in position between the disc 64 and the annulus 102 by pressure exerted by the springs 98. The springs 98 are maintained under slight initial pressure at all times by the thrust member 76.

The construction, thus far described, provides simple and effective means for braking the rotation of the warp beam. In operation, when the tension on the warp sheet tends to exceed a predetermined value, that is, the value for which the braking pressure between annulus 102, the friction annulus 68 and the disc 64 is set, the warp beam and gears of the let-off meshing therewith will tend to rotate at an increased rate to prevent the tension of the warp sheet from substantially exceeding the predetermined value.

The diameter of the warp on the warp beam constantly decreases during operation of the loom and, consequently, means must be provided to compensate for this decrease in diameter in order to maintain constant tension on the warp sheet. To this end, the present construction is provided with means controlled by the diameter of the warp on the warp beam.

The initial pressure of the compression springs 98 is controlled by the thrust member 76 which is rotated in the threaded opening 74 to vary the axial position thereof. The sleeve 72, in which the thrust member 76 is mounted, is prevented from moving axially by a plug 104 which extends through a selected one of a plurality of openings in the projection 70 and into cam grooves 106. Thus, turning of the thrust member 76 in one direction will cause the member 76 to move axially to compress the springs 98 and thus additional pressure is applied to the friction ring 68 and increases the frictional drag on the rotatable disc 64. After the desired initial pressure is applied to the friction ring 68, the thrust member 72 is locked in position by tightening a lock nut 108.

In order to vary the frictional drag on the warp beam as the diameter of the warp thereon decreases, means is provided for rotating the sleeve 72. The pin or plug 104, as above stated, is located in the selected one of the cam grooves 106 and rotation of the sleeve 72 in a clockwise direction, as viewed in Fig. 1 will cause outward axial movement of the sleeve 72 with consequent decrease of tension on the springs 98. The sleeve 72 is provided with gear teeth 110 meshing into a gear segment 112 fixed to a horizontal shaft 114 mounted in bearings 116 and 118 in the casing cover 30 and the body portion 28 of the casing 10, respectively. The shaft 114 extends inwardly of the loom frame and at its inner end has fixed thereto a vertically extending arm 120 which is arranged to bear against the yarn on the warp beam and is maintained in contact therewith by a tension spring 122. Thus as the diameter of the warp decreases, the arm 120 will swing in a counterclockwise direction and, through the segment 112, will cause rotation of the sleeve 70 in a clockwise direction. The shape of each cam groove 106 is carefully calculated to insure that the warp sheet will be maintained under constant tension until warp on the warp beam is exhausted. A plurality of cam grooves 106 are provided for different yarn and weaving conditions.

The let-off is provided with a hand wheel 124 fixed to the shaft 44 for increasing or relieving tension of the warp particularly when the loom is to be stopped for an appreciable length of time.

It is to be noted that the casing and cover are

oil-tight. The openings in the cover and casing are all provided with oil seals 126 to prevent leakage of oil contained within the casing. All of the parts rotate in an oil bath which not only provides adequate lubrication but provides means for preventing atmospheric moisture from affecting the friction elements of the let-off. Since the operating parts are enclosed in a sealed casing, dirt and lint cannot enter to affect the operation thereof. The cover 30 and the body portion 28 of the casing are secured together in oil tight relation by cap-screws 128 and the entire construction is inserted in the opening 12 and secured in position by means of cap-screws 130.

In order to obtain the best results with the let-off just described, the ratios between gears 24 and 36, gears 40 and 42 and gears 50 and 52 are so chosen that in operation disc 64 rotates relative to friction annulus 68 and annulus 102 at such a speed that the relative rubbing velocity is such as to insure operation in a region of hydrodynamic lubrication. Preferably, said rubbing velocity should be in that region of the friction-rubbing velocity curve beyond the minimum value between static and kinetic friction. The metals used for the disc 64 and annulus 102, the material used for the friction annulus 68, the surface areas of the disc 64 and annulus 102 and friction annulus 68, and the lubricant employed are all factors involved in obtaining the desired frictional operation. If proper consideration is given to these factors and a suitable operating speed of disc 64 is chosen so that normal operation is in the region of kinetic friction, adjacent to or beyond the minimum value between static and kinetic friction, referring to the friction-rubbing velocity curve, then the increases or decreases in the angular velocity of disc 64, necessary to maintain the predetermined tension on the warp sheet will result in only small increase or decrease in the friction developed and the braking effect will be predictable and substantially constant.

The let-off described above effectively maintains the warp sheet under substantially constant tension regardless of the diameter of the warp on the warp beam and permits the warp to be let-off continuously and uniformly as the weaving operation continues. Varying temperature and humidity conditions have little if any effect on the tension of the warp.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. In a loom, a rotatable warp beam having warp wound thereon, a gear on said warp beam, a speed multiplying gear train connected to said warp beam gear, a friction element rotatable by said gear train, a second friction element restrained from rotation and frictionally engaging said rotatable friction element, spring means for maintaining said friction means in pressure engagement, means for adjusting the initial pressure of said spring means, a rotatable and axially movable member for varying said spring pressure, and means controlled by the diameter of the warp on the warp beam for rotating said axially movable member and causing axial movement thereof to decrease the spring pressure to maintain the warp under constant and uniform tension as the diameter of the warp beam decreases.

2. In a loom, a rotatable warp beam having warp wound thereon, a rotatable friction element, a speed increasing gear train operatively connecting said warp beam to said friction element for causing said friction element to rotate at a high angular velocity as compared to said warp beam, a friction element movable axially into pressure engagement with said rotatable friction element, spring means for pressing said friction elements into engagement, means for applying initial pressure to said spring means, a rotatable and axially movable cam member for varying said spring pressure, and means controlled by the diameter of the warp on the warp beam for rotating said cam member and causing axial movement thereof in a direction to decrease the spring pressure on said friction element as the diameter of the warp on the warp beam decreases.

3. In a loom, a rotatable warp beam having warp wound thereon, a rotatable friction element, a speed increasing gear train operatively connecting said warp beam to said friction element for causing said friction element to rotate at a high angular velocity as compared to said warp beam, a friction element movable axially into pressure engagement with said rotatable friction element, spring means for pressing said friction elements into engagement, means for tensioning said springs to apply an initial predetermined pressure to said friction elements, a rotatable axially movable cam member for varying said pressure, and means controlled by the diameter of the warp on the warp beam for rotating said cam member and causing axial movement thereof in a direction to decrease said pressure as the diameter of the warp on said warp beam decreases.

4. A loom let-off comprising means for multiplying the rotative movement of a warp beam, and means for continuously restraining said rotative movement to maintain a predetermined tension on the warp, said restraining means including juxtaposed relatively rotatable elements having surfaces in slide engagement and means for lubricating said surfaces, said multiplying means having its input end connected to the warp beam and its output end connected to one of said relatively rotatable elements.

5. A loom let-off comprising means for multiplying the rotative movement of a warp beam, and means for continuously restraining said rotative movement to maintain a predetermined tension on the warp, said restraining means including juxtaposed relatively rotatable elements having surfaces in slide engagement and a body of lubricating oil into which said members extend, said multiplying means having its input end connected to the warp beam and its output beam connected to one of said relatively rotatable elements.

6. A loom let-off comprising a multiplying gear train, having its input gear operatively connected to a warp beam, a device adapted to continuously impose a brake-effect on said warp beam through said gear train, said device including an element mounted for rotation and operatively connected to the output gear of said gear train, an element mounted proximate said rotatable element and held against rotation relative thereto, said elements having juxtaposed surfaces in slide engagement, means for applying pressure to said elements, and a body of oil into which said elements extend for lubricating said juxtaposed surfaces, the friction developed by said elements being in the region of kinetic friction whereby as the rotation of the warp beam approaches zero during the weaving cycle the said developed friction does not increase markedly and said gear train and rotatable element continue movement due to their inertia and carry the beam through the zero point of its movement in said cycle.

7. A loom let-off comprising a device adapted to impose a brake-effect on the rotation of a warp beam, said device including an element mounted for rotation, a second element proximate said rotatable element and held against rotation relative thereto, said elements having juxtaposed surfaces in sliding engagement, means for applying pressure to said elements, and a body of oil into which said elements extend for lubricating said juxtaposed surfaces, and a gear train having its input gear operatively connected to the warp beam and its output gear operatively connected to said rotatable element, the multiplying ratio of said gear train, the character of said surfaces and the lubricating qualities of said oil body being such that the rubbing friction developed by said juxtaposed surfaces is substantially continuously in the hydrodynamic range.

8. A loom let-off comprising a device adapted to impose a brake-effect on the rotation of a warp beam, said device including an element mounted proximate said first element and held against rotation relative thereto, said elements having juxtaposed surfaces in slide engagement, means for applying pressure to said elements, and a body of oil into which said elements extend for lubricating said juxtaposed surfaces, a multiplying gear train having its input gear operatively connected to the warp beam, and its output gear operatively connected to said rotatable element, the multiplying ratio of said gear train, the character of said surfaces and the lubricating qualities of said oil body being such that the rubbing velocity of said elements is constantly in that region of the friction rubbing velocity curve beyond the minimum value between static and kinetic friction.

9. A loom let-off comprising a friction device including a rotatable friction member, a relatively stationary friction member, means for applying pressure to said friction members, and means for lubricating the surfaces of said friction members, means operatively connected to the warp beam and the rotatable friction member for rotating said friction member, and means controlled by the diameter of the warp on the warp beam and operatively connected to said pressure

applying means for varying the pressure on said friction members to permit yarn to be payed off the warp beam at substantially constant tension as the diameter of the warp on the warp beam varies.

10. A loom let-off comprising means for multiplying the rotative movement of a warp beam and having its input end connected to said warp beam, means continuously imposing a brake-effect on the rotation of the warp beam through said multiplying means, said brake-effect imposing means including a stationary element and a rotary element connected to the output end of said multiplying means and having juxtaposed surfaces in slide engagement, adjustable means for applying pressure to said elements, and a body of lubricating oil into which said elements extend to lubricate said surfaces, and means controlled by the diameter of the warp on the warp beam and operatively connected to said adjustable means to reduce the pressure applied to said elements as said diameter reduces, whereby the friction developed by said elements varies with variations in the speed of rotation of said rotary element substantially as a straight line function of gentle slope and the brake-effect imposed reduced from full beam to empty beam substantially as a straight line function.

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