Sept. 19, 1950 J. RINNE 2,523,060

WEAVING METHOD AND LETOFF

Filed April 21, 1948 2 Sheets-Sheet 1

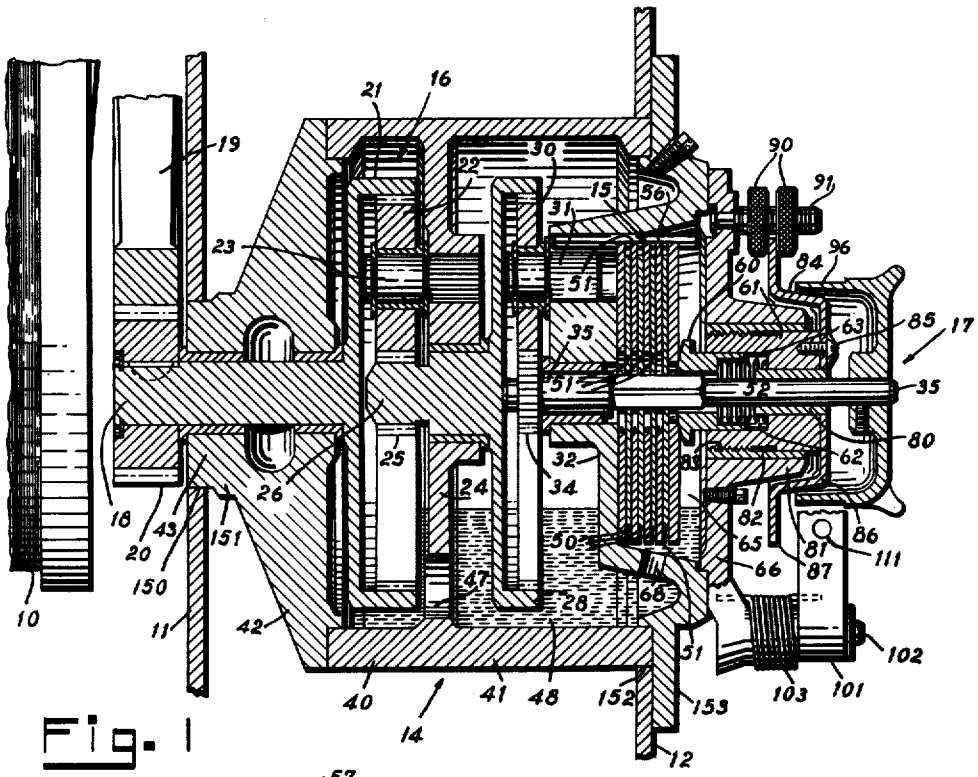


Fig. 1

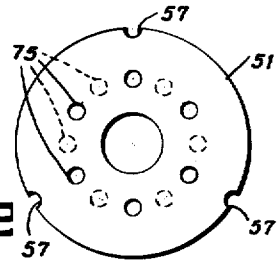


Fig. 2

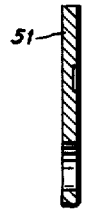


Fig. 3

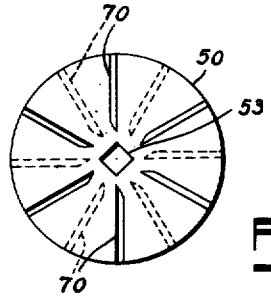


Fig. 4

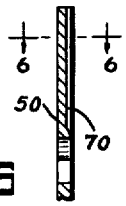


Fig. 5

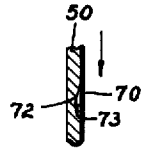


Fig. 6

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WEAVING METHOD AND LETOFF

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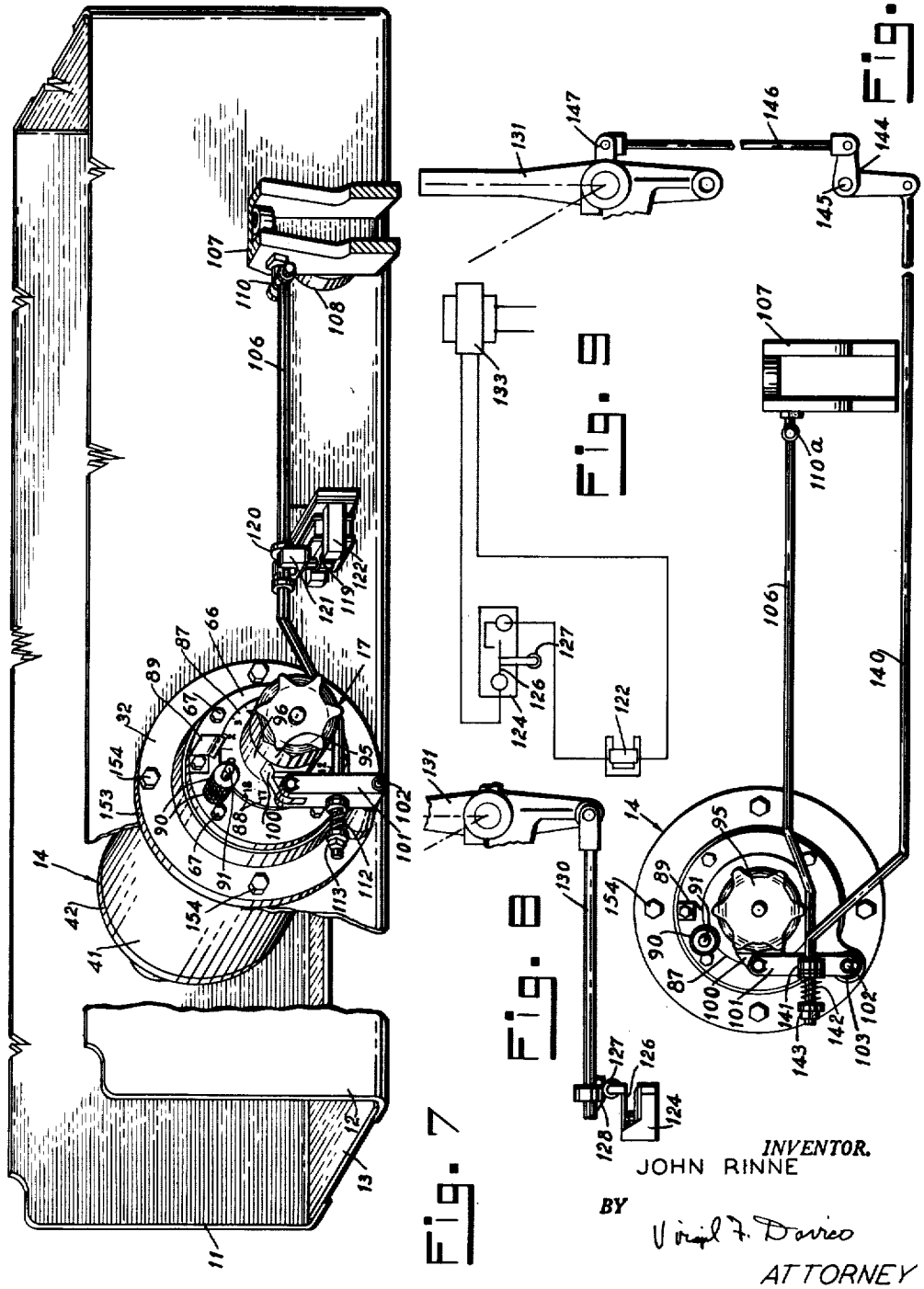


Fig. 7

Fig. 8

Fig. 9

Fig. 10

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WEAVING METHOD AND LETOFF

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Application April 21, 1948, Serial No. 22,472

24 Claims. (Cl. 139—100)

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The present invention relates to improvements in weaving processes employed in connection with loom let-off and beat-up operations and also to improvements in loom let-off motions.

In a conventional loom, a let-off motion is employed to control warp feed so as to allow the necessary amount of yarn to be unwound from the warp-beam and to maintain said yarn under tension during beat-up without interrupting the feed thereof. Such let-off motions are regulated by the tension on the warp which must be sufficient to overcome a predetermined resistance before the warp will unwind from the warp-beam.

In the conventional loom, as the shuttle is thrown from one side of the loom to the other, a pick of filling is deposited in the shed. In the movement of the lay toward front center position, the reed moves the thus deposited filling pick to the cloth previously woven. When the filling density is such that in the operation just described the filling is packed to the extent that previously deposited picks of filling are moved closer together "beat-up" takes place. In weaving without beat-up maximum tension is developed in the warp yarn during the formation of the shed. In weaving with beat-up, the tension developed in the yarn due to beat-ups adds to that due to shed formation to produce a peak tension materially in excess of said maximum tension. Because of the high peak tension, a higher mean tension is required to weave the same cloth. Thus warp breakage is increased and it becomes increasingly difficult to produce cloth without defects.

One object of the present invention is to provide a new and improved weaving process employed in connection with let-off and beat-up operations.

Another object of the invention is to provide a new and improved weaving process, employed in connection with let-off and beat-up operations, in which the paying-off of the yarn from the warp-beam is not effected substantially by the peak tension developed during beat-up and inertial effects of said peak tension on the warp-beam and the let-off control mechanisms are substantially eliminated to the end that said paying-off is better and more easily controlled and steadier weaving conditions are obtained.

Still another object of the invention is to provide a new and improved weaving process, employed in connection with let-off and beat-up operations, in which the beat-up distance is materially reduced and weaving under reduced mean

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tension is made possible to the end that warp breakage, defects and difficulties attributable to high warp tension are reduced to a minimum.

A further object of the present invention is to provide a new and improved let-off motion.

A still further object of the present invention is to provide a new and improved let-off motion operatable to produce better tensioning and weaving conditions during let-off and/or beat-up.

In carrying out certain of the process features of the present invention, a brake is directly or indirectly applied to the warp-beam during the beat-up phase of the weaving cycle to hold said beam stationary and against warp feed during at least a portion of said phase. It has been found that application of the brake to the warp beam during beat-up and especially during the period from the time the force of the reed on the last laid pick is transmitted to the warp threads to the time the lay reaches front center position, substantially eliminates the tensional effects of the beat-up phase on the remainder of the weaving cycle and is conducive to improved warp tensioning and weaving conditions.

In connection with certain structural features of the let-off motion, a brake is provided automatically operatable in accordance with the phase position of the lay to hold the warp-beam against rotation during a predetermined period of each weaving cycle. As far as certain aspects of this feature are concerned, the brake is applied at some time during beat-up and preferably during substantially the full period of said beat-up.

As another feature, a brake is provided applied automatically to the warp-beam upon loom shut-downs to reduce inertial forces on the warp during such shut-downs. As far as certain aspects of this feature are concerned, the brake may be the same as is employed to hold the warp-beam during the predetermined period of each weaving cycle.

As a further feature, a friction device is employed for yieldably resisting rotary movement of the warp-beam and for controlling warp feed thereby and a planetary gear transmission is provided between said beam and said friction device.

The friction device includes a plurality of lightweight members defining relatively rotatable surfaces constantly separated by films of lubricant so that the inertial effects due to starting and stopping and speed changes are reduced to a minimum and the load imposed by the friction

device does not vary materially from the predetermined load due to static friction effects. The multiplying ratio of the planetary gear transmission is so chosen that in the usual range of warp beam speeds the hydrodynamic friction developed by the friction device is in that portion of the friction curve wherein the hydrodynamic friction varies approximately inversely as the speed to the end that the load imposed by the friction device automatically varies as the diameter of the warp on the warp beam varies in the manner required to maintain the desired tension on the warp without the use of any of the usual control devices operated by changes in diameter of the warp on the warp beam.

As another feature, the friction device itself is of new and improved construction permitting constant and effective lubrication of the friction surfaces.

Various other objects, features and advantages of the invention will be apparent from the following particular description and from inspection of the accompanying drawings, in which:

Fig. 1 is an axial section through a let-off motion which embodies certain structural features of the present invention and which can be employed to carry out the process of the present invention;

Fig. 2 is an axial elevational view of one of the stator plates of the friction device employed in connection with the let-off motion of the present invention;

Fig. 3 is a partial radial section of the stator friction plate shown in Fig. 2;

Fig. 4 is an axial elevational view of one of the rotor plates of the friction device employed in connection with the let-off motion of the present invention;

Fig. 5 is a partial radial section of the rotor friction plate shown in Fig. 4;

Fig. 6 is a transverse section of the rotor friction plate taken along lines 6—6 of Fig. 5;

Fig. 7 is a perspective of a form of let-off motion embodying the present invention and having a brake electrically controlled from the clutch lever or shipper handle;

Fig. 8 is a side elevation of part of the structure employed in connection with the let-off motion of Fig. 7 for energizing the electrical system, associated with the brake, upon loom shutdown operations of the clutch lever or shipper handle;

Fig. 9 is a wiring diagram of the electrical system for operating the brake of Fig. 7; and

Fig. 10 is a side elevation of the let-off motion embodying the present invention and having a brake operated mechanically from the clutch lever or shipper handle.

When weaving to produce cloth of such character that it does not require beat-up of the filling, the warp is tensioned and let-off, or unwound, from the warp beam against a constantly applied resistance by the movement of the harness in forming the shed and by the movement of the take-up roll in removing the finished cloth. When the cloth woven is of such character that beat-up of the filling is required, the tension on the warp is materially increased by the beat-up operation for at least a portion of the weaving cycle but the effect of the increase is felt throughout the weaving cycle. Even though the beat-up results in a momentary high peak tension the mean tension on the warp for the whole weaving cycle is increased. Thus when the weaving cycle includes a beat-up phase the weaving cycle is more difficult to control, warp breakage multiplies and cloth defects increase.

Beat-up may be said to occur when as the reed locates a filling pick in the cloth, previously laid filling picks adjacent thereto are moved closer together. Beat-up takes place from the time the reed begins to impose tension on the warp, through the filling picks, to the time the lay reaches front center position.

In accordance with the present invention the effects of beat-up are substantially completely eliminated by holding the warp beam stationary and against warp let-off during a portion, or the whole, of the beat-up phase of the weaving cycle. By this procedure, and for cloth of the same character, the beat-up distance is shortened, sharp tension peaks are eliminated and the mean tension of the warp for the weaving cycle is reduced. All this results in a more stable and more easily controlled weaving cycle, less warp breakage, and a material reduction in cloth defects.

More specifically, a brake is desirably applied, in accordance with the present invention, to the warp-beam to hold it stationary and against warp let-off, intermittently during the weaving cycle and at a predetermined phase, or phases, of said cycle during which beat-up takes place. It is at present preferred to apply the brake to the warp-beam just before each beat-up, or in other words, just before the force of the beat-up operation is transmitted to the warp. The brake should remain on until the lay reaches its front center position and should be released just as the lay leaves its front center position. During the remainder of the weaving cycle the warp is under the control of the harnesses, the take-up roll, and the yieldable resistance and when said warp attains a predetermined tension, it is run off the warp-beam by the pulling action of the harnesses and the take-up roll.

The weaving process of the present invention may be carried out effectively by a let-off motion such as that shown in the drawings, although other forms of let-off motions are also suitable. In these drawings, there is shown a warp-beam 10 on a shaft (not shown) journalled in bearings (not shown) supported in the loomsides, the left hand loomside only being shown. While loomsides of conventional design may be employed it is preferred that each of the loomsides comprises a pair of frame plates 11 and 12 (only the left loomside plates being shown) suitably braced and interconnected as a floor plate 13, as shown in Fig. 7. These loomsides are described more fully in copending application Serial No. 691,237, filed August 16, 1946.

Mounted on the left loomside plates 11 and 12 is a let-off unit 14 comprising a yieldable friction device 15, a reduction gear transmission 16 between the warp-beam 10 and said friction device and a brake device 17 for said friction device. The let-off unit 14 has an input shaft 18 for the gear transmission 16 driven from the warp-beam 10 through a beam spur gear 19 which is secured to the beam shaft (not shown) and which meshes with a pinion 20 keyed to said input shaft.

As a feature of the present invention, the gear transmission 16 between the input shaft 18 and the friction device 15 is a planetary gear train comprising an internal gear 21 affixed to one end of the input shaft 18 and meshing with a number of radially disposed idler gears 22, three such gears spaced 120° apart are employed but only

one of them is visible in Fig. 1. The idler gears 22 are mounted for rotation on stationary pins 23 affixed to a frame plate 24 and meshing with a central pinion 25 on a shaft 26 journalled in said frame plate. The pinion shaft 25 is connected to a second internal gear 28 meshing with a second set of radially disposed idler gears 30 (three being provided 120° apart) mounted for rotation on stationary pins 31 affixed to a frame or wall member 32. The idler gears 30 mesh with a central pinion 34 affixed to one end of a shaft 35 journalled near one end in the frame member 32 and constituting a drive for the movable parts of the friction device 15.

The planetary transmission gearing 16 is desirably enclosed in a housing 40 comprising a cylindrical casing 41 sealably closed at one end by a head plate 42 providing a bearing 43 for the shaft 18 and sealably closed at the other end by a head plate defined by the frame wall member 32. The frame plate 24 constitutes a transverse web extension of the casing 41 and has in its lower part a hole 47 affording communication between gear compartments on opposed sides thereof for a reservoir body of lubricating oil 48 in the housing 40. The internal gears 21 and 28 dip into the oil reservoir 48.

By means of the planetary transmission 16 described, as the warp is run off the beam 10, the resulting rotation of said beam is transmitted to the shaft 35 of the friction device 15 to cause said shaft to rotate at a greatly increased angular speed. The transmission 16 provides an extremely well balanced and compact arrangement capable of multiplying the rotation of beam 10 as required for the proper operation of the friction device 15. Yet, while transmission 16 is amply strong for the service, its component parts are so light that the inertial effects due to starting, stopping and changes in speed are so small that the rotation of the beam 10 and the operation of friction device 15 are not materially affected thereby so that a better control of the weaving cycle is assured.

The friction device 15 comprises a series of comparatively thin rotor plates 50 and stator plates 51 alternately arranged in face to face relation and mounted for slidable movement along the shaft 35. The rotor plates 50 are keyed to the shaft 35 for rotation therewith. For that purpose said shaft has a keying configuration 52 of substantially square cross-section and the rotor plates 50 have central key openings 53 of corresponding shape to lock for rotation with said shaft.

The stator plates 51 are held against rotation by means of a series of rods 56, three such rods spaced 120° apart are employed but only one such rod is visible in Fig. 1, affixed to the frame member 32 and extending with a slide fit into notches 57 in the outer peripheries of said stator plates.

The friction plates 50 and 51 are yieldably pressed together and against the frame member 32 by means of a plunger 60 slidable along the shaft 35 and guided by a sleeve 61 into which it telescopes. The plunger 60 and the sleeve 61 conjointly define a housing 62 for the spring 63 encircling the shaft 35 and bearing against said plunger to press it against the end plate of the friction device 15.

The friction device 15 is retained in a housing 65 formed by the dishing of the frame member 32 to define a hollow for said device and by a cover plate 66 removably and sealably secured to said frame member 32 by any suitable means, as

for example, by the studs 67. A hole 68 in the frame member 32 below the level of the oil 48 permits the oil to fill up to said level in the friction device housing 65.

The friction plates 50 and 51 extend into the oil 48 in the housing 65. To feed the oil to the friction plates and to assure the distribution thereof to their friction surfaces to provide a proper oil film between said surfaces, the rotor plates 50 are provided with a series of radial oil-feed channels 70 on opposite faces thereof extending to their outer peripheries and equally spaced circumferentially of the plates. The oil-feed channels 70 on opposite faces of each of these rotor plates 50 are staggered. As the rotor plates 50 rotate, the channels 70 thereon dip into the oil 48, pick up some of it and feed it radially inwardly therealong. At the same time, the rotor plates 50 spread the oil from their channels 70 as a thin film over the surfaces of the adjoining stator plates 51 in face contact therewith.

To spread the oil more effectively over the surfaces of the stator plates 51 and to prevent the longitudinal edges of the channels 70 from wiping off the oil film from the stator plates 51 as the rotor plates 50 rotate, the cross-section of each of these channels is of triangular shape as shown in Fig. 6 with the base 72 of said channel sloping transversely from the forward side 73 of said channel rearwardly to the face of the plate in a direction opposite to the direction of rotation of the rotor plate.

To assure the presence of a proper oil film between the plates 50 and 51 when starting from rest, each of the stator plates 51 except the outside ones is provided on each face thereof with a series of circularly arranged pockets 75 corresponding in number and spacing with the oil channels 70 on the rotor plates 50. The pockets 75 on opposite sides of each stator plate 51 are staggered and are adapted to be fed with oil by the channels 70 and to retain the oil while the friction device 15 is inactive. Therefore, upon starting, there is assured reservoirs of oil between friction plates 50 and 51 sufficient to provide a proper oil film between the respective opposed faces of friction plates 50 and 51.

The outside stator plates 51 are provided on their inner faces with pockets 75 as described, while their outer faces are free from such pockets.

The shaft 35 is journalled near one end in the frame member 32, as described, and near the other end in a bearing 80 held, as for example, by a press-fit into the sleeve 61. Said sleeve is supported in an axial tubular bearing flange extension 81 of the cover plate 66 and is axially adjustable in said extension to vary selectively the pressure between the friction plates 50 and 51 through the spring-loaded plunger 60 and to regulate thereby the tension on the warp. To provide for such adjustments, there is employed a lining 82 retained in the tubular extension 81, as for example, by a press-fit and having an internal thread 83 into which the sleeve 61 is screwed. A handle 84 for the sleeve 61 is secured thereto, as for example, by studs 85 and has a cup-section 86 enveloping the outer section of the flange extension 81 and an outer peripheral disc flange 87 serving as a dial and having for that purpose a series of graduations 88 on its face cooperating with an index piece 89 secured to the cover plate 66. The handle 84 serves as a warp tension regulator and is held

in adjusted position against rotation by means of a pair of lock nuts 90 which are threaded on to a stud 91, secured to the cover plate 66, and which extend on opposite sides of the outer peripheral flange section of said handle. When the nuts 90 are turned from holding engagement with the tension regulating handle 84, the handle 84 can be rotated to regulate the pressure between the friction plates 50 and 51.

The friction device 15 described is simple and compact and while it is amply strong its rotating parts are so light in weight and so well balanced that inertial effects due to starting, stopping and speed changes are so small that they do not materially affect the rotation of the beam 10. Since the construction described constantly provides a proper oil film between opposed surfaces of the plates 50 and 51 the device 15 operates entirely within the hydrodynamic portion of the friction curve so that the load imposed by it does not vary greatly at starting and stopping and there are no static friction effects.

With plates 50 and 51 made of brass and their opposed surfaces ground flat and with lubricant 48 an oil of about 20 S. A. E. grade, gear transmission 16 is preferably proportional to impart to plates 50 a maximum velocity of about 110 feet/minute, measured at the mean diameter, throughout the contemplated weaving speeds. With this maximum speed and with the plate surfaces and the lubricant of the character set forth the friction developed by device 15 is always within that portion of the friction curve wherein the hydrodynamic friction varies substantially inversely as the speed of rotation. Hence device 15 automatically compensates for the charging diameter of the warp on the warp beam 10.

The brake device 17 by which the shaft 35 is held and stopped against rotation comprises a brake-drum 95 secured to the outer end of the friction device shaft 35, as for example, by a set-screw and presenting a cylindrical brake surface 96. The brake-drum 95 is desirably shaped in the form of a knob to permit the shaft 35 to be manually rotated. Since the planetary gearing is reversible, rotation of the brake-drum 95 in either direction causes corresponding rotation of the warp-beam 10.

A brake-shoe 100 adapted to cooperate with the brake-drum 95 is pivotally connected to the upper end of an upright brake-arm 101 pivotally mounted at its lower end on a pivot pin 102 secured to the cover plate 66. A release coil spring 103 urges the brake-shoe arm 101 angularly about the pivot pin 102 and away from the brake-drum 95.

The brake device 17 is applied during each weaving cycle in synchronism with the operation of the lay (not shown) by means of a let-off brake-rod 106 between the brake-shoe arm 101 and the oscillatory parallel housing member 107 forming part of the parallel motion mechanism, which may be of any preferred form. The housing 107 is secured to a rocker shaft 108 supported in bearings in the loomside plates 11 and 12. A sword (not shown) between the loomside plates is connected near its upper end to the lay and near its lower end to the rocker shaft 108 and is oscillated by a crank connection from the main crank shaft (not shown) in the usual manner.

The let-off brake-rod 106 has a pivotal connection 110 at one end with the member 107 and at its other end passes with a loose slide fit through a hole 111 in the brake-shoe arm 101. A coil spring 112 encircling the brake-rod 106 and confined between the brake-shoe arm 101 and a shoulder member 113, such as a nut and washer, serves as a giveway member to prevent jamming of said brake-shoe arm.

The connection between the lay and the brake-shoe arm 101 is designed to apply the brake-shoe 100 firmly against the brake surface 96 of the brake-drum 95 and thereby to stop rotation of the shaft 35 from a period just before the beginning of the beat-up operation to the end of said operation corresponding to the front center position of the lay and to release said shoe soon after said beat-up operation, so that rotation of said shaft under the tensional influence of the warp is again permitted. This application of the brake device 17 during beat-up holds the warp-beam 10 against rotation, so that beat-up is accomplished while the warp is held against let-off. Release of the brake device 17 permits the warp-beam 10 to be rotated as the yarn is pulled therefrom by the spreading of the harnesses and by the take-up roll (not shown).

Means are provided for applying the brake device 17 automatically upon loom shut-downs, regardless of the weaving cycle phase, to prevent continued inertial movement of the warp-beam 10 during such shut-downs. In Figs. 7, 8 and 9, the shut-down brake applying means is shown electrically controlled and comprises a collar 120 on the brake-rod 106 and a yoke 121 connected to the plunger 119 of a solenoid 122 and straddling said rod on the left side (Fig. 7) of said collar. In the circuit of the solenoid 122 is a normally open switch 124 having one of its terminals connected to a spring arm 126 supporting a roller 127 and carrying one of the switch contacts. The roller 127 engages a cam 128 secured to a clutch rod 130, one end of which is pivotally connected to a clutch lever or shipper handle 131 controlling the stopping and starting of the loom.

The circuit of the solenoid 122 and of the switch 124 may include a transformer 133 with its primary coil connected to a power source, as shown in Fig. 9.

While the clutch lever 131 is in the on position shown in Fig. 8, the clutch is connected and the loom is operating. During loom operation, the clutch-rod 130 is stationary and the cam 128 thereon engaging the roller 127 holds the contact on spring arm 126 away from the other contact of the switch 124 against the action of the spring arm 126, thereby maintaining the solenoid circuit open. While the solenoid circuit is open, the yoke 121 is held in the extreme left hand position shown in Fig. 7, by the action of a spring on the plunger 119 and in this position, the collar 120 on the let-off brake-rod 106 clears the yoke as said rod reciprocates endwise.

Upon movement of the clutch lever 131 counterclockwise (Fig. 8) into loom shut-down position, the corresponding endwise movement of the clutch-rod towards the right (Fig. 8) causes the sloping part of the cam 128 to ride past the roller 127, so that said roller is permitted to rise under the action of the spring arm 126 thereby closing switch 124. This closes the circuit of the solenoid 122 and causes the yoke 121 on its plunger 119 to move towards the right (Fig. 7) and into engagement with the collar

120 to shift the let-off brake-rod 106 towards the right. Since the parallel housing member 107 is stationary during loom shutdowns, the movement of said let-off brake-rod towards the right (Fig. 7) under the action of the yoke 121 is permitted by making the connection 110 of the lost-motion type.

The right hand movement of the let-off brake-rod 106 as described, moves the brake-shoe 100 against the brake-drum surface 96 and thereby holds the warp-beam 10 against rotation. As soon as the clutch lever 131 is swung back into on position to start the loom, the resulting shifting of the clutch-rod 130 towards the left (Fig. 8) opens the switch 124 and deenergizes the solenoid 122, so that the yoke 121 is returned to its inactive position.

In Fig. 10 is shown another form of control means for the brake device 17 operatable to apply the brake upon loom shutdowns. This form of control means is entirely of a mechanical nature and comprises a rod 140 passing near one end with a loose slide fit through a lug 141 in the brake-shoe arm 101 and encircled by a giveway coil spring 142 which is disposed between said lug and a shoulder member 143 in the form of a nut and washer on said rod and which serves to prevent jamming of the brake-shoe 100. The other end of the rod 140 has a connection with the clutch lever or shipper handle 131 comprising a bell crank 144, having a pivot support 145 and having one arm pivotally connected to the end of the rod 140 and the other arm pivotally connected to one end of a link 146. The other end of the link 146 is pivotally connected to an arm 147 forming a transverse crank extension of the clutch lever 131.

With the mechanical brake applying means shown in Fig. 10, while the clutch lever 131 is in the on position shown and the loom is operating, the brake-shoe 100 is intermittently and alternately applied and released through the operation of the let-off brake-rod 106, as already described, without interference from the rod 140 which remains stationary. Upon loom shutdowns, the angular movement of the clutch lever 131 clockwise from the position shown in Fig. 10, causes the rod 140 to be shifted towards the right and the brake-shoe 100 to be applied firmly to the brake-drum surface 96. Since the brake-shoe arm 101 has a loose slide connection relative to the left-off brake-rod 106, the brake applying movement of the rod 140 towards the right is effected freely, regardless of the position of the member 107 and even though the connection 110*a* between said brake-rod 106 and said member is not a lost-motion one, as in the form of the invention shown in Fig. 7.

It should be noted that the friction device 15, the reduction gear transmission 16 and the brake device 17 are connected together by a frame structure to form the self-contained unit 14, and that the part of this unit including the casing 41 and the head plate 42 lie between the loomside plates 11 and 12. The loomside plate 11 has a hole 150 to receive snugly a cylindrical neck 151 formed at one end of the head plate 42 and thereby supports the let-off unit at this end. The other loomside plate 12 has a hole 152 to receive snugly the casing 41, and the frame member 32 has a peripheral flange extension 153 beyond said casing connected to said plate, as for example, by the studs 154.

The pinion 20 on the shaft 18 meshing with the beam gear 19 is slightly smaller in diameter than the diameter of the head plate neck 151 and of the plate hole 150, to permit said pinion to pass through said hole when mounting the let-off unit 14 in position. In mounted position, the pinion 20 will be disposed on the side of the loomside plate 11 opposite the casing 41.

In the operation of the let-off motion, as the warp-beam 10 is progressively reduced in diameter by the consumption of the warp, said warp-beam is rotated at progressively increased angular speed, thereby causing corresponding increase in the angular speed of the rotor plates 50. This increase in rotor plate speed correspondingly decreases the resistance offered to the rotation of the rotor plates 50, so that reduction in the diameter of the warp-beam 10 is compensated for automatically by decrease in the resistance offered to the rotation of said warp-beam. As a consequence, the tension of the warp as it is run off from the warp-beam 10 remains substantially constant during the same phases of successive weaving cycles, regardless of the diameter of the warp-beam.

While the invention has been described with particular reference to specific embodiments, it is to be understood that it is not to be limited thereto but is to be construed broadly and restricted solely by the scope of the appended claims.

What is claimed is:

1. In a loom having a warp-beam, a rocker shaft adapted to mount a sword for operating a lay through recurrent weaving cycles, a let-off motion comprising a brake for holding the warp-beam against rotation, said brake having a brake-drum and a brake-shoe cooperating therewith and a connection between said rocker shaft and said brake-shoe for applying said brake-shoe to said brake-drum in accordance with the position of the lay during a predetermined period of each weaving cycle, to hold said warp-beam against rotation during said predetermined period.

2. In a loom having a warp-beam, a rocker shaft adapted to mount a sword for operating a lay through recurrent weaving cycles, and a member on said rocker shaft forming part of the parallel motion mechanism for a picker stick, a let-off motion comprising a brake for holding said warp-beam against rotation, said brake having a brake-drum, and a brake-shoe cooperating therewith, and a connection between said member and said brake-shoe for applying said brake-shoe to said brake-drum in accordance with the position of the lay during a predetermined period of each weaving cycle, to hold said warp-beam against rotation during said predetermined period.

3. A let-off motion for the warp-beam of a loom operatable through recurrent weaving cycles, comprising a friction device for yieldably resisting the let-off rotation of said warp-beam resulting from the pull of the yarn therefrom and having a shaft with a drive connection from said warp-beam, and a series of stator and rotor plates, the rotor plates being keyed to said shaft for rotation therewith, a brake comprising a brake-drum mounted on said shaft for rotation therewith and a brake-shoe cooperating therewith, and means for applying said brake-shoe to said brake-drum during a predetermined period of each weaving cycle to hold said warp-beam against rotation during said predetermined period.

4. In a loom having a warp-beam and operatable through recurrent weaving cycles, the com-

bination comprising a brake for holding said warp-beam against rotation, means for applying said brake during a predetermined period of each weaving cycle, and means automatically operatable upon loom shut-downs for applying said brake.

5. In a loom having a warp-beam, a lever for controlling loom shut-downs and a member operatable with the lay through recurrent weaving cycles, the combination comprising a brake for holding said warp-beam against rotation, a connection from said member for applying said brake during a predetermined period of each cycle, and means automatically operatable upon loom shut-downs for applying said brake independently of the position of the lay.

6. In a loom having a warp-beam and a lever for controlling loom shut-downs, the combination comprising a brake for holding said warp-beam against rotation, a solenoid having a plunger, a rod for applying said brake when said rod is moved in one direction, a connection between said plunger and said rod for moving said rod in said brake applying direction upon energization of said solenoid, and switch means in the circuit of said solenoid and controlled by the position of said lever, said switch means being closed when said lever is in loom shut-down position to energize said solenoid and being opened when said clutch lever is in loom running position.

7. In a loom having a warp-beam and operatable through recurrent cycles, the combination comprising a brake for holding said warp-beam against rotation and having a brake-drum and a brake-shoe, means for applying said brake during a predetermined period of each weaving cycle and including a let-off brake rod, means for oscillating said rod endwise in accordance with said cycles, means connecting said rod to said brake-shoe to move said brake-shoe towards and away from said brake-drum as said rod is oscillated, to apply said brake during a predetermined period of each weaving cycle, and means automatically operatable upon loom shut-downs for moving said rod endwise in a direction to apply said brake irrespective of the period of the weaving cycle.

8. In a loom, the combination as described in claim 7, said automatically operatable means comprising a solenoid having a plunger, a yoke connected to said plunger and straddling said let-off brake rod, a collar on said rod, said rod being free from interference from said yoke as it is oscillated while said solenoid is deenergized, said yoke being moved into position to engage said collar and thereby to move said rod in a brake applying direction when said solenoid is energized, said solenoid being deenergized while the loom is running, and means for energizing said solenoid automatically upon loom shut-downs.

9. In a loom having a warp-beam and a lever for controlling loom shut-downs and operatable through recurrent weaving cycles, the combination comprising a brake, a let-off brake rod for applying said brake during a predetermined period of each weaving cycle, and a separate rod connected between said lever and said brake for applying said brake automatically upon loom shut-downs.

10. In a loom operatable through recurrent weaving cycles and having a warp beam, a let-off motion comprising a hydrodynamic friction device including a movable part, said device yieldably resisting the let-off rotation of said warp beam resulting from the pull of the yarn therefrom, reduction gearing between said warp beam and said friction device, a brake on said movable part, and means for applying said brake during a predetermined period of each of said weaving cycles to hold said warp beam against let-off rotation during each of said periods.

11. In a loom operatable through recurrent weaving cycles and having a warp beam on a shaft, a let-off motion comprising a hydrodynamic friction device for yieldably resisting the let-off rotation of said warp beam resulting from the pull of the yarn therefrom and having a shaft, one or more rotor friction plates mounted on said shaft for rotation therewith, one or more stator friction plates, said plates presenting opposed friction faces, a film of lubricant between each pair of said opposed faces, reduction gearing between the shaft of said warp beam and the shaft of said friction device, a brake on the shaft of said friction device, and means for applying said brake during a predetermined period of each of said weaving cycles to hold said warp beam against let-off rotation during each of said periods.

12. A loom let-off motion for a warp-beam, comprising a liquid-tight housing adapted to contain a lubricating oil reservoir, and a friction device in said housing for yieldably resisting let-off rotation of said warp-beam resulting from yarn pull and comprising a series of rotor and stator plates having opposed friction faces, the rotor plate or plates being adapted to extend into said oil reservoir and each having on the face thereof opposed to a stator plate a series of substantially radial channels extending to the outer periphery of said rotor plate and adapted to pick up lubricating oil from said reservoir and feed it through said channels to the plate faces to provide a film of oil between said opposed faces as said rotor plate rotates.

13. A loom let-off motion as described in claim 12, each of said channels being of triangular cross-section with the base of said channel transversely sloping obliquely towards said face in a direction opposite to direction of rotation of said rotor plate.

14. A loom let-off motion as described in claim 13 each of said stator plates having on its friction face a series of pockets adapted to store lubricating oil therein and located in position to be fed with oil from said channels.

15. A loom let-off motion for a warp-beam comprising a tubular casing, a head plate at one end of said casing, a wall member at the other end of said casing defining a first compartment with said casing and said head plate, said wall member being dished to define a hollow, a cover plate secured to said wall member and defining therewith a second compartment, a friction device in said second compartment, for yieldably resisting let-off rotation of said warp-beam resulting from yarn pull, and a reduction gear transmission in said first compartment for connection between said warp-beam and said friction device.

16. In a method of weaving through recurrent cycles during which warp is let-off the warp-beam through the pull exerted on the warp by the shed forming and cloth take-up operations and during which predetermined warp tension conditions for the cycle are established by exerting a resistance to the let-off of the warp from the warp beam the steps comprising applying a force to the warp tending to upset said predetermined tension conditions, and restraining the warp beam against warp let-off during the application

of said force whereby the effect of said applied force on said predetermined tension conditions is substantially eliminated.

17. A method of weaving as described in claim 16, in which said force is applied during the same phase of each succeeding weaving cycle and the warp-beam is restrained against warp let-off during the same phase of each succeeding weaving cycle.

18. A method of weaving as described in claim 16, in which the warp-beam is restrained against warp let-off throughout the period during which said force is applied.

19. A method of weaving as described in claim 16, in which the warp-beam is restrained against warp let-off throughout a period beginning just before said force is applied and ending just after the application of said force is discontinued.

20. In a method of weaving through recurrent cycles during which warp is let-off the warp beam through the pull exerted on the warp by the shed forming and cloth take-up operations and during which predetermined warp tension conditions for the weaving cycle are established by exerting resistance to the let-off of the warp from the warp-beam the steps comprising, depositing a pick of filling in the warp shed, moving said pick to the cloth, continuing the clothwise movement of said pick until previously laid picks of filling are moved sufficiently to increase the packing density of previously laid picks a predetermined amount, and holding the warp-beam against warp let-off during said continued clothwise movement of said pick.

21. A method of weaving as described in claim 20, in which the warp-beam is held against warp let-off from the beginning to the end of said continued clothwise movement of said pick.

22. In a method of weaving through recurrent cycles during which warp is let-off the warp-beam through the pull exerted on the wrap by the shed forming and cloth take-up operations, during which predetermined warp tension conditions are established for the weaving cycle by exerting a substantially constant resistance to the let-off of the warp from the warp-beam, and during which filling picks are packed to such a density that in the laying of a filling pick in the cloth prior laid picks are moved closer together, the steps comprising depositing a filling pick in the warp shed, moving the lay and the reed toward front center position of the lay to move said deposited filling pick to the cloth, continuing the movement of the lay and the reed to front center position of the lay to move said deposited filling pick into the cloth and to effect the movement of previously laid picks as required to produce the predetermined degree of packing, and restraining the warp-beam against warp let-off during the continued movement of the lay and reed.

23. A method of weaving as disclosed in claim 22, in which the warp-beam is restrained against warp let-off continuously during said continued movement of the lay and the reed.

24. A method of weaving as disclosed in claim 22, in which the warp beam is restrained against warp let-off throughout the period beginning just before said continued movement of the lay and reed and ending as the lay and reed move away from front center position of the lay.

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