Aug. 8, 1950 H. T. MARCY 2,518,158

ELECTRICAL LET-OFF

Filed May 18, 1948 2 Sheets-Sheet 1

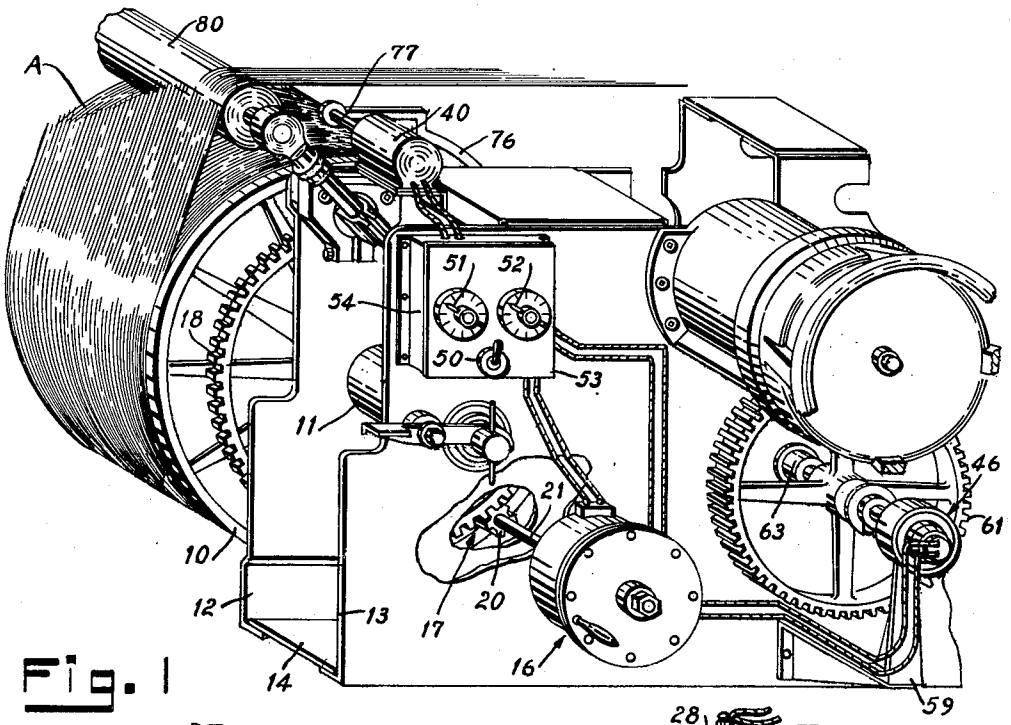


Fig. 1

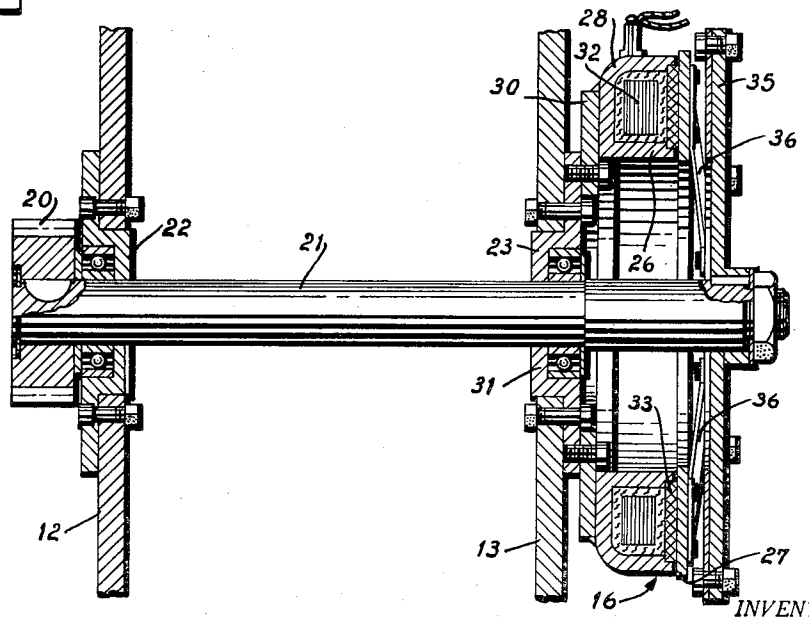


Fig. 2

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ELECTRICAL LET-OFF

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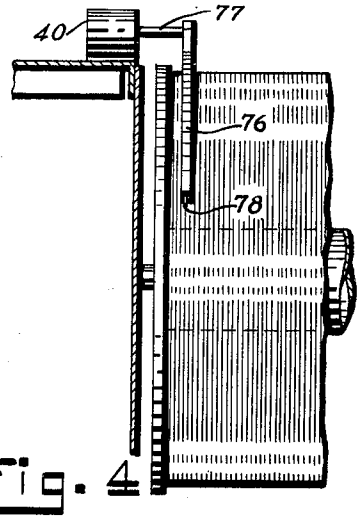
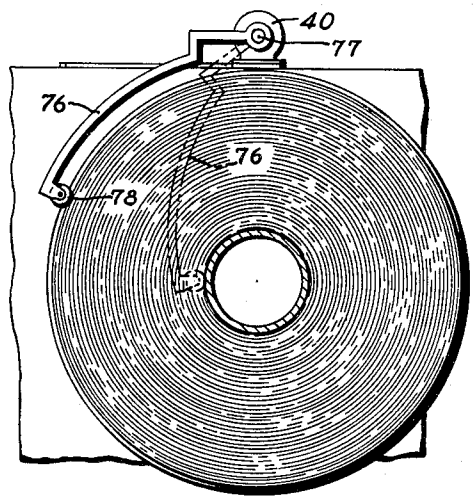


Fig. 4



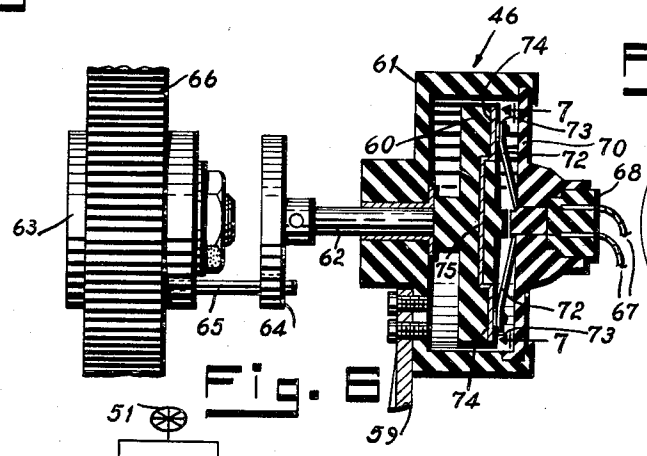


Fig. 6

Fig. 5

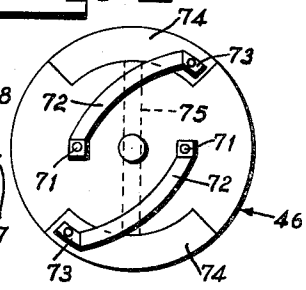


Fig. 7

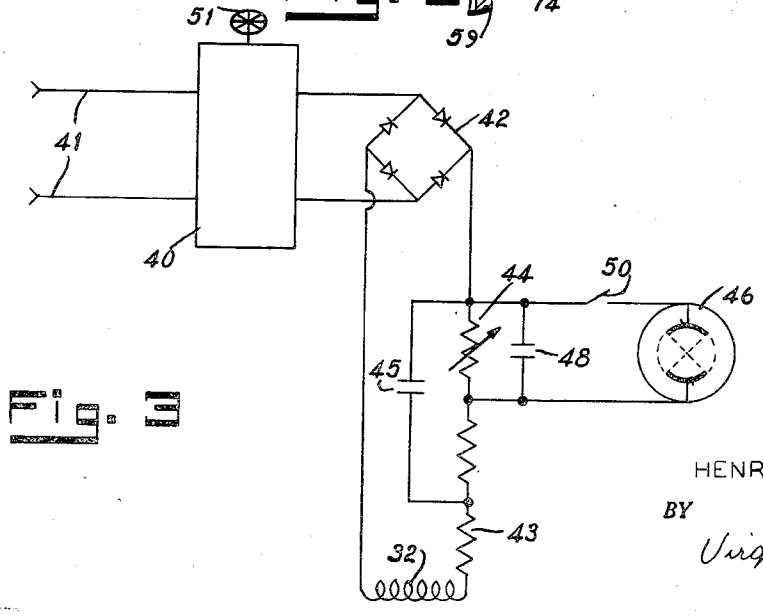


Fig. 3

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ELECTRICAL LET-OFF

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Application May 18, 1948, Serial No. 27,769

12 Claims. (Cl. 139—107)

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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 particularly 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-up 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.

It has been found that if a brake is applied directly, or indirectly, to the warp-beam during a predetermined period, or periods, of each weaving cycle and especially during the beat-up phase to hold said beam stationary against warp feed during at least a portion of said phase better and more stable tensioning and weaving conditions are attained throughout the weaving cycle and better cloth is produced. 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 steadier and improved warp tensioning and weaving conditions.

A primary object of the present invention is

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to provide a new and improved electrically controlled let-off motion.

Another important object of the present invention is to provide a new and improved let-off motion having an electromagnetic friction device for yieldably resisting the rotation of the warp-beam.

A further object of the present invention is to provide a new and improved let-off motion having an electromagnetic brake automatically applied during a predetermined period of each weaving cycle to hold the warp-beam against rotation and to hold thereby the warp yarn against let-off or feed during said period.

Still another object of the present invention is to provide a new and improved let-off motion having an electromagnetic device which is cyclically and automatically controlled to operate alternately as a friction device during certain predetermined periods of each weaving cycle to yieldably resist the rotation of the warp-beam during these periods and as a brake during other periods of each cycle to hold the warp-beam against rotation during said other periods.

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

Fig. 1 is a perspective of part of the left side of the loom showing an electromagnetic 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 section through the electromagnetic part of the let-off motion and shows the drive between the warp-beam and said electromagnetic part;

Fig. 3 is a wiring diagram for the electromagnetic system of the let-off motion;

Fig. 4 is a front elevation of part of the warp-beam and shows between the variable ratio transformer and said warp-beam the tie-up by which the energizing current of the electromagnetic system is automatically varied according to the diameter of the warp-beam;

Fig. 5 is a side elevation of the arrangement shown in Fig. 4;

Fig. 6 is an axial view through the commutator device by which the electric circuit of the system is periodically closed to produce brake applying current surges; and

Fig. 7 is a face view of the commutator disc and the cooperating contact members taken on lines 7—7 of Fig. 6.

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 certain features of the present invention, the warp is tensioned and let-off or unwound from the warp-beam against the constantly applied yieldable resistance of an electromagnetic friction device, and an electromagnetic brake is automatically applied to said beam for a predetermined period during each weaving cycle to hold the warp against let-off during this period. In accordance with other features of the present invention, the electromagnetic friction device and the electromagnetic brake constitute the same unit but the current actuating said unit is varied during each cycle to cause said unit to operate alternately as a friction device and as a brake according to the let-off cycle required.

Although, as far as certain aspects of the invention are concerned, the electromagnetic brake may be applied at any phase during each weaving cycle, it has been found desirable to apply this brake for a period during each beat-up operation to hold the warp against let-off during this period.

More specifically, the electromagnetic brake is desirably applied in accordance with the present invention just before each beat-up or in other words, before the force of the beat-up operation is transmitted to the warp, the brake should remain on until the lay reaches its forward center position and should be released just as the lay leaves front center. From then on, the warp is under control of the harnesses and the take-up roll and the brake, now energized by reduced current, operates as a yieldable friction device permitting said warp when it attains a certain tension to run off the warp-beam.

It has been found that the intermittent let-off-braking cycle of operation described results in reduced beat-up distances and reduced peak tensions in the warp, thereby affording better weaving conditions and producing better cloth.

The drawings show an apparatus by which the process features above referred to may be attained. In these drawings, there is shown a warp-beam **10** mounted on a shaft **11** supported at one end, as for example, on the left hand end in one or both of a pair of frame plates **12** and **13** forming the left loomside. Each of the loomsides desirably comprises a pair of these frame plates

12 and **13** (only the left loomside plates being shown) suitably braced and interconnected by means including a floor plate **14** as shown in Fig. 1 and as described more fully in copending application Serial No. 691,237, filed August 16, 1946.

Mounted on the left loomside plates **12** and **13** is a let-off motion comprising an electromagnetic device **16** and a reduction gear transmission **17** between the warp-beam **10** and said electromagnetic device **16**. The reduction gear transmission comprises a beam spur gear **18** secured to the beam shaft **11** and meshing with a pinion **20** keyed to one end of a short transmission shaft **21**. The latter shaft is journalled in bearings **22** and **23** mounted in the frame plates **12** and **13** respectively. At its inner end, the transmission shaft **21** projects beyond the frame plate **12** to receive the pinion **20** and at its other end projects beyond the frame plate **13** to receive the rotor element of the electromagnetic device **16** as will be more fully described.

The electromagnetic device **16** serves not only as a friction device to yieldably resist the rotation of the warp-beam **10** as the yarn is pulled off said warp-beam but serves also as a brake to hold the warp-beam against rotation during certain periods of each weaving cycle and especially during beat-up. To that end, the electromagnetic device **16** comprises an electromagnet **26** fixed against rotation and a rotor element **27** in the form of an annular ring serving as a magnetic armature brake shoe and having a flat annular face adapted for axial gripping engagement with said electromagnet during energization of said electromagnet. The electromagnet **26** is secured to a fixed part of the loom against rotation and comprises a toroidal ring **28** of magnetic material and of U-shaped cross-section secured to a frame plate **30** which in turn is affixed to the flange of the housing of the bearing **23**. The magnetic ring **28** encloses an annular winding or coil **32**. A friction ring **33** of material similar to that employed for brake linings is affixed to the face of the magnet ring **28** and retained thereon against rotation. In the specific form shown, this friction ring fits snugly in recesses in the flange arms of the magnet ring **28**.

The armature brake shoe **27** is concentrically mounted with respect to the transmission shaft **21** and is secured to a rotary plate **35** keyed to said shaft. The armature brake shoe **27** is mounted for a limited degree of floating axial movement by a plurality of flexible metal strips **36** between said shoe and the rotary plate **35** serving to connect said shoe and plate for rotation in unison.

When the magnet coil or winding **32** is energized, the brake shoe **27** is drawn against the friction ring **33**. Braking torque is controlled by adjusting the current through the magnet coil **32**.

Since the transmission shaft **21** has a torque applied thereto by the pulling action of the warp on the warp-beam **10**, this shaft is either held against rotation by braking action or permitted to rotate against an imposed friction load, according to the amount of current applied to the magnet coil **32**.

The electromagnetic device **16** is operated from a circuit which is controlled according to the characteristics of the weaving cycle desired, to cause said electromagnetic device to operate as a yieldable friction device during a certain period of each cycle and to operate as a brake, during

another period of said cycle. For that purpose, the circuit is arranged and controlled to produce current surges in the magnet coil 32 during the periods when it is desired to strengthen the holding power of the magnet 26 and thereby to prevent rotation of the warp-beam 10. The current restored to a lower valve during the remainder of the weaving cycle develops enough magnetic power in the magnet 26 to retard the rotation of warp-beam 10 while permitting it to rotate against a friction resistance offered by the device 16. Any suitable means may be employed for controlling the magnet circuit to produce these periodic current surges. Fig. 3 shows a suitable type of electric circuit which can be employed for the purpose. In this circuit, an auto-transformer 40 controlling current input is excited by an A. C. current supply 41 and is automatically adjusted to follow the warp-beam diameter in a manner to be described, so that variations in warp-beam diameter resulting in variations in the tension on the warp threads, can be automatically compensated for to maintain said tension substantially constant during corresponding periods of successive weaving cycles, irrespective of changes in said warp-beam diameter. The output current of the tranformer 40 is converted into direct current by a bridge rectifier 42 and is applied to the coil 32 of the electromagnetic device 16. If a D. C. supply is available, then of course, no rectification is required and the autotransformer is replaced by a resistor element such as a potentiometer. Also, if the electromagnetic device 16 is of the A. C. type, then no rectification is necessary.

The direct current from the rectifier 42 flows through a fixed resistor 43 and a variable resistor 44 in series with the magnet coil 32. A condenser 45 forms with the resistors 43 and 44 a R. C. network and a commutator switch 46 driven in synchronism with the lay movement, as will be more fully described, periodically short circuits this network for a predetermined portion of each weaving cycle, and more specifically during beat-up. While the commutator switch 46 is open, electric energy is being stored in the condenser 45. As soon as the commutator switch 46 is closed, there is produced a current surge in the magnet coil 32 caused by the discharge of the condenser 45, increasing the holding power of the magnet and causing said magnet to operate as a brake to hold the warp-beam against rotation. The R. C. network 43, 44 and 45 is for the purpose of reducing the brake time constant in order that the resultant pulse torque will follow the switching action with a minimum of delay and will be confined to that portion of the cycle wherein it is required.

A capacitor 48 across the commutator switch 46 serves as an arc suppressor. A switch 50 permits the pulsing portion of the circuit to be cut out, so that the magnet coil 32 can be continuously energized at a constant current level just sufficient to maintain the necessary yieldable resistance to the rotation of the warp-beam 10, when, for example, it is desired to operate without beat-up, or when, for any other reason, it is desired to operate without intermittent warp-beam braking.

A hand rheostat control 51 may be employed for the transformer 40 so that the input current may be regulated according to the minimum amount of energizing current desired for the electromagnet coil 32. A rheostat control 52 for the variable resistor 44 may be provided to allow for adjustments in the minimum warp thread tension, as may be desired for changes in fill densities, in size of yarn or in cloth construction.

In Fig. 1, the two controls 51 and 52, as well as the switch 50, are shown mounted on a panel board 53 forming one wall of a housing 54 which is mounted on the outer frame plate 13 in easily accessible position for manipulating of said controls and which may enclose the bridge rectifier 42, the resistors 43 and 44 and the two condensers 45 and 48.

The commutator switch 46 is shown in Figs. 6 and 7 comprising a disc 60 enclosed in a housing 61 and made of suitable insulating material such as plastic. The disc 60 is connected to a shaft 62 which is journalled in one of the end walls of the housing 61 mounted on a bracket 59 secured to the frame plate 13 and which has a drive connection desirably from the pick cam-shaft 63. The commutator shaft 62 is desirably mounted co-axially with respect to the pick cam-shaft 63 and is driven therefrom by means of a plate 64 set-screwed to the end of the commutator shaft 62 outside the housing 61 and having a pin connection 65 with the drive gear 66 of said pick cam-shaft.

The leads 67 to the commutator switch 46 pass into the housing 61 through recesses in an insulating plug 68 secured to one of the end walls 70 of said housing and connect to said wall inside said housing to contacts 71. Secured to the contacts 71 are a pair of conductor arms 72 carrying at their outer ends brushes 73 pressing against the face of the commutator disc 60. The disc 60 carries in the circle of these brushes a pair of diametrically opposite arcuate conductor strips or segments 74 interconnected by a conductor 75 embedded in the disc 60.

The pick cam-shaft 63 makes one complete revolution for every two picks. However, since the conductor segments 74 come into engagement with the commutator brushes 73 twice during every revolution of the commutator disc 60, or twice during every revolution of the pick cam-shaft 63, it will be seen that the commutator switch 46 will be closed during each weaving cycle for a period corresponding to the time it takes each conductor strip 74 to ride past the corresponding brush 73.

The rotative position of the commutator disc 60 depends on the phase of the weaving cycle in which it is desired to operate the electromagnetic device 16 as a brake. In the specific form shown, the commutator switch 46 would be seat to operate the device as a brake during the beat-up periods as described, so that the rotative position of the commutator disc 60 would be set accordingly. If it is desired to change the phase application of the brake in relation to the weaving cycle, this can be very easily done, as is apparent from inspection of the drawings.

The automatic compensating device by which the amount of input current is varied according to the diameter of the warp-beam 10, in order to maintain the warp tension constant for corresponding phases of successive weaving cycles, is shown comprising an arm 76 affixed to a rheostat shaft 77 which operates on the rheostat of the autotransformer 40 in any well known manner, and carrying at its outer end a roller 78 bearing on the surface of the warp-beam. The rheostat arm 76 may be spring-pressed against the warp-beam periphery or may be held thereagainst by gravity. As the diameter of the warp-beam 10 is reduced by consumption of the warp

thereon, the automatic compensating device described operates to progressively reduce the current which is delivered to the D. C. circuit.

Although a specific type of electrical system has been described for creating current brake applying surges in the magnet coil **32**, it must be understood, that as far as certain aspects of the invention are concerned any other type of system may be employed. For example, such current surges may be produced by the methods of (1) lead-network (2) pure resistive (3) variable reluctance (4) variable voltage or (5) electronic current source technique. These are well known methods of creating current surges in electric circuits and may be employed in place of the specific technique described.

In the operation of the device described, the yarn A on the warp-beam **10** passes over a guide roll **80** mounted on a shaft held against transverse movement. This yarn is run off the warp-beam **10** and passes through the loom in the ordinary manner to be woven with the filling into cloth. The cloth passes over a take-up roll (not shown) and around a winding shaft (not shown). During the shed opening and closing phases of the harnesses in each weaving cycle, the commutator switch **46** is open and the magnet coil **32** is energized only sufficiently to cause the electromagnetic device **16** to operate as a friction device yieldably resisting rotation of the warp-beam **10**, to impart the desired tension to the warp, while permitting said warp to be run off the warp-beam **10**. At the beginning of beat-up, the commutator switch **46** is closed. The resulting current surges produced in the magnet coil **32** increase the holding power of the magnet **26** so that this magnet operates as a brake and holds the warp-beam against rotation for the full period of the beat-up. At the end of the beat-up or soon after the lay starts its return from front center position, the magnet coil **32** will be restored to its previously energized condition in which it attracts the armature shoe **27** just strongly enough to resist frictionally and yieldably the rotation of the warp-beam **10** according to the desired warp tension. By that time the commutator switch **46** will have opened.

While the invention has been described with particular reference to a specific embodiment, 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. A method of weaving through recurrent cycles in a loom having a warp-beam, which comprises converting an electric current into mechanical resistance yieldably opposing rotation of said warp-beam, and rapidly increasing the intensity of said current during a predetermined period of each cycle to increase said mechanical resistance.

2. A method of weaving as described in claim 1, in which said current is increased during beat-up.

3. A method of weaving through recurrent cycles in a loom having a warp-beam, which comprises converting an electric current into electromagnetic power, converting said power into friction resistance to oppose yieldably the rotation of said warp-beam, and creating current surges during a predetermined period of each cycle to rapidly increase said electromagnetic power and thereby raise the strength of said resistance.

4. The method of weaving as described in claim 3, in which said current surges are created during beat-up.

5. A let-off motion for the warp-beam of a loom operatable through recurrent weaving cycles and comprising an electromagnetic friction device for yieldably resisting the let-off rotation of said warp-beam resulting from the pull of the yarn therefrom, and means for increasing the current power of said friction device during a predetermined period of each weaving cycle to increase the resisting power of said device.

6. A let-off motion for the warp-beam of a loom operatable through recurrent weaving cycles and comprising an electromagnetic brake having an element fixed against rotation and a rotor element having a drive connection from said warp-beam and adapted to be magnetically attracted into contact with said fixed element upon energization of said brake, and means for creating current surges in the coil of said brake during a predetermined period of each weaving cycle to rapidly increase the holding power between said elements during each of said periods to the point where said warp-beam is held against rotation.

7. A let-off motion for the warp-beam of a loom operatable through recurrent weaving cycles and comprising an electromagnetic friction device for yieldably resisting the let-off rotation of said warp-beam resulting from the pull of the yarn therefrom and means for creating current surges in the coil of said friction device during a predetermined part of each beat-up period to rapidly increase the resisting power of said friction device beyond the yieldable point, whereby said friction device is made to operate as a brake to hold said warp-beam against rotation during at least a part of each beat-up period.

8. In a loom having a warp-beam and a lay operatable through recurrent weaving cycles, a let-off motion comprising an electromagnetic brake having an element fixed against rotation and a rotor element having a drive connection from said warp-beam and adapted to be magnetically attracted towards said fixed element upon energization of said brake, a commutator in the circuit of said brake and operated in synchronism with the operation of said lay, said commutator being adapted to close a part of the circuit of said brake during a predetermined period of each weaving cycle, and means operatable upon closure of said circuit part for creating current surges in the coil of said brake during each of said periods to rapidly increase the holding power between said brake elements during each of said periods to the point where said warp-beam is held against rotation.

9. In a loom having a warp-beam and operatable through recurrent cycles, a let-off motion comprising an electromagnetic device for yieldably resisting rotation of said warp-beam, and means operatable in accordance with the diameter of said warp-beam for varying the current energizing said electromagnetic device in accordance with said diameter and to decrease thereby the resistance offered by said device to the rotation of said warp-beam as its diameter decreases.

10. A let-off motion for the warp-beam of a loom having a lay operatable through recurrent weaving cycles, said let-off motion comprising an electromagnetic friction device for yieldably resisting rotation of said warp-beam, a condenser in the circuit of the magnetic coil of said device, and commutator means driven in synchronism with said lay for short-circuiting said condenser

during beat-up periods to create current surges in said coil and thereby rapidly increase the resisting power of said friction device during said periods.

11. A let-off motion for the warp-beam of a loom operatable through recurrent weaving cycles and comprising an electromagnetic friction device for yieldably resisting the let-off rotation of said warp-beam resulting from the pull of the yarn therefrom, means for creating current surges in the magnet coil of said friction device during a predetermined period of each cycle to rapidly increase the resisting power of said friction device beyond the yieldable point, whereby said friction device is made to operate as a brake to hold said warp-beam against rotation during each of said periods and means for selectively cutting off said surge creating means to render said latter means inoperative and to permit thereby said device to operate continuously and yieldably as a friction device.

12. A let-off for the warp-beam of a loom operatable through recurrent weaving cycles, comprising means for yieldably resisting the let-off rotation of said warp-beam resulting from the pull of the yarn therefrom, an electromagnetic brake for holding said warp beam against rotation, and means for applying said brake at the attainment of predetermined conditions during each weaving cycle.

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