United States Patent

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[54] **UNIFORM TENSION TEXTILE ACCUMULATOR**
5 Claims, 10 Drawing Figs.

[52] **U.S. Cl.** **226/25,**
226/44, 226/104
[51] **Int. Cl.** **B65h 25/22**
[50] **Field of Search** 226/25, 44, 104, 105, 106, 107, 42

[56] **References Cited**
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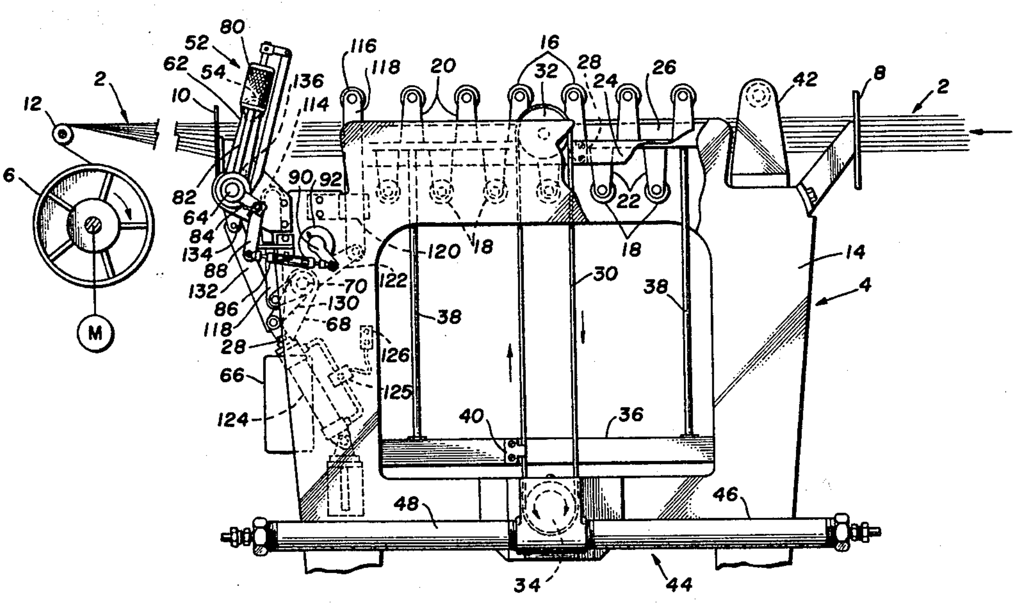
ABSTRACT: Fluid pressure controlled textile accumulator for storing and paying out a warp sheet in a warp winding operation at differential speeds responsively to sensed variations in warp sheet tensions.



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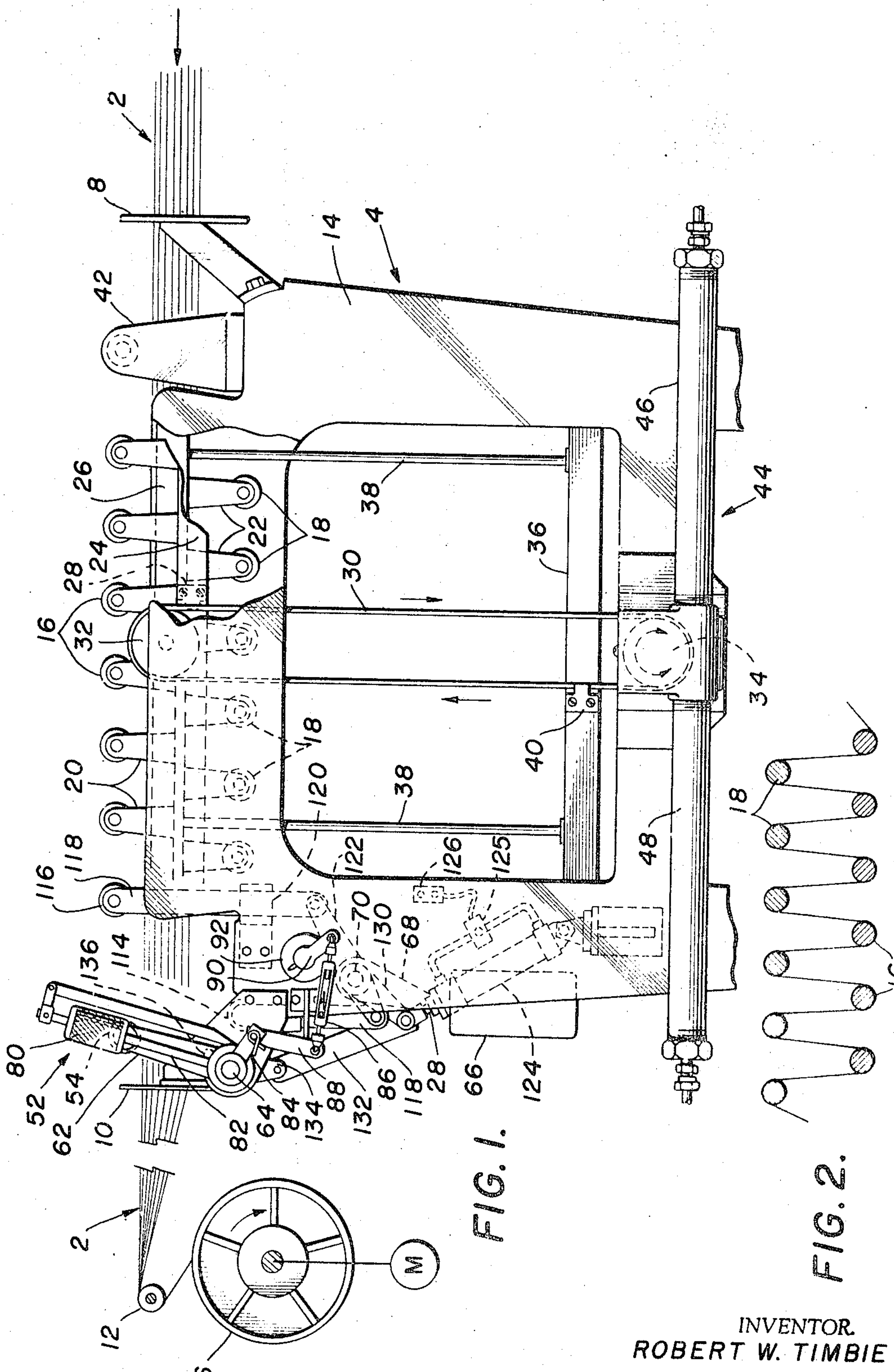

FIG. 1.

FIG. 2.

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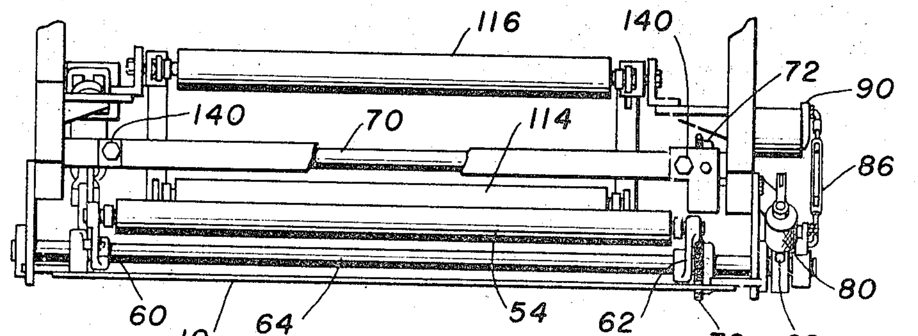

FIG. 4.

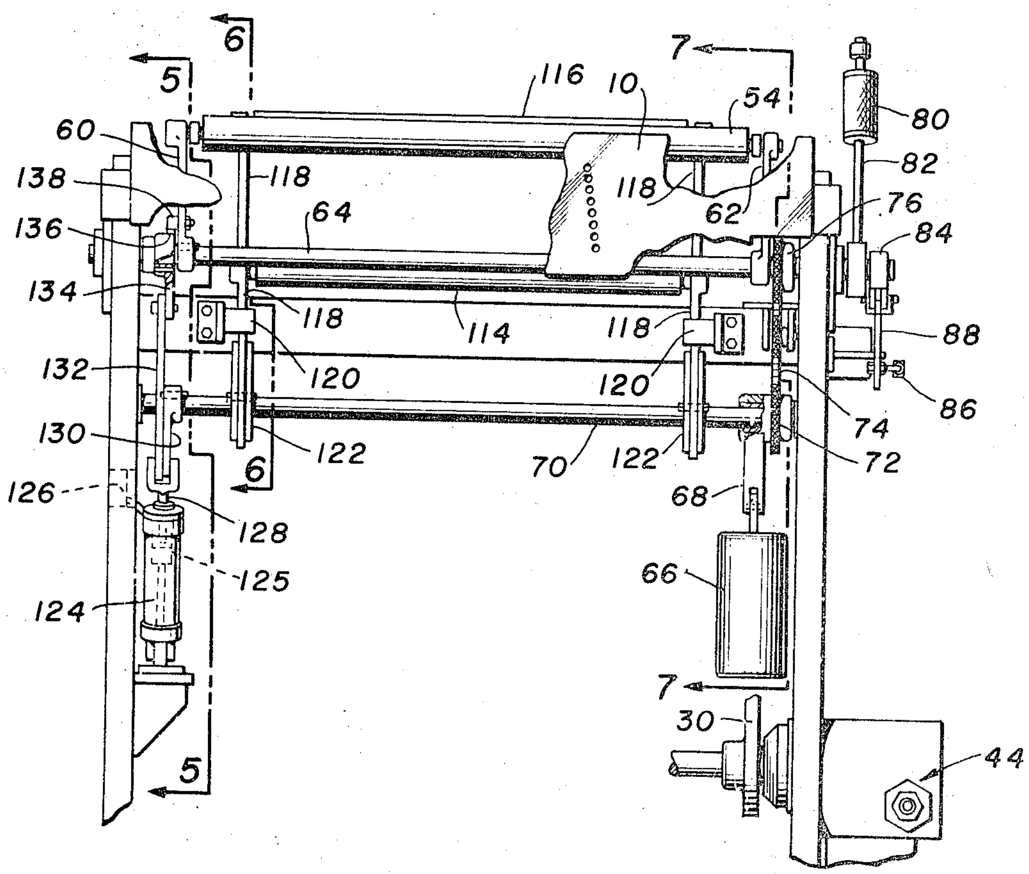

FIG. 3.

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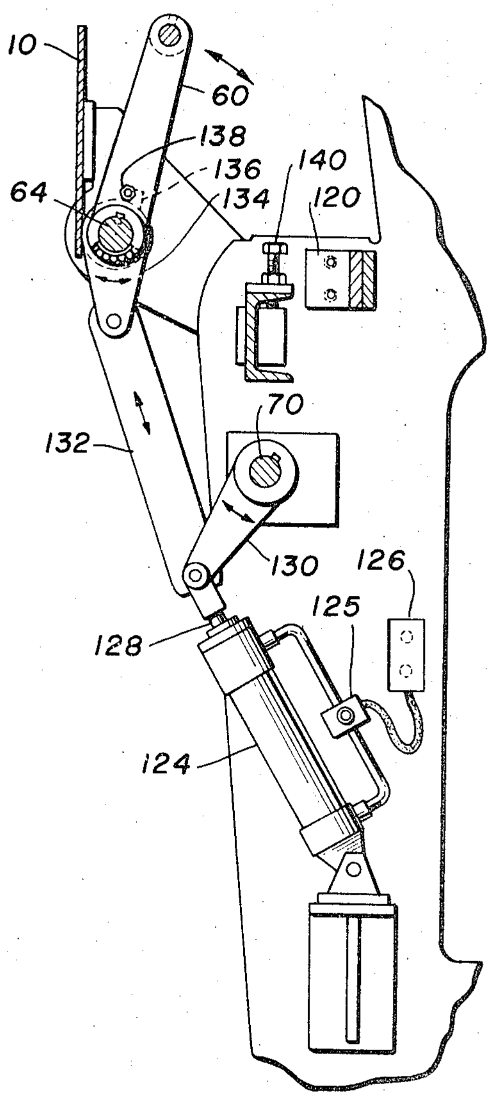

FIG. 5.

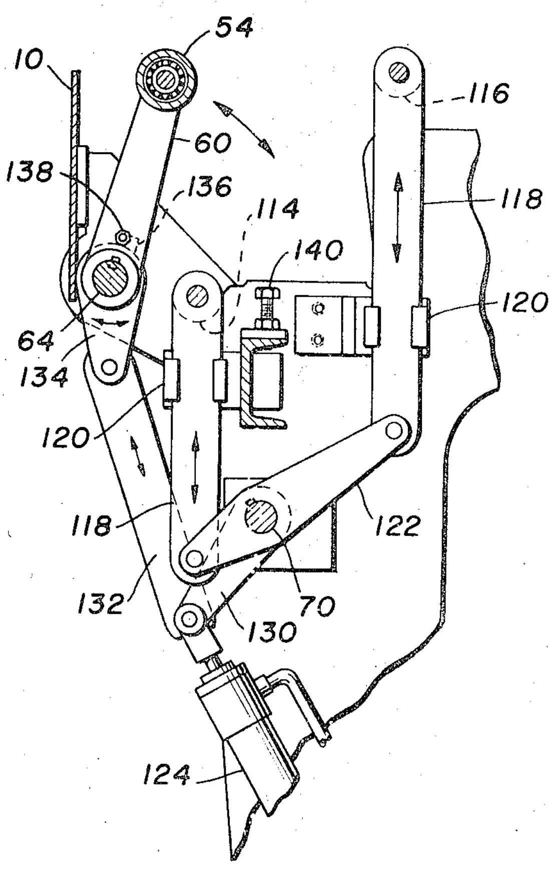

FIG. 6.

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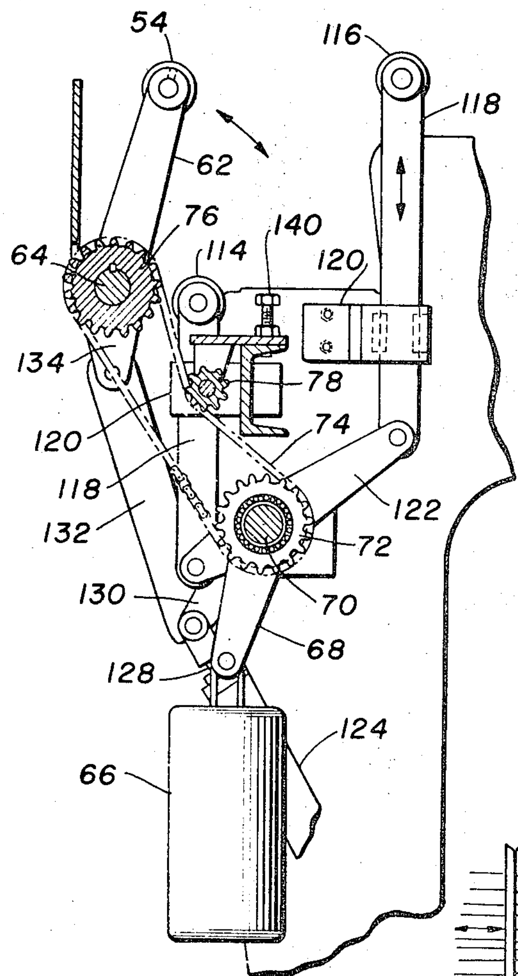

FIG. 7.

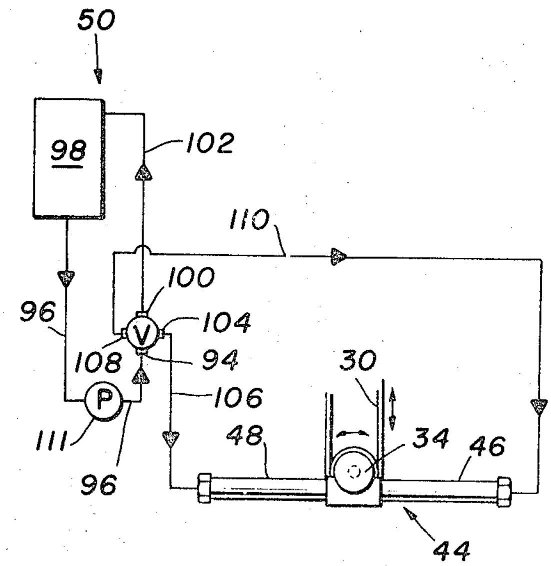

FIG. 8.

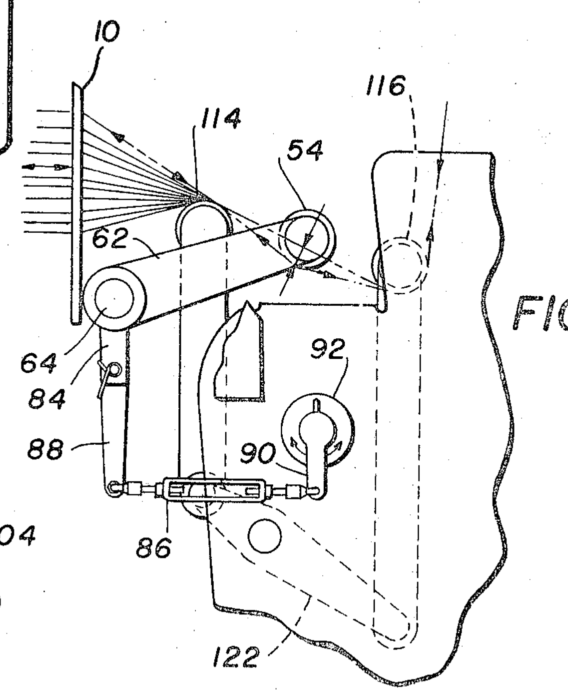

FIG. 10.

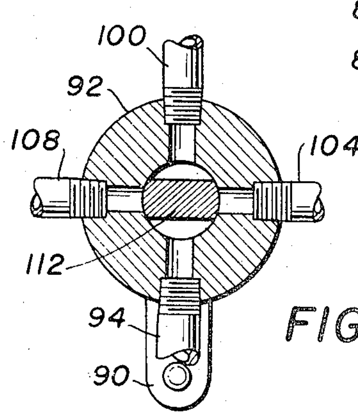

FIG. 9.

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UNIFORM TENSION TEXTILE ACCUMULATOR

BACKGROUND OF THE INVENTION

Conventionally, textile accumulators are used in conjunction with textile warping and beaming apparatus and processes. For example, in beaming or warping, a warp sheet is formed from a plurality of yarn ends withdrawn from a source of supply such as bobbins mounted on creels. The yarn ends are condensed by being passed through an eyeboard positioned at one end of an accumulator to form a warp sheet that extends the length of the accumulator between upper and lower sets of spreadable accumulator rolls, and then passes through another eyeboard before being wound on a driven warp beam.

Frequently a defect in yarn gets wound into a beam during a warping operation necessitating operational interruption and requiring an unwinding of a length of the warp sheet from the warp beam. The warp sheet length unwound from the warp beam is stored in the accumulator and an inspection is made of the yarn defect. Remedial measures are taken and the warp sheet is returned to the warp beam.

In structure, conventionally, accumulators are electrically operated to spread two opposed sets of rolls, one set being actuated upwardly and the other downwardly against the warp sheet in intermeshing relation so that the warp sheet, extending between the two sets of rolls and restrained clampingly at one end thereof, is festooned between the rolls. By festooning the warp sheet, the latter is made to course or take a sinuous path up and down between the rolls in a plurality of draped folds that become larger when the accumulator is storing the warp sheet and smaller when the accumulator is paying out or releasing the warp sheet back to the warp beam. In conventional manner, microswitches and other electric devices are employed to synchronize accumulator and warp beam sequential, timed operations.

It is important in an accumulation operation, as in most textile winding procedures, to maintain uniform warp sheet tension while processing the warp sheet into and out of the accumulator. Presently, accumulators depend on electric synchronization of the warp beam and accumulator roll drives to maintain tension uniformities in a warp sheet, and the accumulator rolls are not controlled to adjust to fluctuations in warp sheet tensions. More sensitive control of warp sheet tension fluctuations is desirable.

The invention described herein is designed to improve warp sheet tension control by providing a fluid pressure controlled accumulator acting responsively to sensed warp sheet tension variations to vary the rate of warp sheet accumulation and thus to maintain uniform warp sheet tensions during an accumulation operation.

SUMMARY OF THE INVENTION

The invention comprises a textile accumulator having the conventional reciprocable accumulator rolls controlled to take up and store or to release a warp sheet therefrom responsively to fluctuations in tension detected in the warp sheet.

Warp sheet tension is sensed by an oscillatable dancer roll that rests on the warp sheet and a cooperate reciprocable tension roll assembly controlled by a fluid actuator. Tension variations sensed by the dancer roll are transmitted to the accumulator rolls through a fluid pressure system.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings,

FIG. 1 is side elevation view of the textile accumulator embodying the invention shown in association with a warp beam,

FIG. 2 is a schematic view illustrating a festooned condition of a warp sheet,

FIG. 3 is an end view of the textile accumulator with portions broken away,

FIG. 4 is a plan view of a portion of the textile accumulator illustrating the tension sensing dancer roll,

FIG. 5 is an elevation view taken along the line 5–5 of FIG. 3,

FIG. 6 is an elevation view taken along the line 6–6 of FIG. 3,

FIG. 7 is an elevation view taken along the line 7–7 of FIG. 3,

FIG. 8 is a schematic of the fluid pressure circuit,

FIG. 9 is a cross section view of the valve in the fluid pressure circuit illustrated in FIG. 8, and

FIG. 10 is an elevation view illustrating the position of the tension sensing dancer roll in an accumulation operation at startup.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawings, a warp sheet 2 is shown moving from right to left through an accumulator 4 and being taken up on a driven warp beam 6. The warp sheet 2 passes through eyeboards, 8 and 10, mounted at opposite ends of the accumulator 4, and travels over a carrier roll 12 before being taken up on beam 6.

Conventionally, the accumulator 4 includes a frame 14 supporting two sets of parallel rolls, an upper and a lower set each having a plurality of rolls, 16 and 18, respectively, extending transversely across frame 14. Roll sets 16 and 18 are offset so that they may be actuated intermeshingly past each other. One side of the accumulator is illustrated in elevation in FIG. 1, and only the supporting structure for rolls 16 and 18 on the one side shown will be described, however, it will be understood that rolls 16 and 18 are supported similarly on both sides of frame 14.

At opposed ends thereof, upper rolls 16 and lower rolls 18 are mounted on brackets 20 and 22, respectively, which in turn are attached to tie bars 24 and 26, respectively. Tie bar 24 is secured by a clamp 28 to a belt 30 that is looped about spaced apart pulleys 32 and 34. Tie bar 26 is connected to a spaced tie bar 36 by tie rods 38, and tie bar 36 is connected to belt 30 by a clamp 40.

Lower pulley 34 is driven, reversibly, in conventional practice by an electric motor. Operationally, when belt 30 is rotated in a clockwise direction by pulley 34, lower rolls 18 are raised and upper rolls 16 are lowered; and, when rotated in a counterclockwise direction the opposite occurs. Typically, the warp sheet 2 passes through eyeboard 8, through a clamp 42, and extends longitudinally through the accumulator 4 traveling freely between upper and lower rolls 16 and 18, passes through eyeboard 10, then over the carrier roll 12 and is wound up on warp beam 6 normally driven in a forward, clockwise direction.

When warp sheet 2 is to be accumulated, the apparatus is stopped, the warp sheet 2 is clamped between pads (not shown) of clamp 42 and the warp beam 6 is driven reversibly, counterclockwise, while belt 30 is driven clockwise. The warp sheet 2 is accumulated by the lower rolls 18 being raised and the upper rolls 16 being lowered, by belt 30, so that the warp sheet 2 takes a meandering course up and down around each of the rolls in lengthening folds. The warp sheet 2 is said to be festooned, as illustrated in FIG. 2.

To withdraw or pay out the warp sheet 2 from the accumulator, the warp beam 6 is driven forwardly, clockwise, and belt 30 is driven counterclockwise. After withdrawing the warp sheet 2 from the accumulator, the sheet 2 is unclamped from clamp 42 and normal winding operation is commenced.

Generally, beam warpers and accumulators are synchronized in operation and are controlled to shutdown and startup by microswitches, solenoids, relays and other electric controllers. For example, "jog" buttons or switches are engaged to drive the warp beam at a relatively slow speed during an accumulation operation, and microswitches are used to indicate the approach to and limit positions of rolls 16 and 18. The opening and closing of clamp 42 at preselected times may be controlled by conventional circuitry.

According to the invention, pulley 34 is driven reversibly by a rotary hydraulic actuator 44, such as that sold under the trade name FLo-Tork and manufactured by Flo-Tork, Inc. Orville, Ohio. Actuator 44, operatively, rotates pulley 34 in a clockwise direction (FIG. 1) when fluid is delivered to the right cylinder 46 while fluid is evacuated from the left cylinder 48 thereof. Rotary actuator 44 is constructed to drive pulley 34, reversibly, through a selected number of degrees for raising and lowering rolls 16 and 18 a corresponding distance, and is supplied with fluid from a fluid pressure circuit 50, FIGS. 8 and 9, in turn controlled by a dancer roll assembly 52.

Referring to FIGS. 1, 3—7, and 10, the dancer roll assembly 52 is mounted at one end of the accumulator frame 14, nearest warp beam 6, and comprises a rotatable dancer roll 54 for sensing tension in a warp sheet. Dancer roll 54 is in parallel alignment with accumulator rolls 16 and 18 and is supported to rotate pivotally from an upper position out of contact of the warp sheet to a lower position contacting the warp sheet. Dancer roll 54 is supported at opposite ends thereof on opposed arms, 60 and 62, that are keyed to a shaft 64 mounted rotatably on frame 14. Dancer roll 54 is balanced to pivot downwardly from its uppermost position, FIG. 1, by a counterweight 66 mounted pivotally on an arm 68 mounted rotatably about a shaft 70. Arm 68 is connected to a sprocket 72, FIG. 7, journaled on shaft 70, and sprocket 72 is connected by a chain 74 to another sprocket 76 fixed on shaft 64. A tension gear 78, mounted on frame 14, applies tension to chain 74.

Balancing of the dancer roll 54 to provide fine tension adjustments to be applied to the warp sheet 2 is obtained by an adjustable mass 80 located slidably on a rod 82 fixed to and extending from shaft 64. A scaled measuring stick is mounted adjacent to mass 80.

Rotation of shaft 64, coincidentally with downward and upward pivotal rotation of dancer roll 54, controls the fluid pressure circuit 50 through a linked connection comprising an arm 84 fixed to shaft 64, a link 86 (preferably adjustable, as a turn buckle) pivotally connected at one end thereof to arm 84 through a link 88 and pivotally connected at its opposite end to a control arm 90 of a conventional, rotary four-way valve 92 in fluid pressure circuit 50, FIGS. 8 and 9. Accordingly, downward motion of the dancer roll 54 correspondingly rotates valve arm 90 in a clockwise direction, and upward motion of the dancer roll 54 rotates valve arm 90 in a counterclockwise direction, FIGS. 1 and 10.

The four-way rotary valve 92 is schematically illustrated in FIGS. 8 and 9. Valve 92 has a supply port 94 connected through a line 96 to a source of hydraulic fluid such as a reservoir 98; a return port 100 connected by a line 102 to reservoir 98; a port 104 connected by a line 106 to cylinder 48 of rotary actuator 44; and, a port 108 connected by a line 110 to cylinder 46 of rotary actuator 44. A pump 111, is interposed in line 96.

Viewing FIG. 9, when valve control arm 90 which is connected to a valve member 112 of valve 92, is rotated clockwise from the position shown, supply port 94 will be open to port 108 permitting fluid to flow to cylinder 46 for rotating pulley 34 clockwise causing rolls 16 and 18 to spread apart and to festoon the warp sheet 2; and, ports 100 and 104 will be open to each other to permit fluid from cylinder 48 to flow back into reservoir 98 via line 102.

If control arm 90 is rotated in a counterclockwise direction from the position shown in FIG. 9, ports 100 and 108, and ports 94 and 104 will be open to each other so that fluid flows back to reservoir 98 from cylinder 46 of actuator 44, and fluid is supplied to cylinder 48 to cause pulley 34 to rotate in a counterclockwise direction for bringing rolls 16 and 18 to their inoperative position from their spread apart operative position.

The position of valve member 112, shown in FIG. 9, corresponds to the position of dancer roll 54 shown in FIG. 10, which is the position at startup of an accumulator operation with the dancer roll 54 resting on warp sheet 2, as will be explained in more detail in the description of the operation of the apparatus, subsequently.

A pair of oppositely articulating warp sheet tension rolls, 114 and 116, act to condense or flatten a section of the warp sheet 2 extending therebetween, FIG. 10. Roll 114 is displaceable upwardly from below the warp sheet 2, and roll 116 is displaceable, cooperatively, downwardly against the warp sheet 2 from above. Dancer roll 54 normally rests on this condensed section of the warp sheet during an accumulation operation. Tension rolls 114 and 116 are rotatable and extend transversely of frame 14 in parallel alignment with rolls 16, 18 and 54.

Each tension roll, 114 and 116, is supported at its respective ends on one end of a respective lever arm, all of the latter being designated by the reference numeral 118, FIG. 3. Each arm 118 is guided and slidably supported to move reciprocably, upwardly and downwardly, by brackets 120 mounted on frame 14. Two of the guide brackets 120 are illustrated in FIG. 7 on one side of frame 14. It will be understood that each lever arm 118 is similarly guided. Each pair of arms 118 on a corresponding side of rolls 114 and 116 is connected at its lower end to a corresponding lever 122. For example, arm 118 supporting roll 114 is connected to one end of lever 122, and arm 118 supporting roll 116 is connected to the opposite end of lever 122. Levers 122 are keyed on shaft 70 intermediate their ends in offcenter relation, as best viewed in FIG. 6.

Reciprocation of tension rolls 114 and 116 is controlled by an air cylinder 124 mounted on frame 114 and connected to a suitable source of fluid under pressure. Cylinder 124 is operable to offretracted and onextended positions through a solenoid valve 125 and a switch 126. Cylinder 124 has a reciprocable actuating rod 128 that is pivotally connected to an arm 130 in turn keyed to shaft 70. Actuating rod 128 is also pivotally connected to one end of a link 132 having its opposite end pivotally connected to an arm 134 that is journaled about shaft 64, FIG. 5.

Arm 134 has a catch or dog 136 (FIGS. 3, 5, 6) that has engagement with a lug 138 mounted on one of the dancer roll arms 60 on the left side of the accumulator, FIG. 3. Dog 136 and lug 138 are positioned in the same rotational plane, and when cylinder 124 is in an "off" position shown in FIG. 5 with the actuating rod 128 retracted, 136 bears against lug 138 and holds the dancer roll 54 in its uppermost position.

Rotation of arm 134 in a clockwise direction, FIG. 5, by actuation of cylinder 124 to an "on" position to extend the actuating rod 128 (not shown) rotates dog 136 away from lug 138 and permits the dancer roll 54 to pivot in a clockwise direction, by the weight of counterweight 66 and adjustable mass 80 acting on shaft 64, and to thus swing downwardly to rest on the warp sheet 2, FIG. 10. When cylinder 124 is actuated to the "on" or extended position, in addition to controlling the dancer roll 54 as described above, simultaneously, actuating rod 128 pivots arms 130 clockwise, FIG. 5, which in turn rotates shaft 70 clockwise, thereby rotating levers 122 (keyed to shaft 70) clockwise, FIG. 7, lifting tension roll 114 and lowering tension roll 116 to apply opposed, equal forces to and condensing warp sheet 2 normally passing therebetween as by bringing the warp yarn ends together to form a horizontally flat sheet. It will be noted that sprocket 72 is journaled on shaft 70 and does not rotate therewith.

A pair of opposed adjustable stops in the form of bolts 140 are provided on frame 14, FIG. 4, to limit the downward swing of dancer roll 54. The stops are aligned in the plane of arms 60.

In operation, assume that a warp sheet 2 is being taken up on driven warp beam 6, and that the components of the apparatus are in relative positions as viewed in FIG. 1: The warp ends pass in continuous travel through eyeboard 8 and clamp 42, between rolls 16 and 18 and through eyeboard 10, over carrier roll 12 and around beam 6. Assume that a defect is detected, that operation is aborted by bringing beam 6 to a stop, and that warp beam 6 must be reversed to unwind a desired length of warp sheet 2 from the warp beam 6 into the accumulator to make an inspection and to take what remedial steps that are required.

Accordingly, an accumulation operation is initiated by clamping the warp sheet 2 within clamp 42 and actuating switch **126** of the double-acting cylinder **124** to an "on" position causing rod **128** to extend outwardly therefrom. By the linkage attached to rod **128**, shaft **70** is rotated clockwise, FIG. **6**, thereby rocking lever **122** clockwise causing reciprocation of tension roll **114** upwardly and tension roll **116** downwardly to a point where roll **114** applies a slight upward force against warp sheet **2**, and roll **116** applies an equal force downwardly against the warp sheet **2**, FIG. **10**. Simultaneously with the reciprocation of rolls **114** and **116**, actuating rod **128** through linkage described above causes dog **136**, FIG. **10**, to rotate clockwise, relieving the force applied to lug **138** and thus permitting the dancer roll **54** assembly to be biased downwardly into engagement with the warp sheet **2**. Dancer roll **54** is adjusted to apply a preselected tension on the warp sheet **2** by proper selection of the counterbalance **66** and by adjustment of mass **80** on rod **82**.

Prior to initiating the accumulator operation, valve arm **90** will be in the position shown in FIG. **1**, so that cylinder **48** of actuator **44** is charged with fluid and, through the pulley **34** and belt **30** arrangement, supports rolls **18** and **20** in their inoperative positions shown. However, in operation, as dancer roll **54** moves downwardly toward warp sheet **2**, valve arm **90** is rotated clockwise, FIG. **1**, until valve member **112** is rotated to the position shown in FIG. **9** which corresponds to the position of dancer roll **54** in FIG. **10**.

The warp beam **6** is now driven reversibly or counterclockwise, FIG. **1**, to feed the warp sheet **2** to the accumulator. According to practice, the warp beam is driven or "jogged" at a slow speed. With the tension on the warp sheet **2** being relieved when the warp beam **6** is reversibly "jogged," dancer roll **54** will take up the slack by its weight and will drop downwardly to a lower position from that shown in FIG. **10**. Downward movement of the dancer roll **54** rotates shaft **64** clockwise, and through the linkage **84**, **86**, and **88** rotates valve arm **90** a small increment clockwise which responsively carries valve member **112** clockwise opening port **94** to port **108** and charging cylinder **46** with fluid; and, opening port **100** and **104** to feed fluid back to reservoir **98** from cylinder **48** of actuator **44**. Charging of fluid to cylinder **46** effects rotation of pulley **34** clockwise in turn rotating belt **30** clockwise, whereby rolls **18** move upwardly and rolls **16** reciprocate downwardly to engage from opposite sides and to commence festooning the warp sheet **2**, as in FIG. **2**.

Valve **92** is, preferably, selected to be sensitive to small movement of valve member **112** to provide incremental degrees of change in the port openings and to thus provide corresponding changes in fluid volume flow to control the rate of separation of the rolls **16** and **18** according to changes in tension sensed by dancer roll **54**. When in an operational position, dancer roll **54** is not restrained by dog **136** but has an unrestricted ranged of pivotal displacement to sense tension fluctuations.

Thus, assuming a decrease in tension in the warp sheet **2** while festooning the latter, dancer roll **54** will drop to a lower position and more fluid will be supplied to cylinder **46** thereby effecting a faster rate of takeup of the warp sheet **2**; while an increase in warp sheet **2** tension will lift dancer roll **54** and effect a reduction in fluid flow to cylinder **46** and produce a slower rate of festooning of the warp sheet **2**.

In conventional manner not shown, an electrical circuit is generally provided to indicate to an operator that rolls **16** and **18** are approaching their festoon limit positions and that the warp beam drive should be stopped. It will be understood that an operator may halt the festooning operation at any time between the full accumulator takeup capacity.

When the warp beam drive is stopped, tension in the warp sheet **2** increases sufficiently to cause the dancer roll **54** to return to its position shown in FIG. **10** at which time valve member **112** will be rotated to the position shown in FIG. **9**, whereby fluid flow will be cut off to cylinders **46** and **48** and rolls **16** and **18** will remain in the position they were in when warp beam **6** was stopped. To assure that fluid flow is cut off to the actuator, a cutoff switch (not shown) may be provided for pump **111**. The cutoff switch may be manually operated or may be connected to operate in an integrated circuit with warp beam **6** in a conventional network.

Generally, the festooned warp sheet is inspected at this time and any required remedial measures taken.

To withdraw the warp sheet **2** from the accumulator **4**, the warp beam **6** is driven "joggingly" in a forward or clockwise direction. Winding of the warp sheet **2** onto the warp beam **6** increases the warp sheet tension and causes the dancer roll **54** to be raised or to rotate counterclockwise so that valve member **112** is accordingly rotated in a counterclockwise direction from the position shown in FIG. **9**. In this case, port **108** is open to port **100** permitting fluid to feed back to reservoir **98** from cylinder **46**; and, port **104** is open to supply port **94** so that fluid is pumped to cylinder **48**. Under these circumstances, pulley **34** and belt **30** are rotated in a counterclockwise direction, whereby rolls **16** rise toward their normal inoperative position while rolls **18** are lowered to their corresponding inoperative position. Meanwhile, warp sheet **2** is payed out or withdrawn from the accumulator **4**.

When rolls **16** and **18** reach positions where the warp sheet is in a substantially "flat" horizontal sheet nearing the end of the festooning operation, once again, the warp beam **6** is stopped and correspondingly the accumulator rolls **16** and **18** come to a stop.

The double-acting cylinder switch **126** is then moved to an "off" position to effect a retraction of rod **128**. In retracting, rod **128** rotates lever **130** and shaft **70** counterclockwise, FIG. **6**, whereby levers **122** are rotated counterclockwise so that tension roll **116** is reciprocated upwardly and tension roll **114** downwardly by arms **118** to their inoperative positions out of contact of warp sheet **2**; while arm **134** is simultaneously rocked in a counterclockwise direction bringing dog or latch **136** into contact with lug **138** thereby lifting dancer roll **54** to its uppermost inoperative position out of contact of warp sheet **2**. When the dancer roll **54** is lifted, valve member **112** is rotated counterclockwise so that cylinder **48** is charge with fluid and cylinder **46** discharges fluid into reservoir **98**. Accordingly, rolls **16** and **18** are reciprocated to their inoperative positions, FIG. **1**.

Clamp **42** is then disengaged to release its hold on the warp sheet **2**, and the beam winding operation is commenced by driving the warp beam **6** in a clockwise takeup direction.

I claim:

1. A continuous material and textile warp sheet accumulator comprising;

first means for festooning a warp sheet;

second means for sensing tension variations in the warp sheet; and

third fluid pressure means, connected to said first and second means, for controlling said first means to festoon the warp sheet at differential rates responsively to tension variation variations sensed by said second means.

2. A textile warp sheet accumulator as in claim **1**, in which said second means includes engaging and disengaging members for controlling the operative and inoperative positions of said second means.

3. A textile warp sheet accumulator as in claim **1**, in which said second means includes a dancer roll assembly for sensing warp sheet tension variations, and a tension roll assembly for tensioning a section of the warp sheet engaged by said dancer roll assembly.

4. A textile warp sheet accumulator as in claim **3**, in which said tension roll assembly is controlled by a fluid pressure actuator.

5. A textile warp sheet accumulator as in claim **1**, in which said first means comprises sets of oppositely reciprocable rolls; said second means has a pivotal dancer roll normally resting on the warp sheet; said third means includes a valve operatively connected to said second means and open to a source of fluid supply and a fluid return, a pump, a fluid pressure actuator operatively connected to said reciprocable rolls and to said valve; wherein, upon pivotal movement of said dancer roll in one direction responsively to an increase in tension in the warp sheet said valve is positioned for actuating said fluid pressure actuator to reciprocate said reciprocable rolls to take up the warp sheet at a slower rate, and upon pivotal movement of said dancer roll in a second opposite direction responsively to a decrease in tension in the warp sheet said valve is positioned for actuating said fluid pressure actuator to reciprocate said reciprocable rolls to take up the warp sheet at a faster rate.