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Bassing et al.

[11] **3,893,489**

[45] **July 8, 1975**

[54] **APPARATUS FOR REGULATING THE TENSION OF WARP THREADS IN POWER LOOMS**

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[52] **U.S. Cl.** **139/110**; 242/75.53

[51] **Int. Cl.²** **D03D 49/06**; D03D 49/10

[58] **Field of Search** ..... 139/110, 109, 97, 99, 114, 139/115; 242/75.5, 75.53; 66/86 A

[56] **References Cited**

UNITED STATES PATENTS

2,565,386	8/1951	Marcy	139/110
2,597,136	5/1952	Snyder	139/110 X
2,753,128	7/1956	Thomas et al.	139/110 X
2,988,297	6/1961	Pawlowski	242/75.53
3,083,602	4/1963	Obenshain	242/75.53 X
3,261,375	7/1966	Berry	139/110
3,706,328	12/1972	Dostal	139/110

FOREIGN PATENTS OR APPLICATIONS

462,063	10/1968	Switzerland	139/110
371,406	9/1963	Switzerland	139/110
1,099,725	1/1968	United Kingdom	139/110

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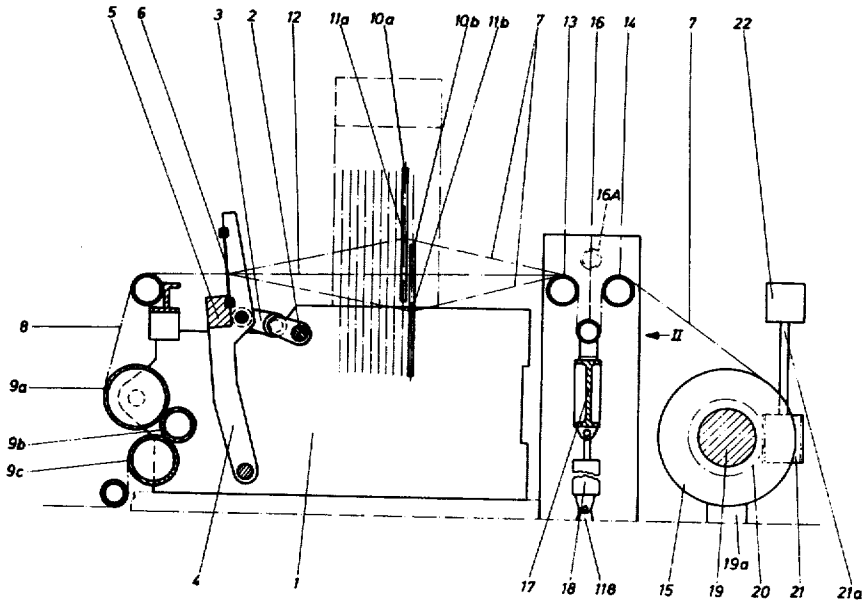
[57] **ABSTRACT**

A power loom wherein a dancer roll is urged against warp threads between the warp beam and the weaving station. The dancer roll engages the upper sides of the warp threads in a space between two cylindrical guides which engage the undersides of the warp threads. The dancer roll is urged against the warp threads with a constant force by two double-acting hydraulic cylinders whose upper chambers receive a pressurized hydraulic fluid from a pump through a conduit which contains an adjustable pressure regulating valve, a pressure accumulator and a check valve. A further valve is provided to connect the upper chambers with the tank while connecting the lower chambers of the cylinders to the pump so that the dancer roll rises above the guides to permit for convenient introduction of warp threads into the loom. The position of the dancer roll is monitored by a fluid flow regulating device which can adjust a variable-delivery pump for a variable-speed hydraulic motor which rotates the warp beam in a direction to pay out warp threads.

10 Claims, 4 Drawing Figures



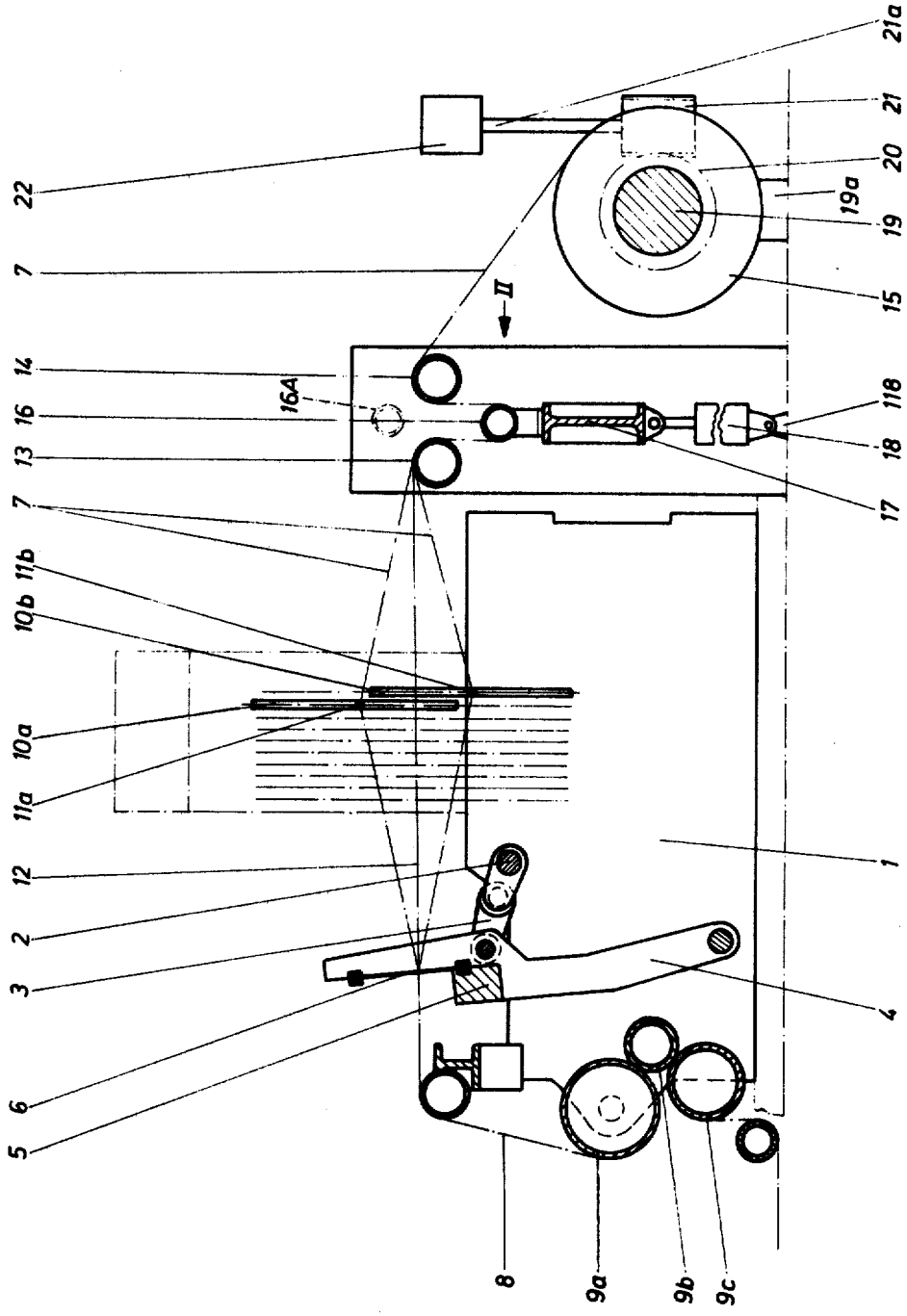

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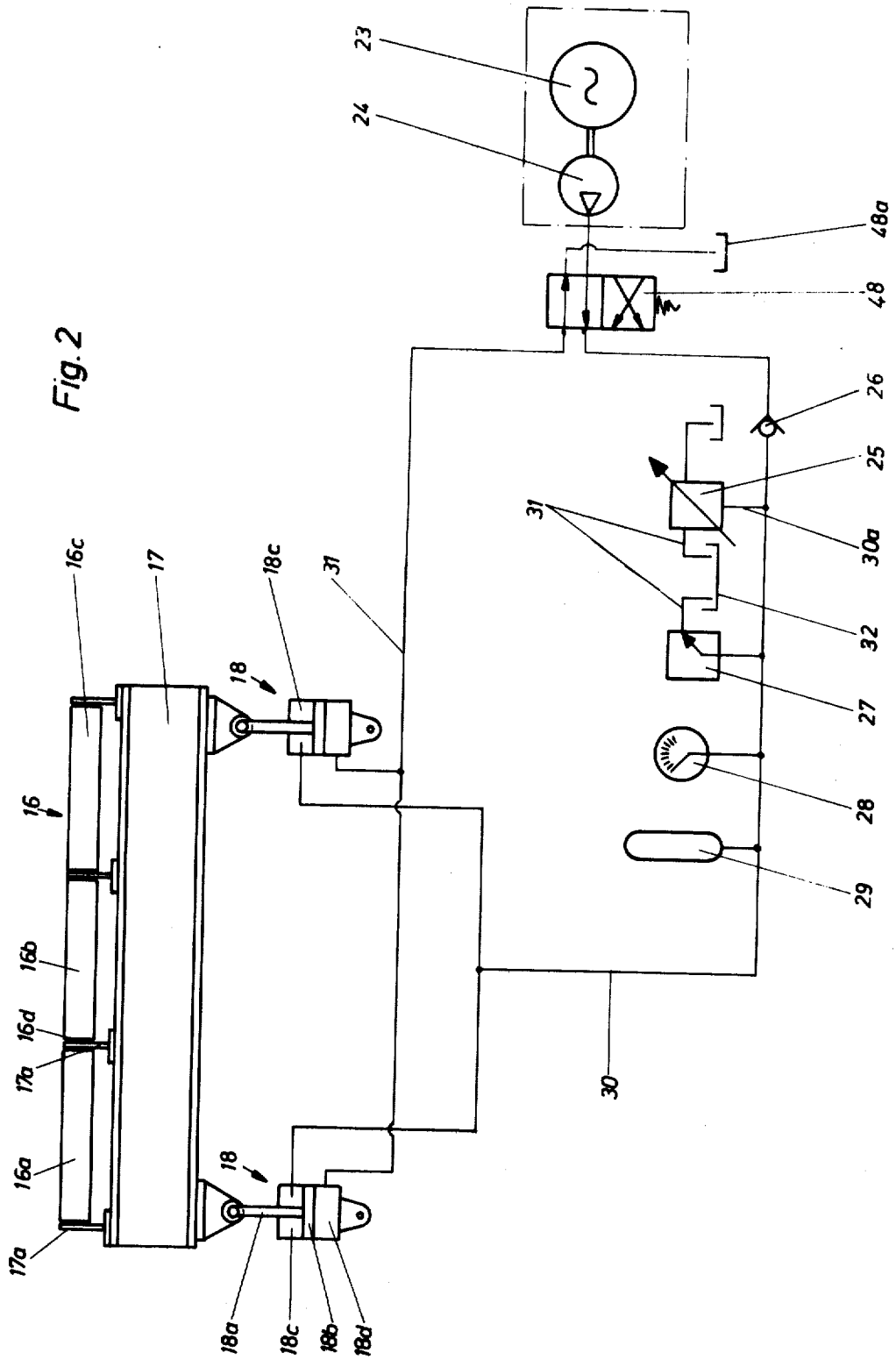
Fig. 1

Fig. 2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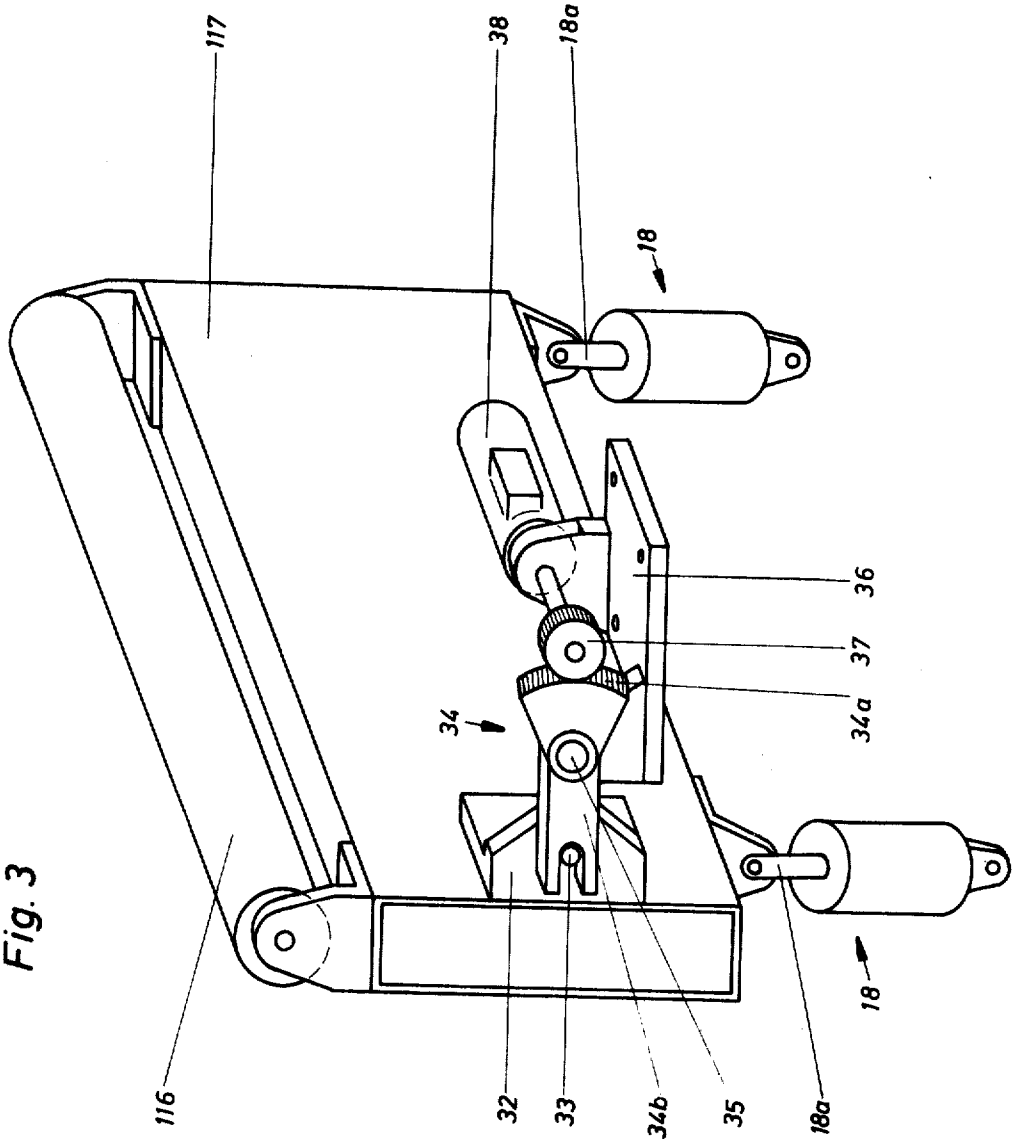

Fig. 3

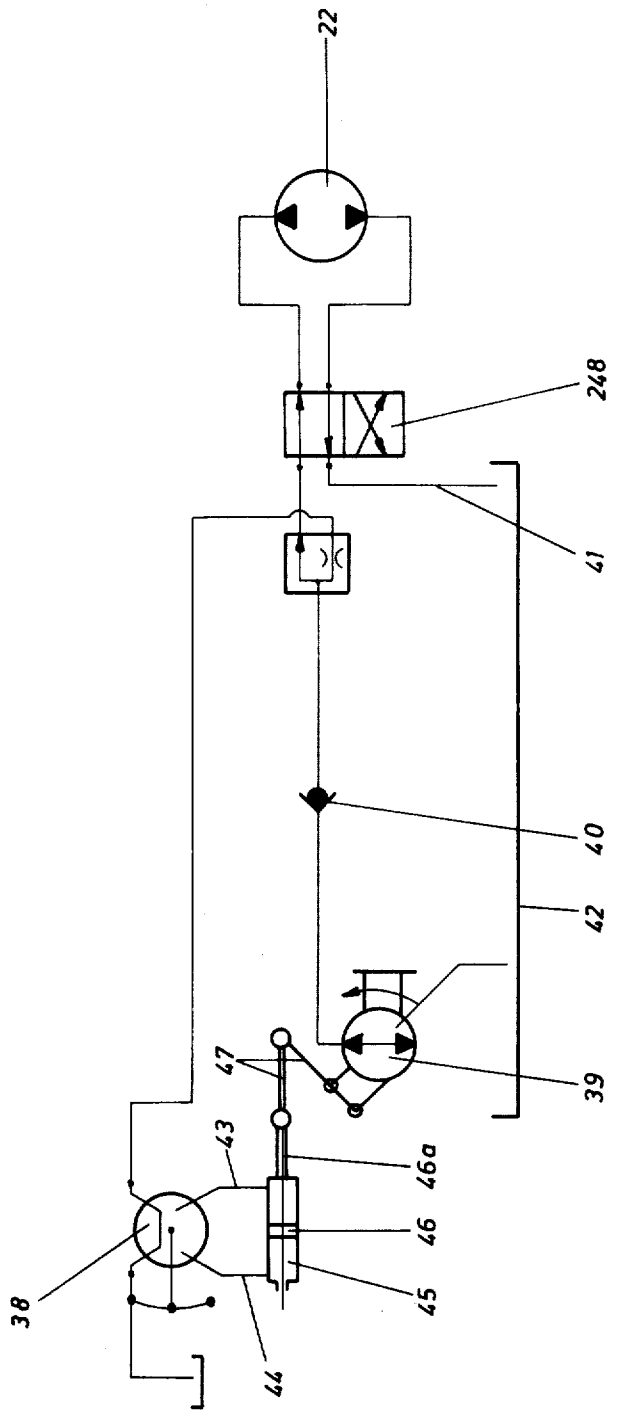

Fig. 4

APPARATUS FOR REGULATING THE TENSION OF WARP THREADS IN POWER LOOMS

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for regulating the tension of warp threads in power looms.

German Pat. No. 1,535,332 discloses an apparatus which monitors the tension of warp threads in a loom between the warp beam and the lease rods. The apparatus employs a dancer roll which is biased against the warp threads by springs and is mounted on a movable supporting rod which cooperates with a detector. The rate at which the warp beam pays out the warp threads is determined by the detector in dependency on the position of the dancer roll. A drawback of the patented apparatus is that each change in the position of the dancer roll entails a change in the bias of springs and hence an automatic change in the tension of warp threads. Also, the regulation of tension is of the follow-up type, i.e., the speed at which the warp beam pays out the warp threads is changed only after the tension of warp threads has already been changed so that the actual tension deviates from a desirable optimum tension. Furthermore, the patented apparatus is capable of monitoring the tension of some but not all of the warp threads in a power loom.

In the making of certain fabrics, such as fourdrinier wire for use in paper making machines, the setting of filling and warp threads is of utmost importance. Even minor deviations from an optimum density of filling and/or warp threads can adversely affect the quality of such product in contrast to many other types of fabrics wherein the exact setting of threads is of no particular importance. In order to insure a satisfactory setting of filling threads, the warp threads and the growing fabric must be moved through a predetermined distance upon completion of each working cycle to thus insure that the tension of the warp threads as well as the tension of the fabric remains unchanged and matches an optimum tension.

SUMMARY OF THE INVENTION

An object of the invention is to provide a novel and improved apparatus for regulating the tension of warp threads in a loom in such a way that the tension of all warp threads remains constant and is not dependent on the regulation of withdrawal of warp threads from the warp beam or beams.

Another object of the invention is to provide the apparatus with simple and inexpensive but reliable means for tensioning all of the warp threads between the warp beam or beams and the station where the warp threads are interwoven with filling threads.

An additional object of the invention is to provide novel and improved means for monitoring the position of the device which biases the warp threads with a constant force irrespective of the rate of withdrawal of warp threads from the warp beam or beams.

A further object of the invention is to provide novel and improved means for changing the speed of angular movement of one or more warp beams in response to changes in the position of the warp biasing and tensioning device.

The invention is embodied in a power loom which comprises at least one rotary warp beam, variable-speed prime mover means (e.g., a hydraulic motor) which can rotate the warp beam in a direction to pay

out warp threads (the connection between the prime mover means and the shaft of the warp beam may comprise a worm drive), means for collecting the fabric which is being formed by interweaving the warp threads with filling threads at a weaving station, a pair of spaced apart guides which engage the undersides of warp threads between the warp beam and the weaving station, a displaceable biasing element (preferably a dancer roll) which engages the upper sides of warp threads between the two guides, means for adjusting the speed of the prime mover means in response to displacement of the biasing element (such displacement normally indicates that the warp threads are not being paid out at the exact rate at which the fabric is being formed), and tensioning means for urging the biasing element against the warp threads with a predetermined but variable constant force so that the tension of warp threads remains unchanged irrespective of displacements of the biasing element. The tensioning means comprises one or more fluid-operated displacing devices (preferably double-acting hydraulic or pneumatic cylinders) which are operatively connected with the biasing element and means for supplying to the displacing devices a pressurized hydraulic or pneumatic fluid at a constant pressure. Such means for supplying pressurized fluid may include a pump which supplies a stream of pressurized fluid, conduit means connecting the pump with a chamber of each displacing device whereby the fluid in such chamber causes the cylinder or the piston of the respective displacing device to urge the biasing element against the warp threads, and a preferably adjustable pressure regulator in the conduit means.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a schematic sectional view of a power loom which embodies the improved apparatus for regulating the tension of warp threads;

FIG. **2** is a view as seen in the direction of arrow II in FIG. **1**, further showing the details of the means for applying a constant force to the element which biases the warp threads;

FIG. **3** is a perspective view of a monitoring unit for the position of the biasing device; and

FIG. **4** is a diagram showing the operative connection between the monitoring unit and the prime mover means for the warp beam.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** shows a portion of a power loom whose frame or housing includes an upright wall **1** which supports a rotary crankshaft **2** for an arm **3** which reciprocates a sword **4** for a sley **5** and a reed **6** through which pass the warp threads **7**. The woven fabric **8** is pulled by three collecting beams **9***a*, **9***b*, **9***c* which are controlled by a suitable regulator (not shown) so that the fabric is shifted through identical distances. A dobby machine (not shown) moves the shafts **10***a*, **10***b* with heddles

11*a*, 11*b* having eyes for warp threads 7 to form the shed 12 through which the filling thread is passed by means of a shuttle (not shown). The parts 10*a*, 10*b*, 11*a*, 11*b* are located at a weaving station.

At the rear side of the wall 1, there are provided two cylindrical supporting elements or guides 13, 14 for warp threads 7 which are supplied by a warp beam 15 having a shaft 19 journalled in bearings 19*a* and provided with a worm wheel 20 mating with a worm 21. The worm 21 is mounted on a worm shaft 21*a* which is driven by a variable-speed prime mover here shown as a hydraulic motor 22.

The warp threads 7 which are trained over the two spaced-apart cylindrical supporting elements or guides 13, 14 are further engaged by a biasing element here shown as a dancer roll 16 which is carried by (i.e., rests on) the threads 7 and bears against the warp threads due to its own weight as well as due to the force applied by a motion transmitting member 17 between the shaft of the dancer roll 16 and the piston rods 18*a* of two hydraulic displacing cylinders 18 mounted in the frame of the loom. The diameter of the dancer roll 16 almost equals or is only slightly less than the distance between the cylindrical guides 13, 14. The guides engage the undersides and the dancer roll engages the upper sides of the threads 7.

As shown in FIG. 2, the cylinders 18 are of the double-acting type and their piston rods 18*a* are articulately connected to the motion transmitting member 17. The lower ends of the cylinders 18 are connected to a stationary support 118 of the frame. The pistons 18*b* separate the internal spaces of the respective cylinders 18 into upper and lower chambers 18*c*, 18*d* which are respectively connected with conduits 30 and 31. The conduits 30, 31 are connected with a fluid flow regulating valve 48 having an inlet port connected to the pressure outlet of a hydraulic pump 24 driven by an electric motor 23. An outlet port of the valve 48 is connected to a tank 48*a* for the pump 24. The parts 23, 24 together constitute a source of pressurized hydraulic fluid.

The conduit 30 contains a check valve 26 which prevents hydraulic fluid from flowing from the upper cylinder chambers 18*c* into the tank 48*a*, an adjustable pressure regulator valve 25 which is mounted in a branch line 30*a*, a pressure accumulator 29 serving as a pressure fluid reservoir, a pressure gauge 28 and a safety valve 27 for the accumulator 29.

The pressurized hydraulic fluid which is supplied by the pump 24 and flows through the regulating valve 48 and check valve 26 tends to urge the pistons 18*b* downwardly, as viewed in FIG. 2, with a constant force independently of the position of the dancer roll 16 so that the latter subjects the warp threads 7 to a constant tension of unvarying magnitude. As shown in FIG. 2, the dancer roll 16 may comprise several coaxial cylindrical sections 16*a*, 16*b*, 16*c* mounted on a common shaft 16*d* which is journalled in bearing brackets 17*a* of the motion transmitting member 17. The number of sections of the dancer roll 16 depends on the width of the power loom.

By changing the position of the valve member in the regulating valve 48, one can admit pressurized fluid into the conduit 31 so that such pressurized fluid flows into the lower chambers 18*d* of the displacing cylinders 18 to thereby move the dancer roll 16 upwardly, for example, to the position 16A shown in FIG. 1 by phantom lines. This allows for convenient threading of warp threads 7 through the loom. The strokes of the pistons 18*b* are selected with a view to insure that the dancer roll 16 can be displaced from a level below to a level above the guides 13, 14, and the uppermost position 16A of the dancer roll 16 is such that the dancer roll does not interfere with the introduction of warp threads 7 through the space between the guides 13, 14 and the dancer roll. When the chambers 18*c* are connected with the pump 24, the piston rods 18*a* pull the dancer roll 16 against the upper sides of the warp threads 7.

FIG. 3 illustrates a presently preferred embodiment of means for monitoring the position of a relatively short (single-section) dancer roll 116 which is mounted on a slightly modified motion transmitting member 117 and is urged against the warp threads (not shown) by the two double-acting hydraulic displacing cylinders 18 substantially in the same way as illustrated in FIG. 2. The member 117 has a laterally extending bracket or holder 32 for a pin 33 which is received in the bifurcated arm 34*b* of a two-armed lever 34. The latter is fulcrumed at 35 on a bracket 36 in the frame of the loom. The other arm 34*a* of the lever 34 constitutes or includes a gear segment in mesh with a spur gear 37 on the shaft of a fluid flow regulating device 38.

FIG. 4 shows the connection between the regulating device 38 and the variable-speed hydraulic motor 22 for the warp beam 15. A variable-delivery hydraulic pump 39 is provided to supply a predetermined quantity of pressurized fluid to the hydraulic motor 22 through a check valve 40 when the loom is in use. The motor 22 supplies a stream of fluid to a conduit 41 which discharges into a tank 42. The flow of fluid to and from the motor 22 is controlled by a valve 248. The flow regulating device 38 is connected with a double-acting adjusting cylinder 45 by conduits 43, 44. The piston 46 of the cylinder 45 is connected with a piston rod 46*a* which can regulate the delivery of the pump 39 by means of a linkage 47.

The exact details of the regulating device 38 and variable-delivery pump 39 form no part of the invention. Such components are of the commercially available type.

When the loom is in use, the collecting beams 9*a*, 9*b*, 9*c* draw the fabric 8 through distances corresponding to the density of the setting of the filling while the motor 22 rotates the worm shaft 21*a* to unwind predetermined unit lengths of warp threads 7 from the beam 15. If the motor 22 reduces the unit lengths of warp threads 7, i.e., to less than is necessary in view of the length of fabric which is being produced on introduction of a filling thread, the dancer roll 16 rises toward the supporting elements or guides 13, 14 whereby the motion transmitting member 17 pivots the lever 34 clockwise, as viewed in FIG. 3, and the gear segment 34*a* changes the angular position of the shaft of the regulating device 38. The latter changes the position of the piston 46 in the adjusting cylinder 45 so that the linkage 47 adjusts the variable-delivery pump 39. The pump 39 changes the rotational speed of the motor 22 so that the latter causes the beam 15 to discharge warp threads 7 at a higher rate and the dancer roll 16 descends back toward its normal position.

If the rate at which the motor 22 allows the beam 15 to pay out warp threads 7 increases beyond that which is needed in view of the rate of fabric growth, the dancer roll 16 descends and the member 17 pivots the

lever 34 in a counterclockwise direction, as viewed in FIG. 3, so that the regulating device 38 causes the cylinder 45 to adjust the pump 39 in order to reduce the rotational speed of the motor 22. This causes the dancer roll 16 to rise back toward its normal position. By appropriate design of the linkage 47, one can select in advance the average delivery of the pump 39 as well as the extent of changes in the rate of delivery when the position of the piston 46 in the cylinder 45 changes to a given extent.

The apparatus of the present invention allows the dancer roll 16 to change its position from (i.e., to float up and down beyond) a neutral or normal position within a relatively long interval of time. However, the tensioning of warp threads 7 remains unchanged because the roll 16 is biased against the upper sides of such threads with a constant force. When the loom is started, the motor 23 begins to drive the pump 24 so that the valve 48 supplies pressurized fluid to the conduit 30 via check valve 26 whereby such fluid enters the upper chambers 18*c* of the displacing cylinders 18. The fluid pressure in the chambers 18*c* is determined by the setting of the adjustable pressure regulating valve 25 so as to insure that the piston rods 18*a* pull the dancer roll 16 downwardly and the dancer roll 16 biases the warp threads 7 with a selected force. When the pressure of fluid in the chambers 18*c* reaches the selected value, the pressure regulating valve 25 opens and discharges additionally supplied fluid into the tank 82 via conduit means 31. The valve 25 closes as soon as the fluid pressure in the chambers 18*c* drops below the preselected value and the fluid delivered by the pump 24 then flows into the chambers 18*c* to restore the preselected bias upon the warp threads 7.

An important advantage of the improved tensioning apparatus is that the bias of the dancer roll 16 upon the warp threads 7 remains constant even if the roll 16 moves up or down and independently of the speed of the motor 22 for the warp beam 15. The bias of the dancer roll 16 is determined exclusively by the setting of the adjustable valve 25 in the conduit 30 which normally supplies pressurized fluid to the cylinder chambers 18*c*. Since the distance between the guides 13, 14 equals or approximates the diameter of the dancer roll 16, the stretches 7*a*, 7*b* of the warp threads 7 are substantially parallel to each other. This also contributes to the fact that the displacements of dancer roll 16 do not alter the tension of warp threads.

The improved apparatus is susceptible of many additional modifications. For example, the hydraulic means for urging the dancer roll 16 or an analogous biasing element against the warp threads 7 can be replaced by a pneumatic system without departing from the spirit of the invention. Moreover, the monitoring means of FIG. 3 can be replaced by a pneumatically, electrically, magnetically or otherwise operated detector system for the position of the dancer roll 16 or an analogous biasing element for the warp threads 7. Still further, the adjusting means 39, 45, 46, 46*a*, 47 for the variable-speed motor 22 can be replaced by pneumatic, electric, electromagnetic or other speed regulating means.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of our contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In a power loom, a combination comprising a frame; at least one rotary warp beam; a variable-speed hydraulic motor for rotating said warp beam in a direction to pay out warp threads; means for collecting the fabric obtained by interweaving said warp threads with filling threads at a weaving station; and an arrangement for regulating the let-off of the warp threads with constant warp thread tension, said arrangement comprising:

a. a pair of spaced-apart guides located between said warp beam and said weaving station and arranged to engate one side of each warp thread,

b. a displaceable dancer roll resting in a bight of the warp threads between said guides and engaging the other side of each warp thread,

c. a support member rotatably supporting said dancer roll,

d. hydraulic cylinders connecting said support member to said frame and each having a piston reciprocably therein and defining at least one pressure chamber,

e. conduit means connecting each pressure chamber to a source of pressurized hydraulic fluid for urging said dancer roll against the warp threads,

f. an adjustable constant pressure regulating valve connected to said conduit means for maintaining a constant pressure in said pressure chambers irrespective of the position of said dancer roll, and

g. regulating means continuously actuated by said support member for adjusting the flow of pressurized hydraulic fluid to said hydraulic motor in response to displacement of said dancer roll.

2. A combination as defined in claim **1**, wherein said dancer roll comprises a plurality of coaxial cylindrical sections.

3. A combination as defined in claim **1**, wherein the diameter of said dancer roll equals or is slightly less than the distance between said guides.

4. A combination as defined in claim **1**, and further comprising a variable-delivery hydraulic pump connected to said hydraulic motor, said regulating means being operatively connected with said support member and said hydraulic pump for chaning the delivery rate of said pump in response to displacement of said support member.

5. A combination as defined in claim **1**, wherein said source of pressure fluid comprises a second hydraulic pump, said conduit means connecting said pressure chambers to said second hydraulic pump, and a pressure accumulator connected to said conduit means between said pressure chambers and said second hydraulic pump.

6. A combination as defined in claim **5**, further comprising a check valve in said conduit means between said second hydraulic pump and said constant pressure regulating valve to prevent pressurized hydraulic fluid from flowing towards said second hydraulic pump.

7. A combination as defined in claim **5**, wherein said hydraulic cylinders are double-acting cylinders and each comprising a first and and a pressure chamber separated by said piston, and including a hydraulic tank, said conduit means comprising a first conduit

connected with said first chambers and a second conduit connected with said second chambers, and including a reversing valve connected to said conduits and movable between two positions in one of which it connects said first chambers to said second hydraulic pump and said second chambers to said tank and in the other of which it connects said first chambers to said tank and said second chambers to said second hydraulic pump.

8. A combination as defined in claim **1**, wherein said hydraulic cylinders are connected to said frame and said pistons are provided with piston rods articulatedly connected to said support member.

9. A combination as defined in claim **1**, wherein said hydraulic cylinders pull said dancer roll downwardly against the upper side of the warp threads.

10. A combination as defined in claim **7**, wherein said dancer roll is normally located at a level below said guides and said hydraulic cylinders are adapted to move said dancer roll to a level above said guides by operating said reversing valve to connect said second pressure chambers to said hydraulic pump and said first pressure chambers to said hydraulic tank.

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