

Jan. 28, 1941.

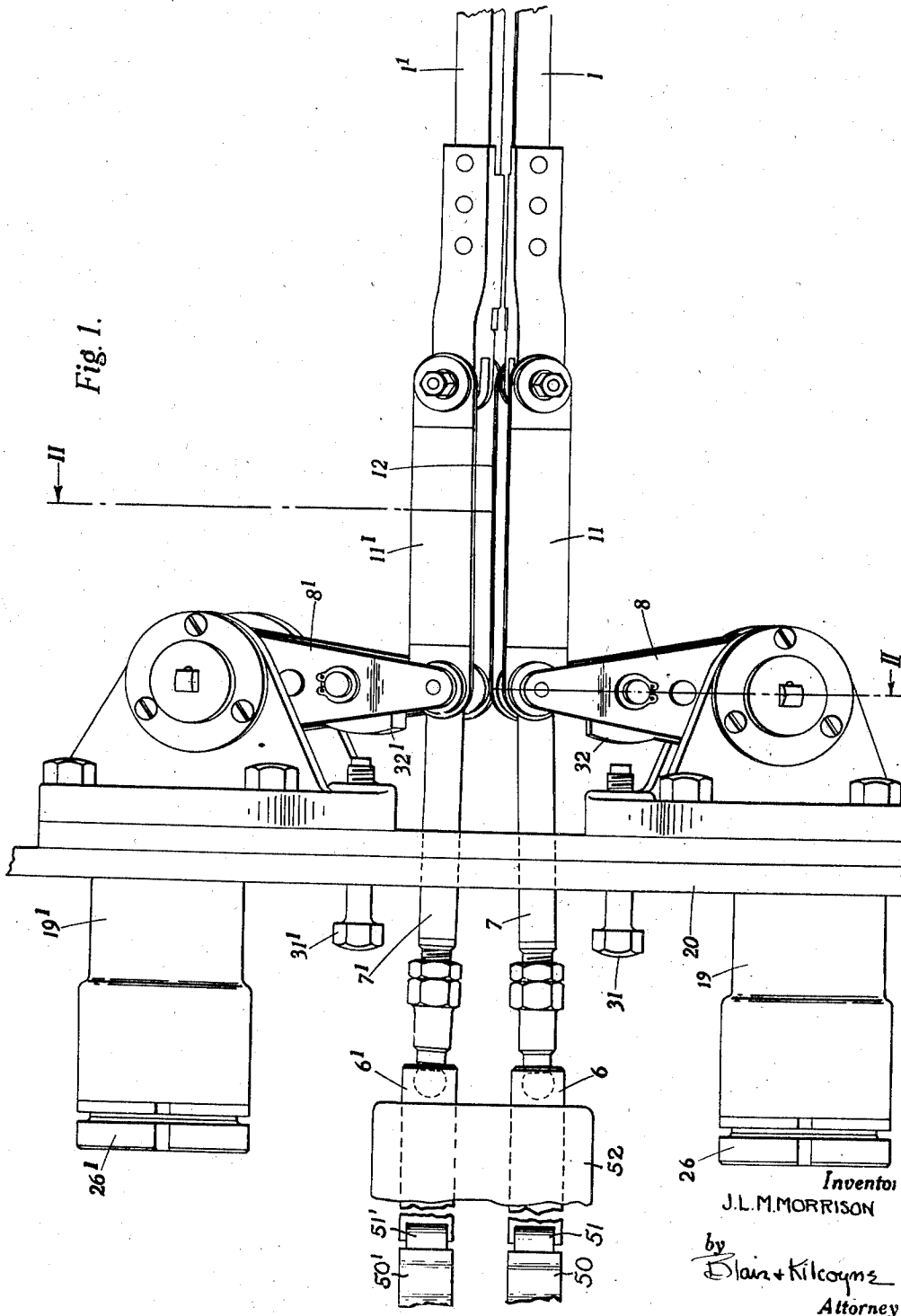
J. L. M. MORRISON

2,229,928

WARP KNITTING MACHINE

Filed Dec. 19, 1939

3 Sheets-Sheet 1



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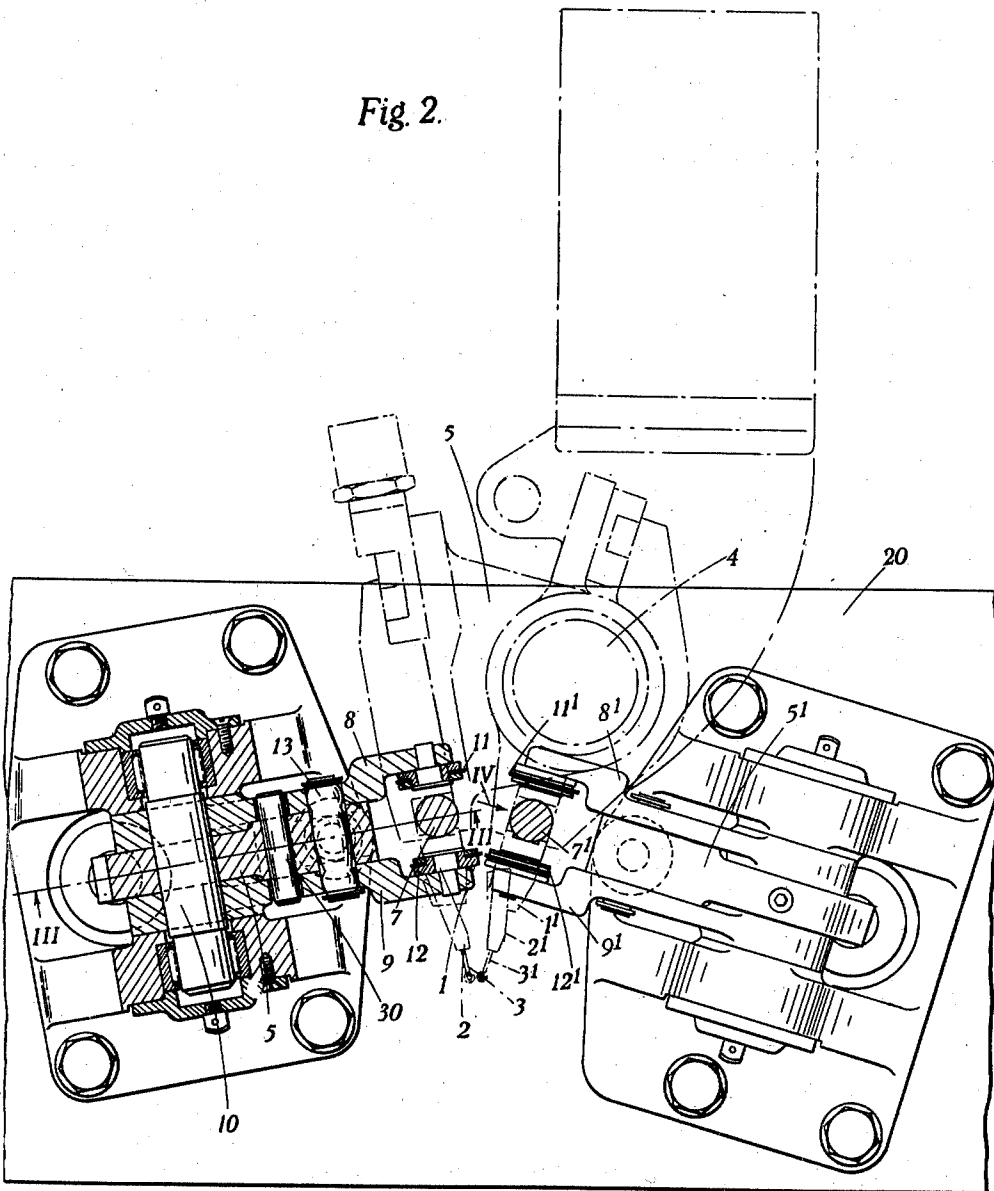
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Fig. 2.



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Fig. 3.

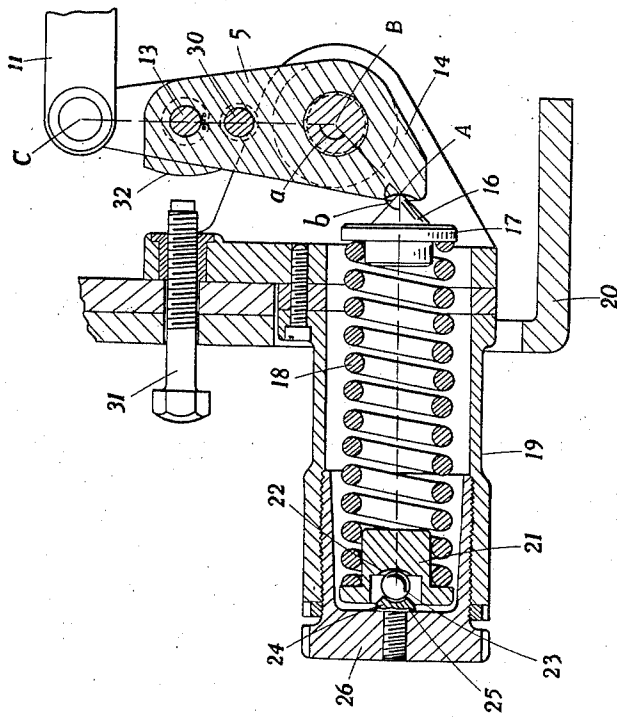
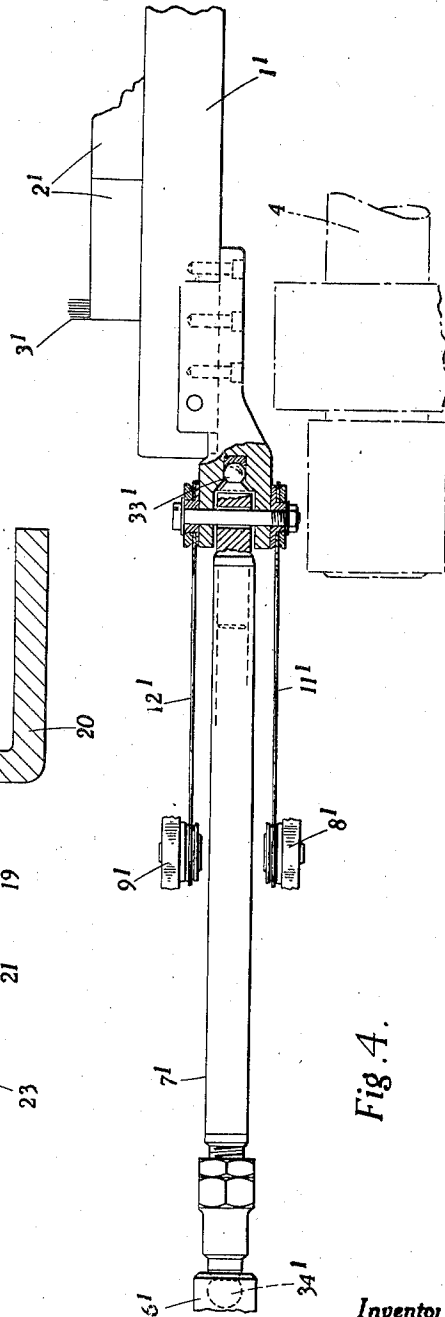


Fig. 4.



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UNITED STATES PATENT OFFICE

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WARP KNITTING MACHINE

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11 Claims. (Cl. 66—86)

This invention relates to warp knitting machines. In such machines there are warp guide bars which are moved to and fro longitudinally and also rocked about a parallel axis to enable the warp guides, carried by the bars, to position threads on the knitting needles. The longitudinal or lapping movements of a guide bar are caused in one direction by a pattern cam and in the other direction by a spring to the extent permitted by the cam. The invention is concerned with the spring and associated mechanism for loading the guide bar on the pattern cam.

In the knitting of relatively simple fabrics the total lengthwise movement of the guide bar is, in general, not more than a few times the pitch of the needles. When a more complicated pattern is required, though the lapping movement in any one knitting cycle is of this order of magnitude, the cumulative distance moved in a number of cycles may be much greater. However, the local action is substantially the same in each knitting cycle, whatever the distance of the guide bar from a mean position. Therefore, the force exerted by the spring should, to a first approximation, remain constant in all positions, because the minimum value of the force is determined principally by the acceleration it must give to the bar and also to a small extent by the force necessary to overcome frictional resistance to motion and the longitudinal component of the force due to the warp tension, and the maximum value should be as near the minimum value as possible to avoid excessive stresses and wear.

Further, it is desirable, to a closer approximation, for the spring force to have its greatest value when the guide bar is at or near its mean position, because it is in the vicinity of this position that relatively simple fabrics are usually knitted. For reasons associated with the design of the other parts of the machine, it is possible to knit such simple fabrics at speeds which entail greater accelerations of the guide bar than in the case of fabrics of more complicated pattern which necessitate a greater total displacement of the guide bar.

It will, therefore, be seen that the ideal spring mechanism should provide a force which is, to a first approximation, constant over the whole range of travel of the guide bar but which to a closer approximation attains a greater value at or near the mean position of the guide bar than when displaced towards the extreme limits of travel. Hitherto the spring mechanism has been designed with a view to attaining as nearly as possible the first of these conditions, the spring

having a low rate in order to keep the force as nearly constant as possible. However, the force has a minimum value at one end of the longitudinal line of travel of the guide bar, and a maximum value, which differs appreciably from its minimum value, at the other end. Such a spring has low natural frequencies of surging, and if the machine runs at such a speed that a vibration in resonance with any one of the natural frequencies of surging occurs in the supports, the spring surges to an extent which is not readily calculable and the force actually applied to the guide bar may differ greatly from that which would be applied when the spring was not surging. Then the guide bar may no longer be positioned by the cam and serious damage to the knitting machine may result.

From the foregoing it will be appreciated that the spring mechanism for loading the guide bar should have a spring with no natural frequency of surging as small as any appreciable vibration which may be imparted to it, and the mechanism should apply to the guide bar a force which does not vary greatly with the position of the guide bar, and which reaches a maximum value when the guide bar is at or near its mean position and a minimum value when the guide bar is near its limits of travel. The aim of the present invention is to provide spring mechanism which approaches these conditions as nearly as possible.

According to the present invention, a guide bar is arranged to be moved longitudinally in one direction by a cam and in the other direction by a short stiff spring, acting on the guide bar through a lever arranged so that the force applied by the spring to the guide bar undergoes small changes in magnitude in relation to the corresponding movements of the guide bar. Conveniently, the lever may have one arm at right angles to the guide bar when the latter is at its mean position, and a shorter arm, constituting a continuation of the first-mentioned arm beyond its pivotal axis, acted upon by a helical compression spring, the second arm subtending an obtuse angle with the first mentioned arm and an obtuse angle with the spring axis. In this arrangement the first arm is pivotally connected through flexible links to the guide bar.

In order that the invention may be clearly understood and readily carried into effect, one construction in accordance therewith will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a plan of part of the guide bar

actuating mechanism in a warp knitting machine;

Figure 2 is a section on the line II—II in Figure 1, the relative position of certain further parts being shown by chain lines;

Figure 3 is a section on the line III—III in Figure 2 showing some of the parts appearing in Figures 1 and 2; and

Figure 4 is an elevation of certain parts appearing in Figures 1 and 2, as viewed when looking in the direction of the arrow IV in Figure 2.

The drawings show the ends of two guide bars 1 and 1' mounted in a warp knitting machine. As is usual in such machines, each guide bar carries a number of blocks 2 and 2' from which project the warp guides 3 and 3'. The guide bars are carried by a rock shaft 4, the position of which, relatively to the guide bars is indicated by chain lines in Figures 2 and 4, through the medium of supporting assemblies 5, shown by chain lines in Figure 2, distributed along the length of the rock shaft and secured thereto. The guide bars are arranged to reciprocate to and fro along their lengths relatively to the supporting assemblies. Thus, the necessary movements are imparted to the warp guides by rocking the rock shaft 4 about its axis and by moving the guide bars to and fro longitudinally. In the rocking movements, the warp guides 3 and 3' pass between the knitting needles (not shown) and, in the longitudinal movements, the warp guides lap the needles. It is the mechanism for imparting these to and fro longitudinal movements to the guide bars that illustrates the present invention, and the mechanism for moving the guide bar 1' to and fro will be particularly described, the equivalent mechanism for the guide bar 1' being precisely the same as that for the guide bar 1. Parts associated with the guide bar 1' that are the same as parts for the guide bar 1 bear the same reference numerals but with the suffix '.

The movement to the right in each reciprocation of the guide bar 1 is imparted by a rotary cam 50 (part of which appears in plan view in Fig. 1) acting on a roller 51 on a tappet 6 between which and the guide bar 1, a push rod 7 is interposed, the tappet being guided in a casing 52. A pair of lever parts 8 and 9 extends to points on each side of the push rod 7 from a common journal 10 (Figure 2) and these are connected at their outer ends to the adjacent end of the guide bar 1 by flexible metal strips 11 and 12, which are pivoted to the lever parts 8 and 9 and to the guide bar 1.

Between the two lever parts 8 and 9 is a member 5, which is also freely pivoted on the journal 10. This member extends some distance between the parts 8 and 9 and is connected to them by a pin 13 passing through bores in the three. This member 5 also extends some distance on the other side of the journal 10 and, with the lever parts 8 and 9, provides a two-armed lever. The part 14 (Figure 3) of the member 5 which provides the second arm of the lever, is formed at one side near its lower end with a V-shaped recess 15, in which a V-shaped projection 16 lies to provide a knife edge pivot at A. The projection is formed on a member 17 against which one end of a helical compression spring 18 bears. This spring extends through a casing 19, closed at one end, fixed to the machine frame 20. The other end of the spring 18 bears against a member 21 formed on its side remote from the spring 18 with a spherical depression 22 in which a hard

steel ball 23 rests. This ball bears, in turn, on a member 24 which is formed with a concave spherical surface 25 of larger radius of curvature, so providing a universal joint which imposes no appreciable directional restraint on the axis of the spring 18. The member 24 is screwed into a cap 26 which serves to close the end of the casing 19, and it is through this cap that the spring force is transferred to the machine frame 20. The spring force can be adjusted at will by screwing the cap 26 further into or out of the casing 19.

Now the length of the arm 14 of the two-armed lever, that is the distance A—B (Figure 3) is, in the example being described, $1\frac{1}{4}$ inches. The length of the other arm, that is the distance B—C, is approximately 4 inches. The angle subtended between these two distances, that is the angle α in Figure 3, is approximately 135° , and the angle between the arm A—B and the spring axis, i. e. the angle β (Figure 3), is also approximately 135° when the guide bar is in its mean position.

It will be appreciated that, owing to the difference in length of the two arms of the lever extending respectively on each side of the axis of the journal 10, the spring 18, which has a high enough rate to avoid surging, undergoes changes in length which are less than the longitudinal movements of the guide bar. Further, owing to the angle between the two arms, i. e. the angle α (Figure 3), the changes which occur in the spring force are not applied to the guide bar without modification. The long arm, consisting of the parts 8 and 9, extending to one side of the axis of the journal 10, is at right angles to the guide bar 1 when the latter is in its mean position, and the force applied to the guide bar decreases slightly as it travels from that position to either of the extremities of its stroke. The reason for this will be realized from the fact that the applied turning moment in any position within the range of movement of the guide bar is equal to the product of the force due to the spring 18 at that position and the perpendicular distance between the line of action of this force and the axis B of the two-armed lever. Further, owing to the angle between the two arms AB and BC, the said perpendicular distance increases when the spring expands and decreases when the spring is compressed. Therefore, although the stress in the spring 18 changes appreciably as the lever moves from one extreme position to the other, the turning moment, and therefore the force on the guide bar remains more nearly uniform. With a proper choice of the variables, the ideal relationship between the guide bar movement and the force exerted thereon may be very closely approached. In the construction being particularly described, the rate of the spring 18 is 714 lbs. per inch, and the maximum guide bar movement which can be accommodated is 1 inch on either side of the mean position in which it is shown in Figure 1. When the closure member 26 for the casing 19 is screwed to a position such that the spring force is 568 lbs. in the mean position of the two-armed lever, the force on the guide bar is 149 lbs. Then, respectively at the ends of the guide bar stroke, the spring forces are 354 lbs. and 729 lbs., and the forces on the guide bar are 119 lbs. and 130 lbs. When the spring force is increased to 605 lbs. in the mean position, the force on the guide bar is 159 lbs. The latter changes to 131 lbs. and 137 lbs. respectively at the extreme positions, 75

while the spring force changes to 391 lbs. and 766 lbs. at those positions. For a force of 204 lbs. on the guide bar at the mean position, the spring is adjusted to exert a force of 779 lbs. at that position. Then the guide bar forces are 189 lbs. and 168 lbs. at the extreme positions, and the spring forces are 565 lbs. and 940 lbs.

In order to equalise the loads on the flexible strips 11 and 12 while providing safety should one of the strips or one of its end connections break, the pin 13, which couples the three lever parts 8, 9 and 12, is formed with three barrel-shaped surfaces, as shown in Figure 2, which bear respectively on cylindrical bores in the lever parts 5, 8 and 9. A second pin 30 rests in clearance holes in the levers 8 and 9 and is normally inoperative. In the event of breakage, however, this pin 30 acts as a coupling device between the centre member 5 and the guide bar.

To enable the guide bar to be relieved of the spring 18, a bolt 31, carried by the machine frame 20, is screwed up to bear against an abutment 32 on the two-armed lever, this abutment being formed on the centre lever member 5.

In the rocking movements of the guide bar about the axis of the rock shaft 4, the push rods 7 and 7' undergo slight angular displacements and to accommodate these, ball and socket joints are provided at the ends of the rods. In Figure 4 the joints for the rod 7' appear and bear the reference characters 33' and 34'.

I claim:

1. In a warp knitting machine, in combination, a warp guide bar mounted for longitudinal to and fro movement, a cam operative to move said guide bar longitudinally in one direction, a stiff resilient device, and a lever interposed between said bar and said device and operative to apply to said bar a force, derived from said device, to move said bar longitudinally in the other direction while said resilient device undergoes small changes in strain in relation to the extent of the longitudinal movements of said guide bar.

2. In a warp knitting machine, in combination, a warp guide bar mounted for longitudinal to and fro movement, a cam operative to move said guide bar longitudinally in one direction, a lever mounted to swing to and fro about an axis and operatively connected to said guide bar, and a stiff resilient device operative to act on said lever to move said guide bar longitudinally in the other direction, said lever and said resilient device being arranged so that the perpendicular distance between the line of action of said resilient device and said axis increases as said device relaxes when said guide bar moves from a position substantially at the centre of its stroke to a position at one end of its stroke, and decreases as said device is stressed while said cam is moving said guide bar from said position to the other end of its stroke.

3. In a warp knitting machine, in combination, a warp guide bar mounted for longitudinal to and fro movement, a cam operative to move said guide bar longitudinally in one direction, a two-armed lever having a shorter arm and a longer arm operatively connected to said guide bar, and a stiff helical compression spring mounted to act on said shorter arm to move said guide bar longitudinally in the other direction.

4. In a warp knitting machine, in combination a warp guide bar mounted for to and fro longitudinal movement, a cam operative to move said guide bar longitudinally in one direction, a cranked two-armed lever having a shorter arm

and a longer arm operatively connected to said guide bar, and a compression spring mounted to act on said shorter arm, at a point within the smaller angle subtended by said two arms, to move said guide bar longitudinally in the other direction.

5. In a warp knitting machine, in combination, a warp guide bar mounted for to and fro movement, a cam operative to move said guide bar longitudinally in one direction, a cranked two-armed lever having a shorter arm and a longer arm operatively connected to said guide bar, and a helical spring mounted to act on said shorter arm, with its line of action substantially parallel to said guide bar, to move said guide bar longitudinally in the other direction.

6. In a warp knitting machine, in combination, a warp guide bar mounted for to and fro longitudinal movement, a cam operative to move said guide bar longitudinally in one direction, a cranked two-armed lever having a shorter arm and a longer arm operatively connected to said guide bar, an abutment, and a stiff helical compression spring pivotally applied at one end to said abutment and pivotally applied at the other end to said shorter arm to move said guide bar longitudinally in the other direction.

7. In a warp knitting machine, in combination, a warp guide bar mounted for to and fro longitudinal movement, a cam, a push rod substantially in alignment with said guide bar and interposed between same and said cam, enabling said cam to move said guide bar longitudinally in one direction, a pivoted lever having parallel parts lying respectively on opposite sides of said push rod, two tension members respectively connecting said parts to said guide bar, and spring means arranged to act on said lever to move said guide bar in the other direction.

8. In a warp knitting machine, in combination, a warp guide bar mounted for to and fro longitudinal movement, a cam, a push rod substantially in alignment with said guide bar and interposed between same and said cam enabling said cam to move said guide bar longitudinally in one direction, a pivoted lever including two parts lying respectively on opposite sides of said push rod and mounted to swing about the lever axis and means interconnecting said parts while permitting same to undergo limited movement relatively to each other about said lever axis, two tension members respectively connecting said parts to said guide bar, and a resilient device arranged to act on said lever to move said guide bar in the other direction.

9. In a warp knitting machine, in combination, a warp guide bar mounted for to and fro longitudinal movement, a cam, a push rod substantially in alignment with said guide bar and interposed between same and said cam to move said guide bar longitudinally in one direction, a two-armed lever including two parts providing a longer arm of said lever and formed respectively with cylindrical bores, and a third part located between said two first-mentioned parts and providing a shorter arm of said lever and also formed with a cylindrical bore, said lever further including a pin formed with three barrel-shaped surfaces lying respectively in said three bores to permit limited relative movement between said three parts about the lever axis, two tension members respectively connecting said first-mentioned two parts to said guide bar, and a resilient device arranged to act on said shorter arm to move said guide bar in the other direction.

10. In a warp knitting machine, in combination, a warp guide bar mounted for to and fro longitudinal movement and for to and fro movement about an axis parallel thereto, a cam operative to move said guide bar longitudinally in one direction, a cranked two-armed lever having a shorter arm and a longer arm disposed to lie substantially perpendicular to said guide bar when the latter is substantially at the centre of its stroke, a flexible tension member connecting said longer arm and said guide bar, and a helical spring mounted to act, with its line of action substantially parallel to said guide bar, on said shorter arm to move said guide bar longitudinally in the other direction.

11. In a warp knitting machine, in combination, a warp guide bar mounted for to and fro longitudinal movement and for to and fro movement about an axis parallel thereto, a cam operative to move said guide in one direction, a cranked two-armed lever having a shorter arm and a longer arm disposed to lie substantially perpendicular to said guide bar when the latter is substantially at the centre of its stroke, a flexible tension member lying substantially parallel to said guide bar and connecting the latter to said longer arm, and a resilient device arranged to act on said shorter arm to move said guide bar longitudinally in the other direction.

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