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W. LIEBCHEN

3,205,684

DEVICE FOR PRODUCING RADIAL MOVEMENT OF GUIDE BARS
IN CUT PLUSH WARP KNITTING MACHINES

Filed March 22, 1962

3 Sheets-Sheet 1

Fig. 1

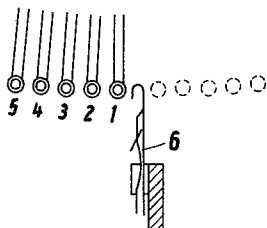


Fig. 2
(PRIOR ART)

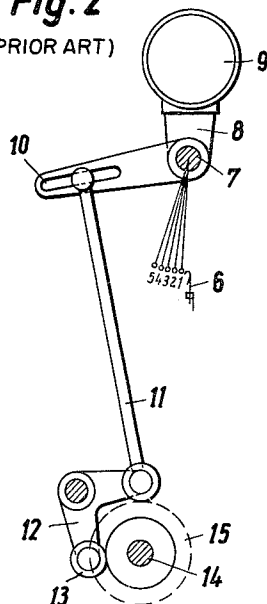


Fig. 5

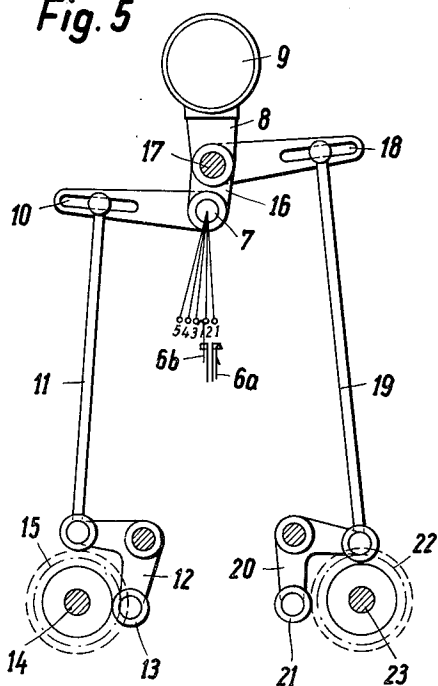
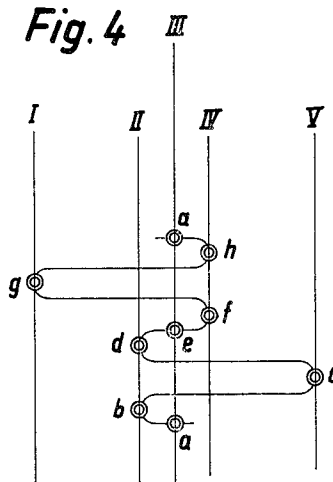


Fig. 4



Inventor:

WALDEMAR LIEBCHEN

By
Bailey, Stephens & Hettig

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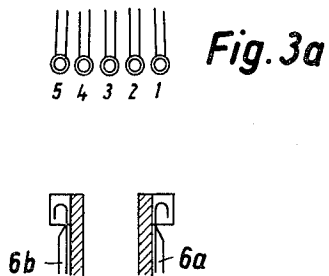
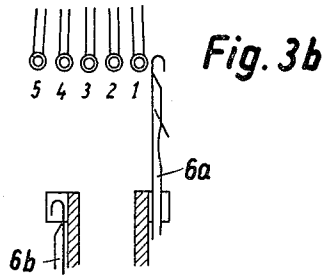
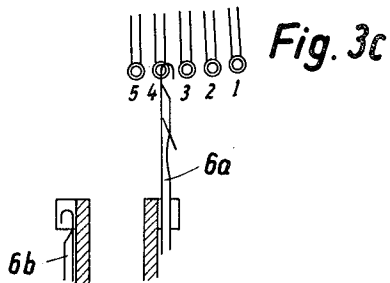
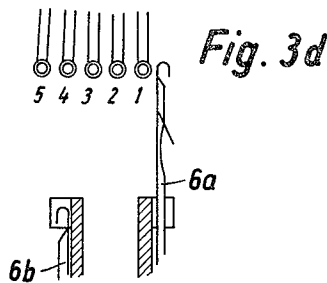
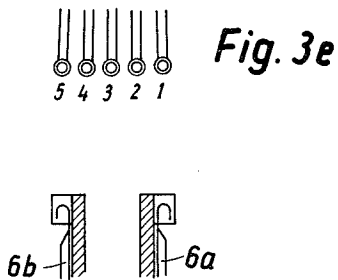
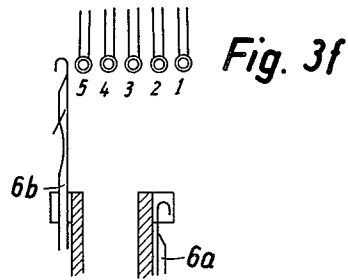
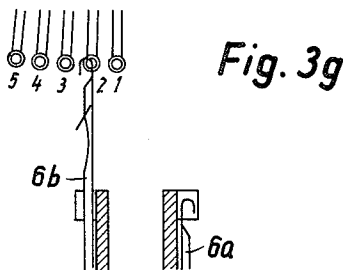
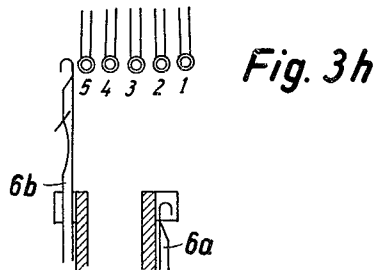
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3 Sheets-Sheet 2



Inventor:

WALDEMAR LIEBCHEN

By *Bailey, Stephens & Huetting*

ATTORNEYS

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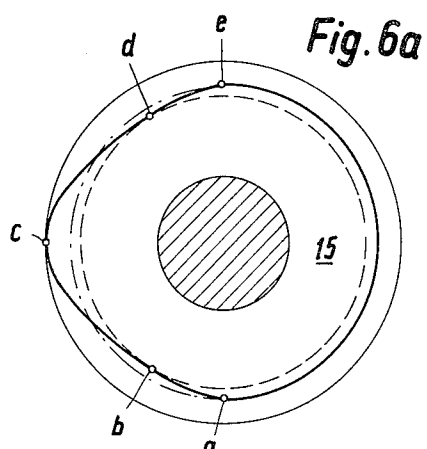
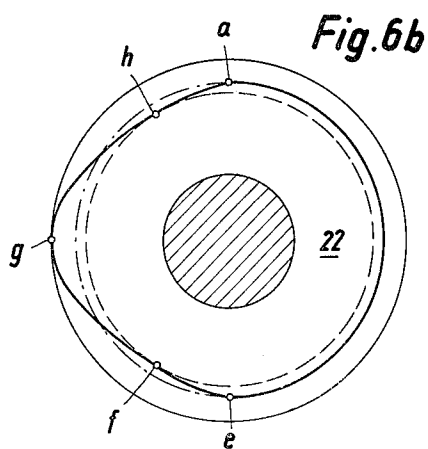
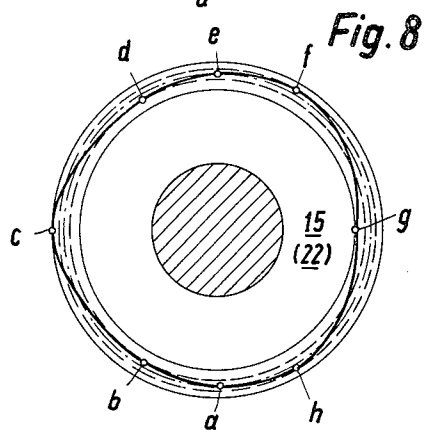
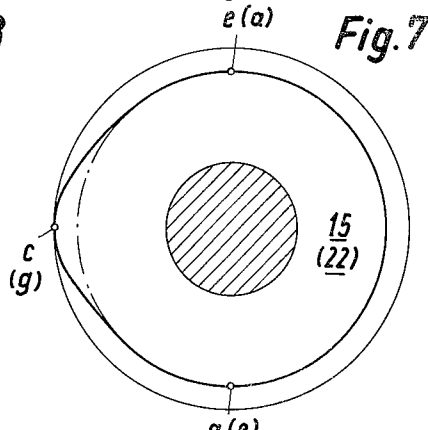
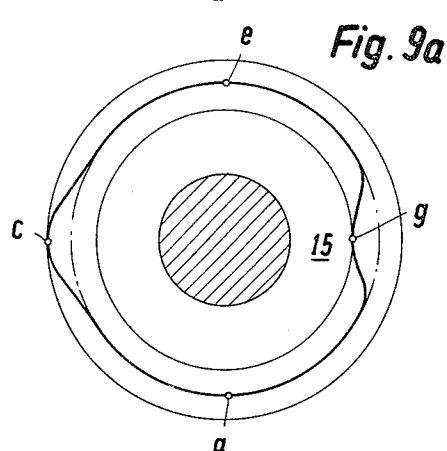
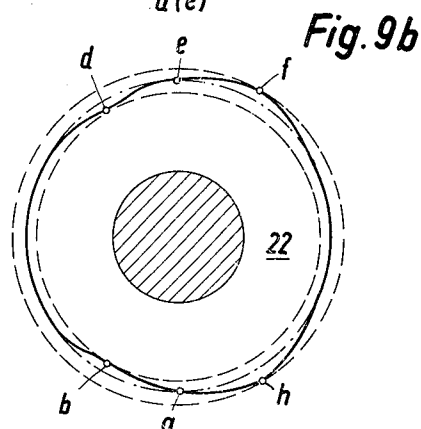
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3 Sheets-Sheet 3



Inventor:

WALDEMAR LIEBCHEN

By

Bailey, Stephens & Huetting

ATTORNEYS

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**DEVICE FOR PRODUCING RADIAL MOVEMENT
OF GUIDE BARS IN CUT PLUSH WARP KNIT-
TING MACHINES**

Waldemar Liebchen, Aschaffenburg (Main), Germany,
assignor to Jean Güssen, Maschinenfabrik-Eisengies-
serei, Dülken, Rhineland, Germany, a firm of Germany

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G 31,907

6 Claims. (Cl. 66—87)

The invention relates to warp knitting machines having two beds of latch needles and adapted to produce cut plush and concerns a method of producing the radial outward movements of the guide bars on both sides by means of a disc cam drive, and arrangement for performing the method.

A warp knitting machine which is required to produce cut plush must, of course be provided with two beds of latch needles and three or five guide bars; to lay the warp yarns around the two latch needles, the guide bars are moved out alternately to both sides of the machine. If five guide bars are used and the pile is of reduced height, the warp guides secured to the guide bars must, in addition to performing these radial casting-off movements, perform oppositely directed and smaller movements in between the casting-off movements, in order that the warp guides may move out of the way of the raised latch needles for the axial movements of the guide bars. The change of movement of the warp guides radially is therefore much more rapid than in other work requiring the use of one or two needle beds. For the latter purposes, the warp guide performs only a single transverse radial reciprocation during one revolution of the camshaft, whereas in the production of low-nap cut plush with the use of five warp guides, three reciprocations are performed per camshaft revolution although each latch needle forms only a single loop, there being one major outward movement to each side in between each two minor avoiding motions to the opposite hand. Consequently, when cut plush is produced with the use of the conventional system for controlling transverse movement of the guide bars by means merely of a single sensing of the correspondingly shaped disc cam, the performance of the warp knitting machine for a given smoothness of running and for a given wear and tear is much less than in the case of the simple movement changes of other kinds of jobs requiring single and double needle beds.

It is an object of the invention to increase the smoothness of operation of a warp knitting machine when producing cut plush and thus to improve the efficiency of a warp knitting machine without reducing the working life thereof and with satisfactory performance of the work. To this end, according to the invention the radial outward movements of the guide bars are produced by a combination of rocking movements initiated by two different disc cam systems. This subdivision of guide bar movements means that the cams operating the two motion-transmitting systems have a less sharp and more even outline so far as the disc cam periphery is concerned; consequently, the cam-engaging means, such as roller type follower levers or the like, and the means for transmitting the cam-initiated motions to the place where the motions initiated by each cam are combined, operate more smoothly and quietly than in the known apparatus. Mass acceleration forces and their reactions on the disc cams and on the bearings of the transmission means are therefore reduced, the knitting machine runs more quietly and more evenly than previously, the rate at which the knitting machine can operate is increased, and output is therefor increased.

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According to a particular feature of the invention, to perform the method, the guide bar shaft which is so connected to the warp guides as to rotate solidly therewith and which in manner known per se is rotatable by a disc cam operating through follower means is rockably suspended by means of links on a stationary intermediate shaft, the links being pivotable, independently of the follower means, by way of further follower means by a second disc cam or by a different part of the first disc cam.

Further particulars of the invention will become apparent from a description of the embodiments diagrammatically illustrated in the drawings wherein:

FIG. 1 is a schematic illustration of the needle arrangement in a single-needle-bed warp knitting machine the casting-off position (solid-line illustration) and in the knocking-over position (chain-line illustration) of the warp guides;

FIG. 2 is a radial section through a known guide bar suspension driven by a disc cam through a roller type follower lever, in association with a needle arrangement of the kind shown in FIG. 1;

FIGS. 3a-3h schematically illustrate the needle arrangement in a double-needle-bed warp knitting machine having five warp guides, the same being shown in various positions during one operating cycle;

FIG. 4 illustrates a time distance diagram for the motion of the central warp guide during one cycle of operations of double-needle-bed warp knitting machines for producing cut plush with five warp guides;

FIG. 5 is a radial section through a guide bar suspension according to the invention in association with a needle arrangement as shown in FIGS. 3a-3h;

FIGS. 6a and 6b illustrate two co-operating disc cams for the guide bar suspension shown in FIG. 5;

FIG. 7 illustrates a disc cam for the guide bar suspension shown in FIG. 5, the warp guides performing merely an outward movement without any avoiding movement;

FIG. 8 illustrates another form of disc cam for use where the warp guides perform the avoiding movement as well as the outward movements, and

FIGS. 9a and 9b illustrate another form of cooperating disc cams for use where warp guides perform an avoiding movement as well as the outward movements.

Referring to FIG. 1, five warp guides 1-5 are disposed transversely of the longitudinal axis of a warp knitting machine at a fixed transverse spacing from one another and co-operate with a latch needle 6 which determines the gauge of the knitting machine. While the latch needle is moved up and down at regular time intervals, the warp guides move, at the same rhythm, transversely of the machine longitudinal axis—i.e., from right to left in FIG. 1 and vice versa—laying in their movements, by simultaneous axial displacements, the warp yarns present in the eye of each warp guide as loops around the upper hooked end of the latch needle, and the latter joins the loops together by its up and down movements. In single-needle-bed work of this kind, the warp guides are reciprocated only once per cycle of operations between a casting-off position (shown in solid line) and a knocking-over position (shown in chain line) to form each loop.

For many years the preferred arrangement for producing these transverse movements of the warp guides has been the arrangement shown in FIG. 2 in which axial guide bars (not shown) each bearing warp guides (1 to 5) are so secured to a guide bar shaft 7 that the rotation thereof pivots the warp guides transversely with no change in their transverse separation from one another. The guide bar shaft 7 is suspended in downwardly extending lugs 8 of a stationary support 9 extending over the whole length of the knitting machine. Disposed on one end of the

shaft 7 and rotating solidly therewith is an arm 10 to which a connecting rod 11 is pivoted. The effective length of the arm 10 relative to the pivot point of the rod 11 can be adjusted by means of a slot in the arm 10. Pivoted to the other end of the downwardly extending rod 11 is a substantially horizontally extending arm of a bent lever 12 which is rotatable around a stationary pivot and the other arm of which has rotatably mounted at its free end a follower roller 13; means which are known per se but not shown urge the roller 13 into operative bearing engagement with the periphery of a disc cam 15 disposed on a shaft 14. The disc cam 15 has a camming part, the periphery of which rises once from the solid-line base circle shown in FIG. 2 to the broken line addendum circle shown in FIG. 2, then returns to the base circle. Consequently, for each revolution of the camshaft 14 the warp guides 1-5 are reciprocated transversely once, corresponding to a single vertical reciprocation of the latch needle 6 by the camshaft 14; the casting-off position, denoted by the solid lines in FIG. 1, occurs when the follower roller 13 is in engagement with the base circle, while the broken line knocking-over position occurs when the follower roller 13 is at the position of maximum deflection on the addendum circle of the cam 15.

As already mentioned, when it is required to produce cut plush, a second needle bed having latch needles 6b must be provided, the open hook side of the needles 6b being turned away from the open hook side of the other latch needles 6a in the manner shown in FIG. 3a. Provided that the distance between the needle beds is greater than the distance between the first warp guide and the last warp guide, as nearly always occurs when only three guide bars are used, the warp guides need perform only a single casting-off motion each from the central position to each side in order to lay the loops around the two latch needles, which are raised consecutively during a single cycle of operations, the latch needles then knocking the loops over into stitches, because the warp guides when in the central position can move unimpeded past the still raised latch needles when the guide bars move axially. Provided that the distance between the beds of latch needles—i.e., the height of the nap of the plush to be produced—is large enough, the warp guides can still move freely when in their central position even when five warp guides are used. However, when the height of the nap decreases to about 7 mm. or less, the outer warp guides would knock against the raised latch needles during the axial movement of the guide bars unless the warp guides were simultaneously moved transversely from their central position. Provision must therefore be made to enable the warp guides to perform so-called avoiding movements in the opposite direction to their radial casting-off movements.

FIG. 3a illustrates the position of the needles at the start of the cycle of operations. The two latch needles are in the lowered position and the warp guides are in the central position. Before the right-hand casting-off position shown in FIG. 3c is reached, where the warp yarns passing through the warp guides 3-5 are laid around the latch needles 6a to form a loop, the guide bars and, with them, the warp guides pivot to the left (FIG. 3b) by an amount such that the warp guides 3-5 can pass unimpeded axially past the raised latch needle 6a. A similar avoiding movement is performed again at the end of looping (FIG. 3d), since the latch needle 6a is still in the raised position and, if there were no avoiding movement, would impede the axial return movement of the warp guides. The latch needle 6a then descends to perform the knocking-over movement, and the warp guides return to their symmetrical central position (FIG. 3e). The movement from the position shown in FIG. 3a to the position shown in FIG. 3e takes up half a working cycle. During the second half thereof the movement is repeated but in reverse order, as shown in FIGS. 3f, 3g

and 3h, the warp yarns of the warp guides 1-3 being laid around the raised latch needle 6b. At the end of the cycle of operations the position shown in FIG. 3a has been regained and the cycle recommences.

Referring to FIG. 4, the movement of the central warp guide 3 during a working cycle is plotted against time, the time axis being vertical; the positions indicated by lower-case letters correspond to the positions in FIGS. 3a, 3b and so on. The reference III denotes the centre line of the outward movements, and the warp guide 3 is on the centre line III in positions a and e and upon its return to position a and in intermediate positions (not shown). Before and after moving into the casting-off positions c and g, such positions being on the casting-off lines V and I respectively, the warp guide 3 and, with it, the other warp guides perform, with an offset corresponding to their transverse separation, avoiding movements in opposite directions into positions b and d on the avoiding line II and into positions f and h on the avoiding line VI. Consequently, FIG. 4 shows that the direction of guide bar movement changes six times per working cycle, the casting-off distances varying from one another.

Conventionally, these casting-off movements are produced by the same known guide bar suspension as is shown in FIG. 2, the disc cam having, in accordance with the pattern of the distance time curve shown in FIG. 4, one large and two small protuberances and, therebetween, just as many large and small recesses with reference to a mean base circle on the periphery. The directions of movement of the bent lever 12, of the rod 11 and of the arm 10 are therefore reversed in such a rapid sequence and with such large acceleration and deceleration forces that the output of the loom must be reduced considerably if it is to operate smoothly and if its working life is not to be reduced excessively.

In the guide bar suspension according to the invention which is shown in FIG. 5, the guide bar shaft 7, instead of being directly mounted for pivotal movement in the downwardly extending lugs 8 of the support 9 as in the known suspension shown in FIG. 2, is rotatably mounted in links 16 which are secured to an intermediate shaft 17 rotatably mounted in the lugs 8 and which rotate solidly with the shaft 17. Connected to the intermediate shaft 17 at one end of the machine is a second arm 18 which can be identical with the arm 10 rigidly secured to the guide bar shaft 7 but which, conveniently, extends in the opposite direction thereto. A connecting rod 19 is pivotal to the arms 18; the effective length of the arms 18 can be varied by the pivot pin being slid along a slot. Pivoted to the other end of the downwardly extending draw rod 19 is the substantially horizontally extending arm of a bent lever 20 which is rotatable around a stationary pivot and the other arm of which bears at its free end a rotatably mounted follower roller 21; means which are known per se, but not shown, urge the follower roller 21 into operative bearing engagement with a disc cam 22. Cam 22 is so secured to a second cam shaft 23 as to rotate solid therewith, the camshaft 23 rotating at the same speed as the camshaft 14. The advantage of suspending the guide bars in accordance with the invention and using the combination motion is that, within wide limits, the pattern of movement shown in FIG. 4 can be broken down as between the disc cams 15 and 22 exactly as required, with a resultant considerable reduction in the stressing of the disc cams and of the sensing means and of the motion-transmitting means.

The disc cams 15, 22 illustrated in FIGS. 6a and 6b provide a timewise breakdown of the movement pattern shown in FIG. 4. In both of the disc cams 15, only the left-hand side (referred to the drawing) has recessed parts and raised parts corresponding to the casting-off positions b, c, d and f, g, h respectively in FIG. 4, whereas the right-hand half of each cam has a mean constant radius corresponding to the central positions a and e in FIG. 4. Since in the arrangement illustrated in FIG. 5

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the bent levers 12, 20 engage through their respective follower rollers 13, 21 with parts of the respective disc cams 15, 22 which are opposite one another, one follower roller is always on the constant-radius part of the cam, so that the left-hand and right-hand follower means and motion-transmitting means operate alternately and the knitting machine therefore runs more smoothly than previously.

As will be apparent from a consideration of FIGS. 6a and 6b taken together with FIG. 5, all the minor avoiding movements of the warp guides are produced by recessed parts of the disc cams, whereas the two major casting-off movements are produced by correspondingly large raised parts of the cams. In contrast to this, a disc cam used in the known arrangement shown in FIG. 2 to produce the same pattern of movement can have only one large raised part and, in lieu thereof, a correspondingly large recessed part on the opposite side, in order that the major casting-off movements may be initiated on opposite sides of the cam. Since the angles of rotation available for the recessed part and for the raised part are equal, however, the cam portion producing the major movement is longer in the raised part than in the recessed part—i.e., the gradient of the raised part is less than the gradient of the recessed part. The raised part is therefore less steep, and therefore acts at a better angle on the follower roller, than the recessed part, with the result that the cam portion containing the raised part, not to mention the bearing of the follower roller, is stressed less in following the raised part than is the cam portion containing the recessed part, and the said bearing, in following the recessed part. Since in the disc cam shown in FIGS. 6a and 6b the major casting-off movements are performed solely by raised parts, the total loading of the disc cams and of the bearings for the follower rollers is reduced, the knitting machine runs more quietly, and wear is further reduced.

Of course, if the motion-transmitting means are arranged correspondingly, the two disc cams shown in FIGS. 6a and 6b can be disposed on a single camshaft; indeed, the two disc cams can be combined to form a single disc cam, in which event the follower rollers 13, 21 engage with diametrically opposite parts of the single cam. If required, the arms 10, 18 can extend on the same side of the machine axially but staggered relatively to one another. In order to retain in this arrangement the advantage of using raised parts of the cam for the major casting-off movements, the bent levers 12, 20 must extend in the same direction and must engage on the same side of disc cams 15, 22, as shown in FIGS. 6a and 6b, which are 180° offset from one another. A simplified form of the disc cams shown in FIGS. 6a and 6b is shown in FIG. 7, and two such elements can be provided in the machine or can be used if the nap is high enough, or if only three warp guides are used, for the minor avoiding movements to be omitted. The difference between this embodiment and the embodiment illustrated in FIGS. 6a and 6b is that the embodiment illustrated in FIG. 7 has no recessed parts for producing the avoiding movements of the warp guides. Since the major casting-off movements are produced solely by raised parts of the cam, the same advantage as described with reference to FIGS. 6a and 6b is provided when the cam shown in FIG. 7 is used in association with the guide bar arrangement according to the invention.

In the form of disc cam shown in FIG. 8, the operative part of the cam has the same pattern as the disc cam used for the arrangement shown in FIG. 2, except that the raised parts and recessed parts are only half as high or half as low respectively. In the case of the arrangement shown in FIG. 5, two such cams are used and are not offset angularly from one another. Consequently, when one follower roller engages in a recessed part, the other follower roller engages with an equally large raised part and vice versa. Since the arms 10 and 18 extend to

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opposite sides of the machine, the oppositely directed movements of the rods 11, 19 combine with one another to act on the guide bar shaft 7 in the same direction, so that the required pattern of movement is fully maintained as previously in the arrangement shown in FIG. 2. However, the operative parts of the cams 15, 22 shown in FIG. 8 have only half the gradient and therefore exert much less of a load on the follower rollers 13, 21 and the other motion-transmitting means as far as the guide bar shaft 7 where the movements of the two systems are combined.

It will be readily apparent that the disc cams illustrated in FIG. 8 also allow the arms 10, 18 to be disposed on the same side of the knitting machine. Also, provided that the follower means and motion-transmitting means are disposed appropriately, the disc cams can be disposed on the same shaft. If required, merely a single disc cam of the kind shown in FIG. 8 can be used, in which event the follower rollers 13, 21 preferably engage with diametrically opposite parts of the single cam.

Further possibilities for cam shape are shown in FIGS. 9a and 9b. In contrast to the embodiments just described, the operative parts of these two associated cams are of different design from one another; the disc cam 22 which is shown in FIG. 9b is disposed on the shaft 23 and transmits to the intermediate shaft 17 via the arm 18 only the movement required for the minor movements of the warp guides, whereas the disc cam 15 which can be seen in FIG. 9a is disposed on the shaft 14, acts directly via the arm 10 on the guide bar shaft 7 and produces only the major casting-off movements of the warp guides. This subdivision of the pattern of movement means that, in particular, the start and termination of the major raised parts and recesses of the cam 15 shown in FIG. 9a can be of greater angular extent, with the result that the associated follower roller 13 and the other motion-transmitting means operate more smoothly.

The disc cams illustrated in FIGS. 9a and 9b can, without departing from the scope of the invention, be further varied in that the disc cam 22, as a further development of the embodiment illustrated in FIG. 9b, produces, by means of one extra raised part and one extra recessed part, three equal reciprocations of the warp guides between lines II and IV movement pattern amplified in chain lines in FIG. 4 during each revolution, and to amplify this up to the full casting-off distance, corresponding to position c and g in FIG. 4, the cam 15 has to provide only the difference corresponding to movement between lines IV and V or II and I. The cam 15 can therefore be provided with a smaller recessed part and with a smaller raised part than can the cam shown in FIG. 9a, so that the associated motion-transmitting means perform shorter movements, are correspondingly less accelerated and retarded, and therefore operate more quietly.

Of course, these latter disc cam forms are also such that, if the levers are arranged correspondingly the two associated disc cams can be disposed on a single shaft and/or the arms 10, 18 can be disposed on the same side of the machine. However, it is not possible to use a single common disc cam in this modification.

I claim:

1. In a double-needle bed cut-plush warp knitting machine having warp guides and guide bars carrying said warp guides, means to produce movement of the guide bars in both directions across the path of the latch needles comprising a spindle, said guide bars being rigid with said spindle, an intermediate shaft, links carried by the intermediate shaft, said spindle being turnably mounted in the links, cam means driven in synchronism with the motion of the latch needles, first means to transmit movement from the cam means to the spindle to turn the same about its axis, and second means independent of the first movement transmitting means to transmit movement from the cam means to the links to rock them about the axis of the intermediate shaft, said cam means producing large move-

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ments of the warp guides alternately on opposite sides of the center line for casting off and, between each of two such large movements, two smaller avoiding movements across said center line, said guide bars extending substantially radially with respect to said shaft.

2. In a device as claimed in claim 1, said cam means comprising two cams, each movement transmitting means operatively engaging one of the cams.

3. In a device as claimed in claim 2, said cams being identical.

4. In a device as claimed in claim 1, said cam means being a single cam, said movement transmitting means each engaging at any moment a different part of the cam.

5. In a device as claimed in claim 1, said cam means including at least one cam having a circular outline in one half of the arc corresponding to one complete cycle of movement of the warp guides and having deviations from such circular outline in the other half only of such arc.

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6. In a device as claimed in claim 1 in which said cam means includes two cams and said warp guides are moved through greater and less distances in one cycle of movement, one of said cams producing the movements through the greater distances and the other producing the movements through less distances.

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RUSSELL C. MADER, *Primary Examiner.*