March 24, 1931. M. C. MILLER 1,797,435

KNITTING MACHINE

Filed Sept. 15, 1926 2 Sheets-Sheet 1

Fig. 1

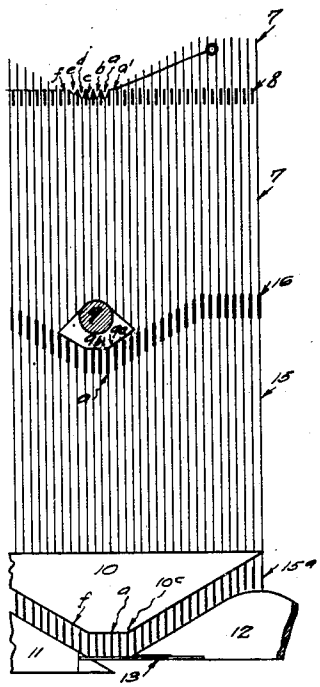


Fig. 2

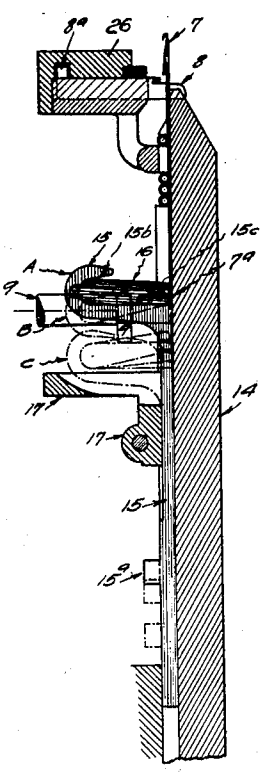


Fig. 3.

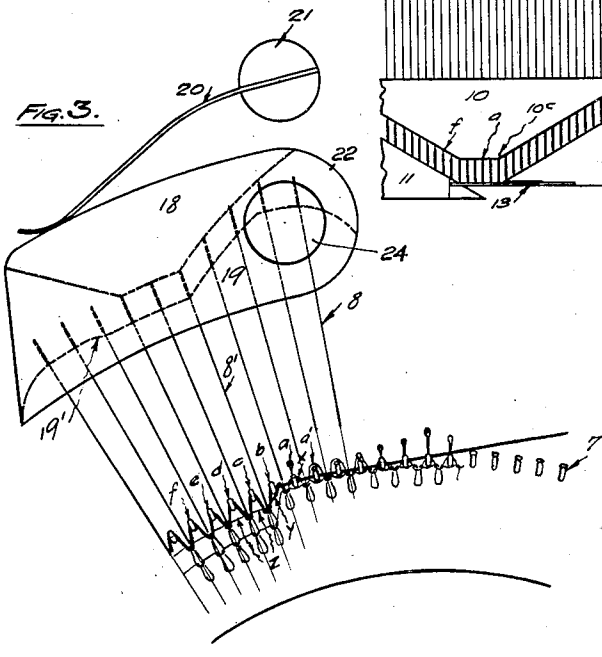


Fig. 4

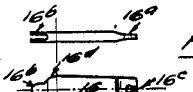


Fig. 5.

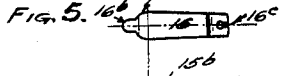


Fig. 6

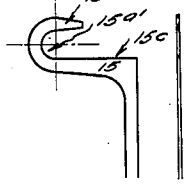


Fig. 7.

INVENTOR.

M. C. Miller

March 24, 1931. M. C. MILLER 1,797,435

KNITTING MACHINE

Filed Sept. 15, 1926 2 Sheets-Sheet 2

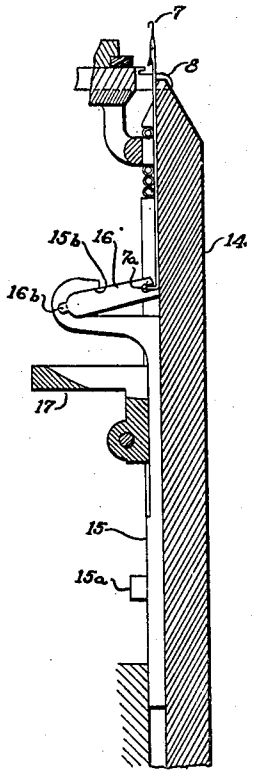


Fig. 8

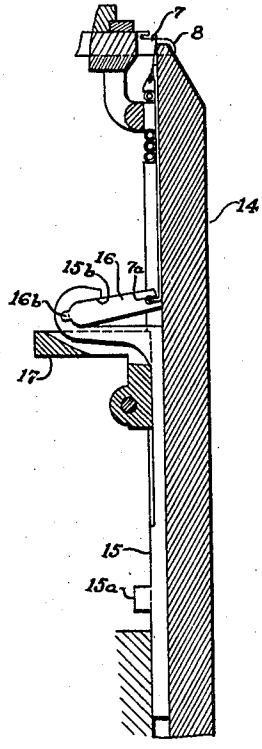


Fig. 9

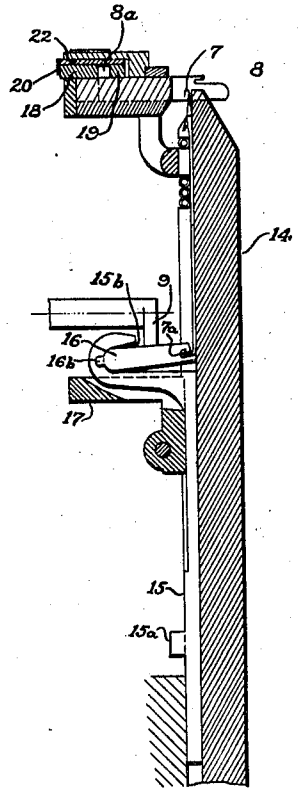


Fig. 10

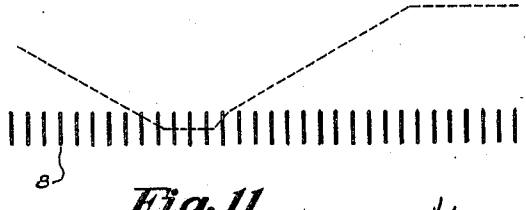


Fig. 11

INVENTOR:

Max C. Miller

Patented Mar. 24, 1931

1,797,435

UNITED STATES PATENT OFFICE

MAX C. MILLER, OF CUMBERLAND, RHODE ISLAND

KNITTING MACHINE

Application filed September 15, 1926. Serial No. 135,569.

The invention relates to knitting machines and is herein disclosed as embodied in a circular latch needle machine in which the yarn is fed directly to the needles without the intervention of sinkers or similar elements.

The object of the invention is to introduce into a knitting machine certain novel and improved features which will cause the machine to operate more efficiently and with reduced wear and tear on the parts and which will produce a better and more regular appearing knit fabric than machines previously developed.

In knitting machines such as latch needle machines where the yarn is fed directly to the needles, it is desirable in order to prevent unnecessary strain on the feeding yarn for each needle to reach its maximum down position with its yarn drawn over the knock-over surfaces of the web holders before the next following needle comes in contact with the new yarn. In practice, however, where the needles and their operating butts are ordinarily spaced about the same distance apart so that the angle of the stitch cam will represent approximately the angle of the knitting wave formed by the cam, the desired independent operation of the needles will not be attained even with 45° or 50° cams. Take for example a normal stitch of twenty-two needles to the inch. These needles are spaced .046″ from center to center, will take .150″ of yarn each, and must therefore be retracted below the knock-over a distance of .075″. But even a 50° cam would depress the needle only .05″ before making contact with the next needle. The result is in present day machines that the following needle will have begun to kink the feeding yarn against the knock-over surfaces of the adjacent web holders before the first needle has been retracted to its maximum down position, thus causing considerable strain on the feeding yarn.

In order to relieve this strain and prevent a breaking of the feeding yarn, the stitch cam is sharply pointed so that the next preceding needle is permitted to rise slightly and give up part of its yarn. The regularity of the length of loops formed depends therefore considerably on how quickly or how slowly this needle permits the robbing yarn to draw it upwardly. If this needle has considerable resistance, greater yarn strain is built up and longer loops are formed, whereas if it is free to come up there is less yarn strain and shorter loops will be formed.

To obviate the disadvantages of this method of knitting, consisting principally in the uneven nature of the loops formed and the undue straining of the yarn, one feature of the invention consists in the novel arrangement and mode of operation of the needle operating means hereinafter to be described.

After the needles have been retracted drawing the new loops below the knock-over level, it is customary to raise them again immediately to a greater or less extent by means of a cam situated directly under the stitch draw. Before the needles are raised an appreciable amount the previously knit loop must be formed beyond the back line of the rising needle. This is usually accomplished by means of web holders which act to force the heads of the loops beyond the backs of the needles, the length of the forward stroke being limited in accordance with the amount of yarn measured off by the needles. Because the amount of yarn taken by each needle varies to some extent, as above pointed out, it has heretofore been found to be impossible to set the web holder actuating cam with any great degree of accuracy, and it has been found desirable to guard against undue yarn strain from this source by making this cam pointed so that the web holders, if the yarn strain is great enough, may be forced out immediately.

The results of this system of knitting are very haphazard, being attended by a continual robbing and sawing action, and varying greatly with the nature and tension of the yarn and with the speed of knitting and with the various frictional factors in the machine.

Another feature of the invention consists in a novel and improved web holder actuating device which causes the web holders to draw the loops out evenly and to the full

limit of the length of yarn previously drawn without undue strain. This feature of the invention also makes possible the production of small sinker loop fabric with the ordinary robbing system of knitting by making the needle loops relatively large as compared to the sinker loops, thus making a fine gauge appearing fabric.

A further feature of the invention consists in the use of a light angle needle draw-down cam for the purpose of retracting the needles at a comparatively slow rate at that part of the needle stroke when the needle latches are being closed by coming in contact with the previously knit loop. The relatively high speed with which the needles ordinarily move at this point places a considerable strain on the previously knit loops and since the latches offer a varying amount of resistance to the closing action of the loops the result is to make the loops uneven. By the use of light angle draw-down cams, the strain is diminished, tending to make this unevenness less pronounced.

The various features of the invention consist also in the devices, combinations and arrangement of parts hereinafter described and claimed and, together with the advantages to be obtained thereby, will be readily understood by one skilled in the art from the following description taken in connection with the accompanying drawings, in which Fig. 1 is a diagrammatic developed view of a portion of a needle cylinder with needles and operating cams illustrating certain features of the present invention; Fig. 2 is a cross section of the portion of the needle cylinder illustrated in Fig. 1 only so much of the machine being disclosed as is necessary to show the application of the present invention thereto; Fig. 3 is a plan view showing a portion of the top of the needle cylinder with needles, web holders and web holder operating cams; Fig. 4 is a detailed plan view of the needle accelerating lever; Fig. 5 is a side view of the same; Fig. 6 is a side view of a needle jack; and Fig. 7 is an end view of the same; Figs. 8, 9 and 10 are sectional views similar to Fig. 2, Fig. 8 showing the needle at the top of its stroke, Fig. 9 showing the needle partially retracted but before the needle has been drawn below the knock-over level, and Fig. 10 illustrating the needle retracted almost to its fullest extent; and Fig. 11 is a somewhat diagrammatic view illustrating the path taken by the needle in its retracting movement as shown by Fig. 1.

The invention is herein disclosed as embodied in an ordinary circular latch needle knitting machine equipped with ordinary latch needles and web holders which are mounted on a web holder dial fixed to the needle cylinder.

Referring specifically to the drawings which illustrate the present invention, the needles are indicated at 7 and the web holders at 8. The needle stitch cam is shown at 10 and the auxiliary stitch cam at 9, each having comparatively slightly angled surfaces and a long maximum draw surface. As in the ordinary construction, there is the corresponding raising cam 11, center cam 12 and a stitch cam spring guard 13. The needles are carried in slots provided in the needle cylinder 14 and are controlled by means of the needle jacks 15 equipped with butts 15*a* and mounted to slide in the lower portion of the needle slots. The upper portion of each jack projects outwardly from the needle cylinder in the form of a hook, within which is placed the normally horizontal needle accelerating lever 16. The outer end of the lever is provided with two prongs 16*b*, which serve to lock this end of the lever in contact with the hook. The inner end of the lever is tapered to fit into the corresponding needle groove and is notched to receive the needle butt 7*a*.

As a needle jack 15 is drawn down by the stitch cam 10, the needle accelerating lever 16 will tend to swing about the needle butt 7*a* as a pivot until it comes in contact with the tip 15*b* of the hook on the needle jack, when the parts will be locked in position and the needle will be drawn at a rate corresponding to the inclination of the draw-down surface of the stitch cam 10. A relatively slow retracting movement is thus imparted to the needle during that part of its stroke when the needle latches are being closed by contact with the old loops preparatory to drawing the new loops through the old, and the strain on the old loops incident to this operation is materially decreased.

As the jack butts 15*a* reach the surface *a* of the stitch cam 10, marking the maximum draw point of the jacks 15, the needle accelerating levers 16 are brought into contact with the cam surface 9*a* of the auxiliary stitch cam 9, causing these levers to be depressed to a horizontal position and causing the needles to be drawn down during the latter part of their downward stroke at a much faster pace. With this arrangement, each needle will have been drawn down to its maximum low position as marked by the surface 9*b* of the cam 9 before the next succeeding needle has begun to kink the feeding yarn so that no undue strain is placed on the feeding yarn from this source. Further departing from the usual practice in machines of the type here disclosed where the stitch cam is ordinarily shaped to permit yarn robbing of the preceding needles, the maximum draw point surfaces *a* of the cam 10 and 9*b* of the cam 9 are made relatively broad so that each needle will be held in its maximum low position while yarn kinks are being formed by several succeeding needles. Each kink or loop of yarn will consequently be

drawn entirely from the feeding yarn while the needles holding the previously knit loops will retain the entire amount of yarn drawn by them.

Directly after the needles have reached their maximum down position and before they have been advanced any appreciable amount by the raising cam 11, the web holders 8 are caused to advance, reforming the new loops to the backs of the needles. The advancing cam 18 provided for this purpose, and the web holder guard and cover cam indicated at 19 are mounted on a plate 22 which is pivotally mounted at 24 on the web holder cam ring 26 and are held yieldingly in position by means of a spring 20 mounted at 21 on the cam ring to bear against the plate 22. By the use of the spring seated cam described, it is possible to force the new loops back of the needles to the full extent of the yarn contained in each loop without placing undue strain on the yarn, due to any irregularities in the loops and so to enlarge the needle wale loops at the expense of the sinker wale loops.

The cam as illustrated on the drawings is provided with a comparatively long maximum advance surface so that several web holders are held in advanced position at a time, tending further to iron out irregularities in the succeeding loops. The web holders are then relieved or withdrawn somewhat by the surface 19′ of the cover cam 19.

The operation of the machine has already been indicated but may be briefly summarized as follows: After the needles have been raised to the clear position preparatory to taking new yarn, the stitch cam 10 is brought into contact with the butts 15*a*, causing the needles to be depressed to take the new yarn and cast off the old loops. The relatively slow rate at which the needles are retracted during this portion of their downward stroke due to the slight angle of the stitch cam 10 causes a relatively small strain to be placed on these loops in closing the needle latches and tends to reduce to a minimum any irregularities in the lengths of these loops which might result from the varying resistance offered by the succeeding latches to the closing pull of the loops. After the needle jacks have reached a maximum down position, as indicated by needle *a*′ and its corresponding jack in Fig. 1, the needles are retracted at a much faster rate to form the new loops by the contact of the auxiliary stitch cam 9 with the needle accelerating levers 16, each needle being brought to a maximum low position before the succeeding needle has begun to kink the yarn around the knock-overs.

Each needle is held in its maximum down position during the kinking movement of several succeeding needles by the maximum draw surface 9*b* of the cam 9 so that each needle holds the full amount of yarn drawn by it without robbing by the succeeding needles and making possible a much greater uniformity in the loops drawn than has heretofore been achieved.

The web holders are now advanced before the needles have been permitted to rise any appreciable extent to reform the new loops to the backs of the needles thus causing the needle wale loops to be lengthened at the expense of the sinker wale loops. The spring seated advancing cam utilized for this purpose has a broad maximum advance surface so that several web holders are in advanced position at the same time tending still further to iron out any inequalities remaining in the loops. The web holders are then retracted slightly or relieved by the surface 19′ of the web holder cover cam to prevent any unnecessary straining of the yarn.

The nature and scope of the invention having been indicated and one embodiment thereof in a circular latch needle knitting machine having been described, what is claimed is:

1. In a knitting machine in which yarn is fed directly to the needles the combination of a series of needles, knock-over surfaces associated with the needles, means for actuating the needles to form new loops, means for imparting an accelerating downward movement to each of the needles in turn to cause each to knock over its loop to the fullest extent before the yarn is kinked about the knockover surfaces by the next succeeding needle, and means for holding each needle at the limit of its downward stroke during the forming of a plurality of loops.

2. In a knitting machine in which yarn is fed directly to the needles the combination of a series of needles, knock-over surfaces associated with the needles, means for actuating the needles to form new loops, means for causing each needle in turn to knock over its loop to the fullest extent before the yarn is kinked about the knock-over surfaces by the next succeeding needle, and means for holding a plurality of needles at a time at the limit of their downward strokes so that the amount of yarn originally measured off by them is not lessened.

3. In a knitting machine in which yarn is fed directly to the needles the combination of a series of needles, knock-over surfaces associated with the needles, means for feeding yarn to the needles, a cam for moving the needles to kink new yarn between the knock-over surfaces and operating to hold the needles in such a position that the amount of yarn originally kinked will not vary and means for accelerating the downward movement of each of the needles in turn to cause each to knock over its loop to the fullest extent before the yarn is kinked about the

knock-over surfaces by the next succeeding needle.

4. In a knitting machine in which yarn is fed directly to the needles the combination of a series of needles, knock-over surfaces associated with the needles, means for feeding yarn to the needles, cam means for moving the needles to kink the feeding yarn between the knock-over surfaces and operating to hold each needle at the limit of its kinking movement during the kinking movement of the succeeding needle and means auxiliary to said cam means for causing each needle to knock over its loop to the fullest extent before the yarn is kinked about the knockover surfaces by the next succeeding needle.

5. In a knitting machine in which yarn is fed directly to the needles the combination of a series of needles, knockover surfaces associated therewith, cam means for retracting the needles to a position to kink the yarn over the knockover surfaces, and auxiliary means for causing the needles successively to form kinks in the feeding yarn so that the kinking movement of each needle is completed before the feeding yarn is kinked by the succeeding needle.

6. In a knitting machine in which yarn is fed directly to the needles the combination of a series of needles, a stitch cam for moving the needles successively to form kinks in the feeding yarn, an auxiliary stitch cam and means cooperating therewith for accelerating the kinking movement of the needles.

7. In a knitting machine in which yarn is fed directly to the needles the combination of a series of needles, a stitch cam for moving the needles successively to form kinks in the feeding yarn, an auxiliary stitch cam and means cooperating therewith for accelerating the kinking movement of the needles so that the kinking movement of each needle is completed before the yarn is kinked by the succeeding needle.

8. In a knitting machine in which the yarn is fed directly to the needles the combination of a series of needles, a stitch cam for moving the needles successively to form kinks in the feeding yarn, a series of levers cooperating with the needles, and an auxiliary stitch cam for operating the levers to accelerate the kinking movement of the needles.

9. In a knitting machine in which yarn is fed directly to the needles the combination of a series of needles, cam means for successively operating the needles having a maximum draw point of a length to hold down a plurality of needles to prevent robbing, means for accelerating the downward movement of each of the needles in turn to cause each to knock over its loop to the fullest extent before the yarn is kinked about the knock-over surfaces by the next succeeding needle, a series of web holders having knock-over surfaces against which kinks are formed by the needles, and a spring seated cam for advancing the web holders to reform the same kinks at the same place in the yarn the kinks were originally formed.

10. In a knitting machine in which yarn is fed directly to the needles the combination of a series of needles, a series of web holders having knock-over surfaces and operating on a plane at substantially right angles to the needles, a needle stitch cam having its maximum draw point surface of such length to hold down a plurality of needles so that the original amount of yarn kinked by each needle will not be lessened by the yarn kinking of the succeeding needles, and a spring seated cam for actuating the web holders to reform the kinks made by the needles.

11. In a knitting machine in which yarn is fed directly to the needles the combination of a series of needles, a series of web holders operating at approximately right angles to the needles and having knock-over surfaces cooperating with the needles, cam means for causing the needles to kink the feeding yarn about the knock-overs and operating to hold down a plurality of needles to prevent robbing, means for causing each needle in turn to knock over its loop to the fullest extent before the yarn is kinked about the knock-over surfaces by the next succeeding needle, and a spring seated cam for causing the web holders to re-kink the loops to the limit of the amount of yarn originally measured out.

12. In a knitting machine the combination of a series of needles, a series of web holders having knock-over surfaces cooperating therewith, a spring seated cam for yieldingly advancing the web holders and having its maximum thrust surface of such length to hold a plurality of web holders at a uniform maximum thrust at the same time, a corresponding cam surface to prevent the web holders from advancing beyond the limit set by the advancing cam, and means for withdrawing the web holders slightly from the position to which they were extended by the advancing cam.

13. In a knitting machine the combination of a series of needles, jacks for the needles, a series of levers connecting the needles to the jacks permitting limited play between needles and jacks, a stitch cam for moving the jacks, and an auxiliary stitch cam cooperating with the levers to accelerate a portion of the retracting movement of the needles.

14. In a knitting machine the combination of a series of needles, a series of web holders having knock-over surfaces cooperating therewith, means for drawing the needles down to take yarn, and means for causing each needle during this downward movement to be accelerated to cause each needle in turn to knock over its loop to the fullest extent before the yarn is kinked about the knock-over surfaces by the next succeeding needle.

15. In a knitting machine in which yarn is fed directly to the needles, the combination of a series of needles, knockover surfaces associated with the needles, means for retracting the needles to take new yarn and cast off the old loops at a relatively slow rate, and means for retracting the needles to the knockover position at a relatively rapid rate.

16. In a knitting machine in which yarn is fed directly to the needles, the combination of a series of needles, knockover surfaces associated with the needles, means for retracting the needles to take new yarn and cast off the old loops at a relatively slow rate, and means for retracting each needle to the knockover position at a relatively rapid rate to cause each needle to knock over its loop to the fullest extent before the yarn is kinked about the knockover surfaces by the next succeeding needle.

17. In a knitting machine in which yarn is fed directly to the needles, the combination of a series of needles, knockover surfaces associated with the needles, means for retracting the needles to take new yarn and cast off the old loops, and auxiliary means for retracting the needles to the knockover position so that each loop will be knocked over by its needle to the fullest extent before the yarn is kinked about the knockover surfaces by the next succeeding needle.

In testimony whereof I have signed my name to this specification.

MAX C. MILLER.