June 11, 1946. E. ST. PIERRE 2,402,098

KNITTING MACHINE

Filed April 25, 1945 2 Sheets-Sheet 1

FIG. 1.

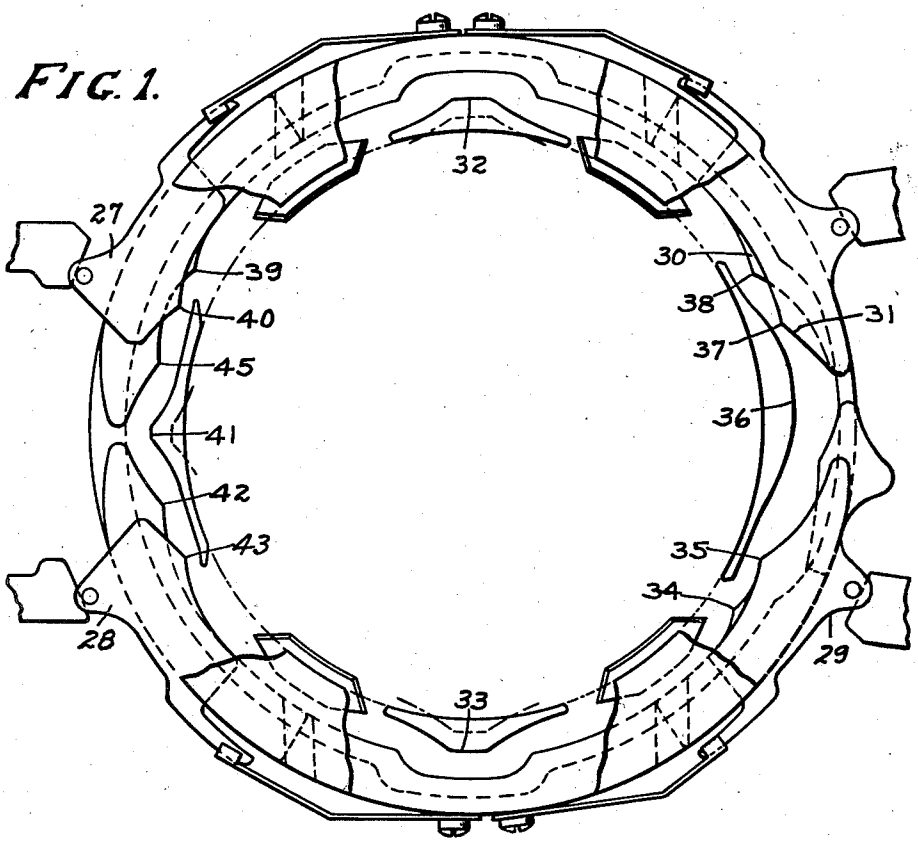
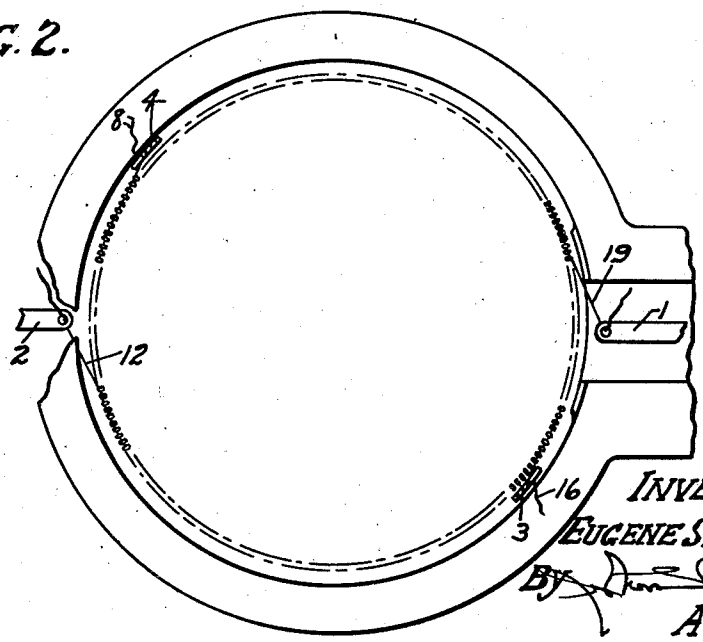


FIG. 2.



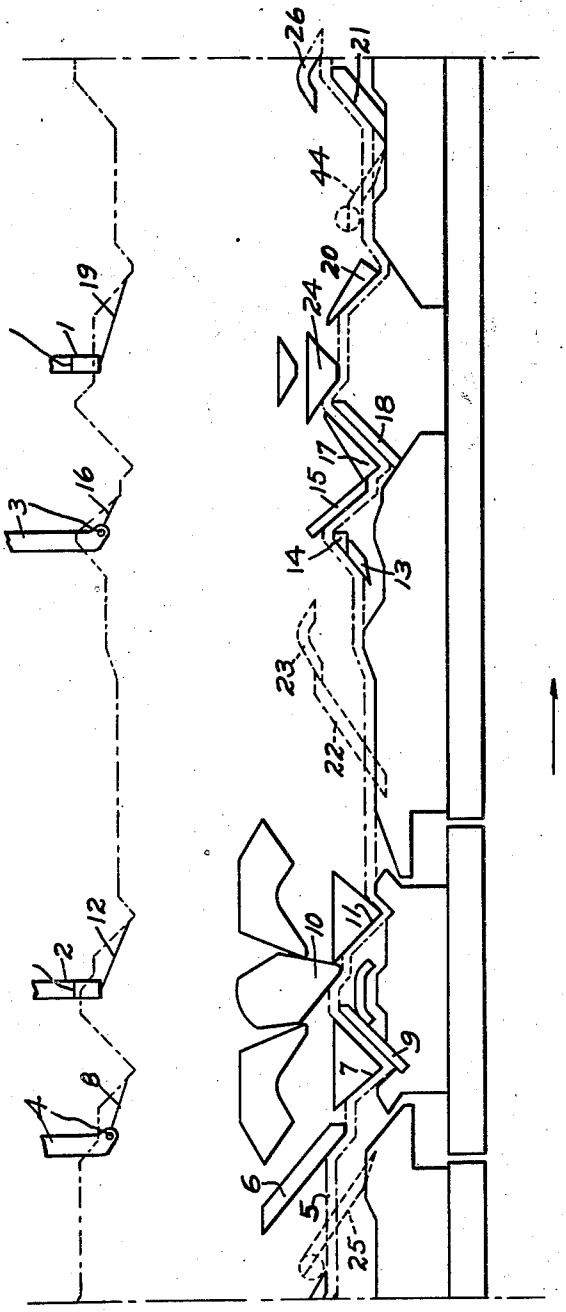
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FIG. 3.



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2,402,098

UNITED STATES PATENT OFFICE

2,402,098

KNITTING MACHINE

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2 Claims. (Cl. 66—43)

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This invention relates to a method of knitting and to an improvement in knitting machines of the kind in which the leg of a stocking is knit of a plurality of yarns all of which are independently fed and knit during each revolution of the needle cylinder whereby an equivalent number of courses of the stocking are produced. The invention also relates to a method of multi-feed knitting of this character. Although the machine and method are peculiarly adapted to the knitting of stockings of the finer grades, sheer ladies' stockings, for example, they may be employed for making any desired type or weight of circularly knit stockings. The invention, as shown in the accompanying drawings, is designed for the Banner type of circular, independent needle, knitting machine but is readily adaptable to any other type of circular machine.

In the drawings:

Fig. 1 is a plan view of a sinker cam cap embodying the invention.

Fig. 2 is a plan view of a carrier ring showing the needle circle and multiple yarn feeds; and

Fig. 3 is a diagrammatic lay out of suitable needle cams and also showing the approximate relation of the several yarn feeds.

In Figs. 2 and 3, four yarn feeds 1, 2, 3 and 4 are shown, each of which is capable of feeding a separate yarn to the needles. Yarn feeds 1 and 2 may be the usual main and auxiliary feeds. Yarn feed 3 is positioned ahead of the main feed 1 so that the yarn fed by it can be knit under the front stitch cam of the main cam block. Yarn feed 4 is positioned behind the rear stitch cam of the auxiliary block so that it can feed its yarn to knit under the rear auxiliary stitch cam.

A suitable needle cam arrangement is snown in Fig. 3. The cams shown in full line are those required for four feed rotary knitting in counter-clockwise direction, indicated by the arrow. The cams shown in dotted line are not required for this knitting and are movable out of operating position. As indicated by broken line 5 in Fig. 3, the needles are lowered by cam 6 so that they will engage and pass under rear auxiliary stitch cam 7 to knit the yarn 8 fed by yarn feed 4. Thereafter the needles are raised again by cam 9 to transfer the newly knitted loops from the hooks to the shanks of the needles below the latches. Thereupon the needles immediately pass down center cam 10 and front auxiliary stitch cam 11 to knit again after receiving yarn 12 from yarn feed 2. They then travel along the indicated path until they are raised by raise cams 13 and 14 to transfer the loops of yarn 12 to the

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shanks below the latches whereupon the needles move down along cam 15, receive a third yarn 16 from yarn feed 3 and knit under front main stitch cam 17. They then move up raise cam 18 to clear the latches of these newly knitted loops and receive yarn 19 from yarn feed 1 while passing down rear main stitch cam 20 under which they knit this yarn. Thereafter their latches are cleared as they pass up raise cam 21 to repeat the cycle. In this way, four courses are in simultaneous production during each rotation of the cylinder and, in consequence, the normal production of the ordinary circular knitting machines is greatly increased.

If the stocking foot is also knit in the rotary manner it can proceed as above described, all four yarn feeds being active. For finer and better grades of stockings, however, split knitting is to be preferred. If this method is followed, multi-feed knitting is preferably discontinued. Specifically, yarn feeds 3 and 4 may be moved out of operating position and split knitting continued with auxiliary feed 2 feeding the instep yarn to needles of the long butt group and yarn feed 1 feeding the sole yarn to the needles of the short butt group in the usual way. During such split foot knitting, needle cams 6, 9, 14, 15, 18 and 21 are withdrawn from action and the cams shown in dotted line in Fig. 3 brought into action. The path followed by the long and short butt groups of needles in each direction of reciprocatory knitting is the usual one requiring no detailed description. The long butt needles will knit under auxiliary stitch cam 11 in one direction and under auxiliary stitch cam 7 in the other. The short butt needles will knit under main stitch cam 20 in one direction and under main stitch cam 17 in the other. After knitting in counter-clockwise direction, the long butt needles are raised by cams 22 and 23 so that they will pass above the stitch cams 17 and 20 and center cam 24 in the usual way. In clockwise knitting, they are similarly raised by cams 25 and 26.

The heel and toe may be knitted in the usual way by needles of the short butt group operated by the cams of the main cam block. During this knitting the needles of the instep group do not knit. To effect this, auxiliary center cam 10 may be withdrawn.

Associated with needle cams of this character is a sinker cam cap such as that shown in Fig. 1. The most perfect fabric is produced by the method in which the yarn is drawn over the backs of the sinkers behind the nibs instead of in their throats. This method is disclosed and described

in U. S. Patents #2,374,857 and #2,360,668. Since this invention was made primarily for the production of the most perfect sheer fabric possible, the sinker cam cap shown is one adapted to the above method. In addition to the usual cams, it includes on the auxiliary side two flopper cams 27 and 28 and on the main side two flopper cams 29 and 30 and a third flopper cam 31. It also includes two drawing out cams 32 and 33 not found in the usual rotary or split foot sinker cam cap. With this arrangement, all four yarns 8, 12, 16 and 19 may be drawn over the backs of sinkers and otherwise manipulated in accordance with the method mentioned above.

During rotary knitting all of the flopper cams 27—31 are in their inward, active positions shown in Fig. 1. By means of cam 34, the sinkers are moved in sooner and further than usual so that they will receive yarn 16 over their backs behind their nibs. After receiving yarn 16 from yarn feed 3 and knitting it under front stitch cam 17 of the main cam block, at which time the sinkers are moved in by point 35 of flopper cam 29 for casting off, the sinkers continue to rotate and are drawn out by center cam 36 to transfer the newly drawn loops from their backs to their throats over their nibs. Then the sinkers are pushed in again earlier and sooner than usual by point 37 of flopper cam 31 as a preliminary to receiving yarn 19, fed by yarn feed 1, over their backs. When this yarn is knit under rear main stitch cam 20, the sinkers are moved in for casting off by point 38 of flopper cam 30.

Further rotation of the sinkers causes them to be drawn out by cam 32 to transfer the newly formed loops of yarn 19 from the backs to the throats of the sinkers. Thereafter they are moved in again by cam 39 to receive yarn 8 fed by yarn feed 4 over their backs. After knitting this yarn under rear auxiliary stitch cam 7, at which time the sinkers are moved in for casting off by point 40 of flopper cam 27, the sinkers are drawn out by center cam 41 to transfer the newly made loops of yarn 12 from their backs to their throats. After this they are immediately moved in again to yarn receiving position by cam 42, draw yarn 12 fed by yarn feed 2 over their backs and knit this yarn under front auxiliary stitch cam 11, the sinkers being moved in for casting off by point 43 of flopper cam 28. To transfer these loops from the backs to the throats of the sinkers, they are drawn out by cam 33 before they are moved in again to yarn receiving position by cam 34 to begin a new cycle. By the means above described, four yarns may be separately fed and knit during each revolution of the needle cylinder.

Three feed rotary knitting by the method described may be accomplished by rendering yarn feed 3 and yarn 16 inactive and withdrawing cams 15, 18 and preferably 14 also. Then yarn 8 knits under stitch cam 7 and the latches are cleared at cam 9. Yarn 12 knits under stitch cam 11 and the latches are cleared by cams 13 and 17. Yarn 19 is knit under cam 20 and the latches released by cam 21.

For two feed knitting, yarn 19 may also be removed so that all the knitting occurs at the auxiliary side by means of yarns 8 and 12 which knit under knitting cams 7 and 11, respectively, the latches being cleared by cams 9, 13 and 21, respectively. Cam 17 is withdrawn.

Single feed rotary knitting may be accomplished by utilizing yarn feed 2 and yarn 12 only

and knitting under auxiliary stitch cam 11, cams 6, 9, 14, 15, 17 and 18 being withdrawn.

As already stated, it is advisable to perform reciprocatory knitting by two yarns only, one for the instep and one for the sole. For example, the instep may be knit at the auxiliary side by yarn 12 which is drawn over the backs of the sinkers and the sole at the main side by yarn 19 drawn in the throats of the sinkers thus utilizing the two regular main and auxiliary feeds. For such knitting, needle cams 6, 9, 14, 15, 18 and 21 are withdrawn and cams 22, 23, 25 and 44, shown in dotted line of Fig. 3, brought into action. All of the sinker cams remain as before, with the exception that flopper cam 31 is withdrawn so that the sole yarn may be drawn in the throats of the sinkers.

When knitting in counter-clockwise direction, yarn 12 is fed to the long butt group of needles only which knit under cam block 11. After knitting, the latches of these needles are cleared by cams 22 and 23. These needles are also raised by these cams so that they will pass over the knitting cams of the main cam block in the usual way. Sole yarn 19 is knit under main stitch cam 20 by needles of the short butt group, their latches having been cleared by cams 13 and 17. The sinkers are moved in to receive the yarn over their backs by cam 45.

In clockwise direction yarn 12 is knit under auxiliary stitch cam 7, the latches having been cleared during the previous counter-clockwise stroke by cams 22 and 23, as just stated, and after knitting they are again cleared by cams 25 and 26. The short butt needles knit yarn 19 at cam 17, the latches having been previously cleared by cams 44 and 20.

The heel and toe are preferably knit in the customary manner in the throats of the sinkers at the main cam block. For this purpose, the auxiliary needle cams are withdrawn so that the instep needles will not knit and the heel and toe knitting carried out with yarn 19 in the same manner as for reciprocatory knitting with the exception that flopper cam 31 is withdrawn so that the sinkers will take the yarn in their throats and will not be moved in soon enough and far enough to receive it over their backs.

In the above description, reference has been made to yarn feeds 1, 2, 3 and 4 and to yarns 8, 12, 16 and 19. This is not intended as a definition of certain specific yarn levers and yarns but rather to identify yarn feeding stations and yarns fed thereat. For example, if yarn feed 1 is referred to as feeding yarn 19, this means that a yarn feed of this particular feeding station feeds a yarn 19 of a character suitable for the part of the stocking being produced by it.

Various refinements may be added to the mechanisms described above such as stitch length regulating mechanism whereby the length of the stitches at all of the feeds may be equalized and varied at will. See, for example, U. S. Patents #2,369,780 and #2,369,781. Also a means for controlling the flopper cams 27—31 may be included so that the inward projecting of the cams can be varied automatically to conform the sinker action to the length of loops being knit. Such a mechanism is disclosed in U. S. application #533,744, filed May 2, 1944. If no such control of the sinkers is required, flopper cam 28 is not essential. A fixed cam of similar characteristics may be substituted therefor.

When knitting by the method referred to above in which the yarn is drawn over the backs of the

sinkers behind the nib, the use of sinkers having flat backs is preferable because they provide a drawing surface of a definite height so that the length of the loops drawn will be the same even through there may be slight deviations in the inward projection of certain sinkers and also so that, as long as the loops remain on the backs of the sinkers, they will be unaffected by the necessary sinker motion such, for example, as the extreme inward projection of them when casting off. Also preferably the sinkers should not move radially while the yarn is being drawn to further insure that the loop length is not influenced at this time by sinker motions.

This method of knitting is not to be confused with methods of reverse plating in which yarns are drawn over the backs of the nibs while the sinkers are moving out to obtain the correct relative placement of the two yarns and in which the loop length is necessarily influenced by the fact that the backs of the nibs are sloping. Two variables are injected into the drawing operation which when added to the fact that the motion of all sinkers can not be absolutely the same results in unwanted differences in loop length which, though small, nevertheless impair the actual and apparent perfection of the fabric. By the method

of knitting referred to herein, the needles are the only thing which are in motion in relation to the sinkers so that these disturbing factors are eliminated and much more perfect fabric obtained both as to uniformity of loop length and the shape of individual loops.

I claim:

1. In a circular, independent needle, knitting machine having main and auxiliary cam blocks and capable of split knitting, means for causing the needles to knit in succession, two independent yarns one under the front and the other under the rear stitch cam of the auxiliary cam block and for causing the needles to knit at least one other yarn under a stitch cam of the main cam block and means for positioning the sinkers so that the yarn knitted under each of said stitch cams is drawn over the backs of the sinkers.

2. In a circular, independent needle, knitting machine having main and auxiliary cam blocks and capable of split knitting, means for causing the needles to knit in succession different yarns under both stitch cams of each cam block and means for positioning the sinkers so that the yarn knitted under each stitch cam will be drawn over the backs of the sinkers.

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