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J. J. McDONOUGH

2,971,358

KNITTING MACHINE

Filed Jan. 14, 1957

2 Sheets-Sheet 1

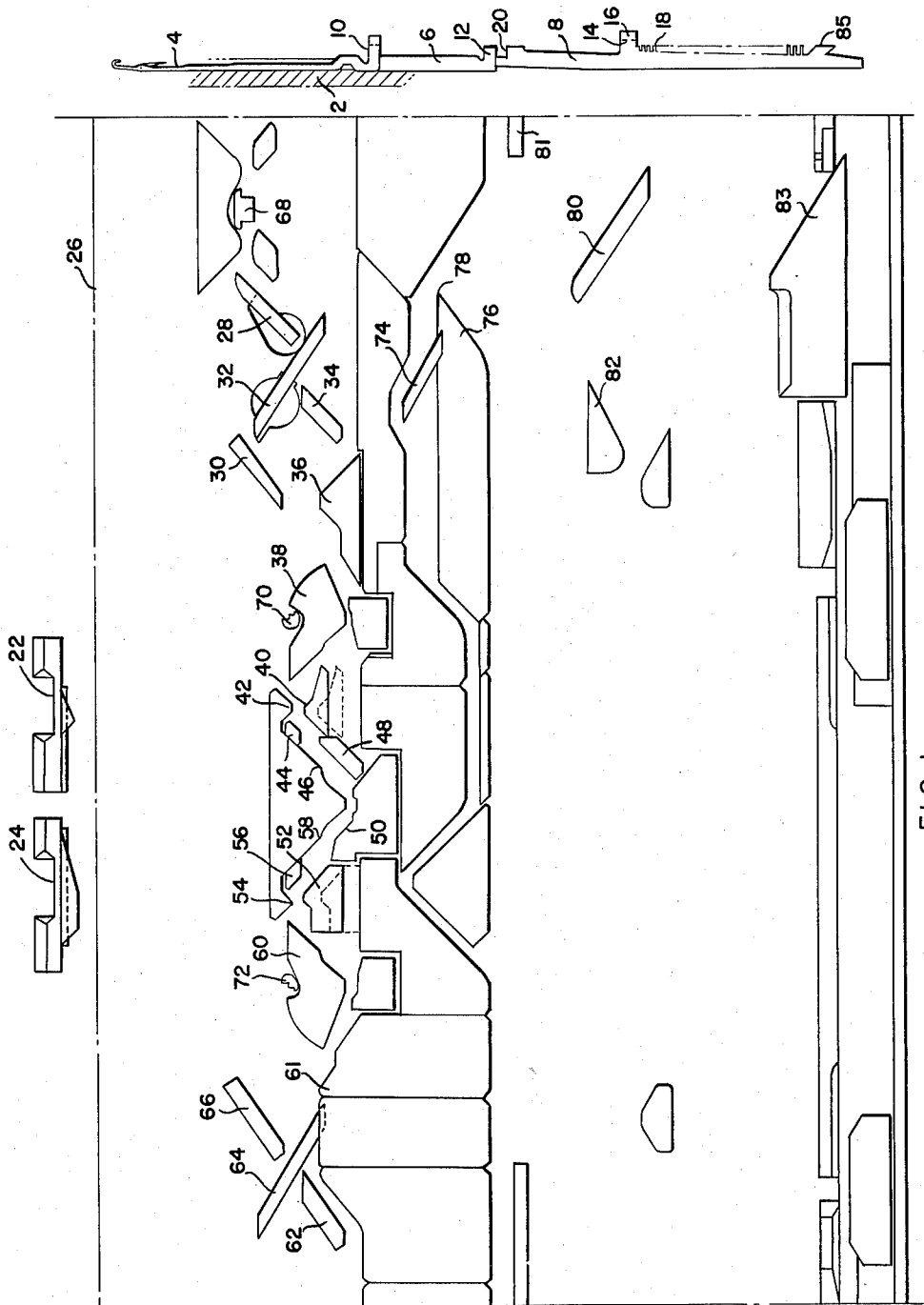


FIG. 1.

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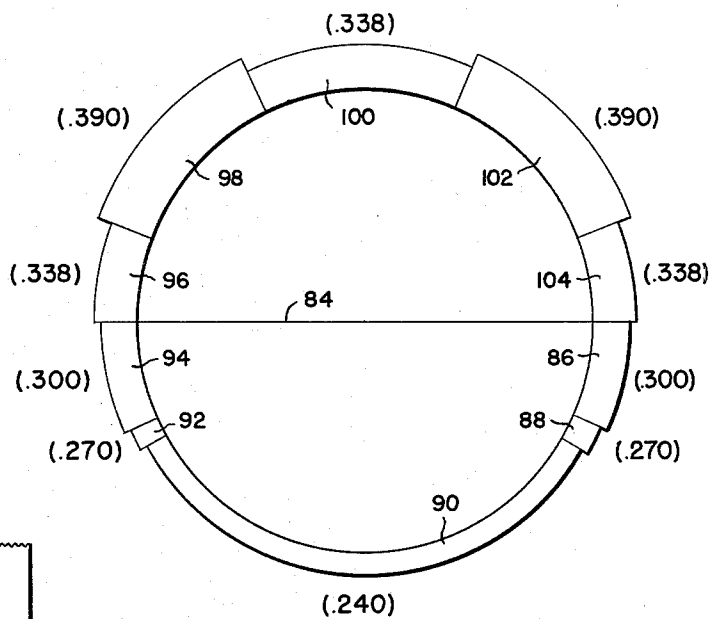


FIG. 2.

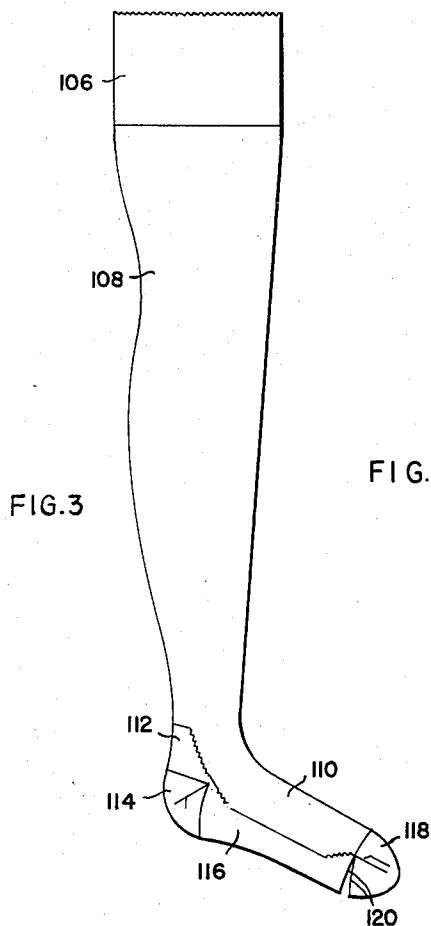


FIG. 3

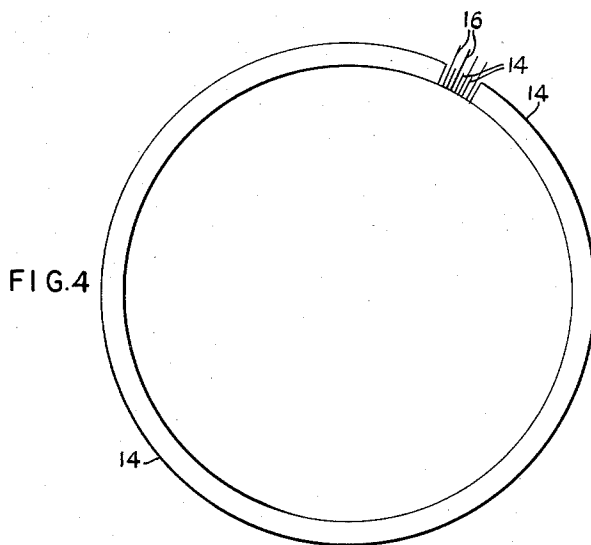


FIG. 4

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2,971,358

KNITTING MACHINE

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7 Claims. (Cl. 66—42)

This invention relates to knitting machines and methods and stockings produced thereby, and has particular reference to the effecting of proper formation of a loopers' loose course in a stocking in which a toe is knit multi-feed.

The multifeed knitting of stockings throughout, during both rotation and reciprocation, is advantageous because of the increased rate of production which results. Heretofore, when a two-feed toe was knit, knitting through the portion containing the loopers' loose course was also effected at two feeds. When looping such a stocking a serious problem has presented itself since the loopers' loose course was necessarily made at only one feed, to define a single course of loose loops, and when the doubled fabric was placed on the looper points the adjacent stitches at one end which had to be on the same point were separated walewise by a stitch resulting in a defective looping.

In order to avoid this defect, in accordance with the present invention knitting is effected so that the machine knits at only one feed after the toe is completed in order that the loopers' loose course may be formed in a normal manner and the stocking looped in conventional fashion. A difficulty arises, in that in passing from the two-feed knitting of the toe to the single feed knitting of the loose course provision must be made to close the eyelet resulting from removal of the feed. In the past machines have been designed to remove extra feeds before the heel and toe and introduce them after the heel and at other desirable points in the stocking. However, when the toe is knit at two feeds many problems are encountered in successful transition.

In accordance with the invention the loose course is formed substantially in the second course following the toe, rather than in the adjacent course as is now general practice in conventional single feed machines. However, the position may be varied as required.

The improved stocking which results is also a part of the invention.

The objects of the invention relate to the attainment of the matters just discussed and will be apparent from the following description, read in conjunction with the accompanying drawings, in which:

Figure 1 is a developed inside view of the cams which act upon needles, intermediate jacks and pattern jacks, these last elements being illustrated at the right of Figure 1;

Figure 2 is a diagram illustrating the distribution of needle butts throughout the needle circle;

Figure 3 is a diagrammatic elevation showing a stocking provided in accordance with the invention.

Figure 4 is a diagram similar to Figure 2 but showing the distribution of jack butts.

Since the invention relates solely to the matter of production of the loopers' loose course following the knitting of a two feed toe, only so much of the machine is herein shown and discussed as is pertinent to this subject matter, the construction and operation of the machine being

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otherwise essentially conventional. In particular, the machine corresponds in general, with only minor deviations, to that illustrated and described in my prior Patent 2,576,962, dated December 4, 1951. As disclosed in this patent a two feed knitting machine serves to knit a stocking utilizing the two feeds throughout, the loopers' loose course being formed during two feed knitting. The knitting procedure in accordance with the present invention is the same as described in said patent except for the matter relating to the proper transition from a two-feed toe to the single feed knitting of the looper's loose course. Reference may be made to this patent for details of the machine and its operation in knitting the other parts of a stocking.

Referring to Figure 1, the cylinder of a circular knitting machine is indicated at 2, there being mounted in slots in this cylinder in conventional fashion needles 4, intermediate jacks 6 and pattern jacks 8. The needles are provided with butts 10 which are of different lengths as will be described in detail hereafter. The intermediate jacks 6 are provided with butts 12 for cam operation thereof. The pattern jacks contain at the same level either short butts 14 or long butts 16 the distribution of which in conjunction with the needles will be later described. The pattern jacks contain the usual pattern butts 18 and otherwise are formed as is conventional and described in my prior patent. A shoulder 20 near the upper end of each pattern jack is involved in the novel operation about to be described.

The right hand feed of the machine is provided by the throat plate 22 with which are associated the usual yarn feeding fingers, no shown. The left hand feed is provided by the throat plate 24 which is also associated with conventional yarn feeding fingers. The level of the sinker ledges of the machine is indicated at 26.

Reading generally from the right to the left in Figure 1 the cams, which will be recognized as generally similar to those of my prior patent, or at least obviously equivalently operating, include the switch cam 28 adjacent to which are the cams 30, 32 and 34 which, during the operations herein discussed, are withdrawn from operation. A cam 36 is arranged to raise needles to tuck height. A cam 38 acts both as a clearing cam in forward reciprocations and during rotary knitting and as a right hand feed stitch cam during reverse reciprocatory strokes. A cam 40 in the full line position illustrated serves as a clearing cam but may be lowered to the dotted line position wherein it raises needles to tuck level. Needles are depressed during forward reciprocatory strokes and rotary knitting by the successive cams 42, 44 and 46 and are then raised during the same knitting by cams 50 and 52, the latter effecting clearing prior to approach to the left hand feed stitch cam 60. A cam 48 serves to raise needles at the right hand feed during reverse reciprocations, receiving the needles after they are depressed by the successive cams 54, 56 and 58. The stitch cam 60 provides clearing during reverse reciprocatory strokes. Cams 62, 64 and 66 are provided and are radially movable. The cams 64 and 66 are inactive in the knitting described herein.

A lowering picker is provided at 68 and raising pickers are provided at 70 and 72.

A cam 74 is arranged to act on the butts 12 of intermediate jacks. A cam 76 having a pointed end 78 is provided to act upon the shoulders 20 of pattern jacks. A cam 80 serves to act on butts 16 and a cam 82 acts upon butts 14 and 16 of the pattern jacks. The cam 80 is radially movable for purposes hereafter described.

Reference may now be made to Figure 2 which shows the distribution of needle butts about the needle circle, the needles which will be referred to as short butt needles being those below the diameter indicated at 84 while the remaining needles are long butt needles. However, the

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needles of the two series do not have butts of uniform length, but rather the butts are distributed as illustrated in Figure 2, the butts having the lengths indicated by the decimal figures which are in inches.

Referring to the butts as they move in rotary knitting, the leading short butts at 86 have 0.300 butt. This group is followed by the butts indicated at 88 measuring 0.270, and these in turn are followed by the butts 90 measuring 0.240. These are in succession followed by butts of the groups 92 and 94 having the respective length 0.270 and 0.300.

The first group 96 of long butts measure 0.338. The next succeeding group 98 measures 0.390. The central series 100 of long butts measure 0.338. The group indicated at 102 measures 0.390 and the trailing group 104 measures 0.338. These figures are, of course, arbitrary and may be changed, but they serve to indicate relative lengths which are involved in the operation. The uses of the various different length butts will in general be apparent from my prior patent. In the case of the present invention the group of primary interest is that indicated at 102. Particularly involved is the association of pattern jacks with the needles having this group of butts. The pattern jacks under all but several of the leading needles of the group 102 have short butts 14. In the case of several leading needles of this group the first and the alternate needles have associated with them jacks with long butts 16 while the intervening needles have associated with them jacks having short butts 14. The number of these alternating jacks is open to considerable choice but it is generally desirable to have at least three or four of the long butt jacks involved. As will appear later this arrangement, shown in Fig. 4, is particularly involved in the closure of the eyelet which would otherwise result from the transition from double feed to single feed knitting.

Figure 3 diagrams the stocking produced in accordance with the invention. With the exception of the region at the loopers' loose course the stocking is conventional and may take various forms. In situations in which the present invention is involved, namely in the case of two-feed toes, the stocking would ordinarily be made two-feed throughout or with the exception solely of makeup courses. Generally speaking it involves the welt 106, leg 108, instep 110, shaped high splice 112, heel 114, shaped sole 116, and toe 118, all of which, except the shaped high splice and sole, may be produced as described in my prior patent. As will be evident the invention is applicable to stockings which may omit certain of the characteristics of that illustrated or may have other characteristics. Consistently with the disclosure of my prior patent, the heel 14 is knit on the short butt sole needles while the toe 118 is knit by the long butt instep needles. Looping is accordingly effected at the bottom of the toe. It will be evident from what follows, however, that the invention is equally applicable in the knitting of stockings in which the looping is effected at the top of the toe, the toe being knit two-feed on the sole needles. From what will be described of the operation, the changes necessary to produce this latter result will be quite evident without detailed additional description.

Since the knitting is conventional down to the completion of the toe, the description of the operation may well begin with what occurs during the last reverse stroke of the needle cylinder completing the toe. At this time the removable cams 62, 64, 66, 30, 34, 32, 28 and 80 are out of action, the knitting being on the long butt series of needles, with the short butt needles riding high and inactive.

On the last reverse stroke of the needle cylinder completing the toe, during which stroke two courses are produced by two feed knitting, the switch cam 28 is fully introduced while the long butt series of needles are passing beneath it at the tuck level resulting from their rise

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over the cam 36. At the end of this stroke all of the long butt needles will have passed the cam 36 while the needles of the short butt series will be located above the knitting cams, with the leading short butt needle during this reverse stroke reaching a position short of the cam 28.

As the cylinder begins to revolve, raising cam 48 is withdrawn. The long butt needles, having been raised to tuck height by cam 36 on the last reverse stroke, are now cleared by cam 38, and are lowered by cams 42 and 44, taking yarn at the right hand feed and knitting as they pass down stitch cam 46. They are then raised by cams 50 and 52 and take yarn at the left hand feed as they pass down the stitch cam 60, thereby knitting a second course. They are then raised to tuck height by cam 61. During this movement the intermediate jack cam 74 is withdrawn.

As the cylinder continues to rotate, the short butt needles are lowered by switch cam 28 to follow the knitting path taken by the long butt needles. However, while the needles of the group 90 having the 0.240 butt are passing above cam 36 it is withdrawn, and while they are being raised by cam 38 this cam also is withdrawn after which the remaining short butts feed directly from the lower end of cam 28 to the clearing cam 40 which is in its upper position. However, the short butt needles had their latches cleared as they were elevated for the formation of the toe, and cam 40 thus serves only to elevate them before taking yarn at the right hand feed.

As the long butt needles pass the lowering cam 62 it is moved inwardly to just miss the 0.338 butt of the group 100 and as it lowers the group 102 of 0.390 butt it is moved fully inwardly to continue lowering all succeeding needles.

As the long butt needles again come around, the groups 96, 98 and 100 are fed from the cam 61 at tuck height, following the path taken by the short butt needles through the knitting cams, two-feed knitting continuing by the raising of these needles over cam 40 to clearing height, followed by their passage through the knitting cams at both feeds.

Before the leading needle of the group 102 reaches the position of the jack cam 80, this cam is moved into an active position to engage the long jack butts 16. Thereby the corresponding intermediate jacks 6 have their butts 12 raised above the point 78 of cam 76 and the first and several succeeding leading alternate needles of the group 102 associated with the jacks having long butts 16 are thus raised to tuck height. The other needles of the group 102 are not so raised and consequently pass at lowwelt level to which they were lowered by cam 62 so that they are first raised by cam 50, cams 36 and 48 having been withdrawn as previously described. The shoulders 20 of the elevated jacks engage and are partially lowered by cam 76 and are completely lowered by the action of cam 82 which is in position to engage both sets of butts 14 and 16.

The elevated needles of the group 102 which have thus been raised to tuck height by the jacks follow the needles of the group 100 up the clearing cam 40, but as soon as the last needle of the group 100 has reached the top of cam 40 and cleared its latch, the cam 40 is lowered to tuck height and, consequently, though a few of the alternate raised needles may clear their latches, the remainder of these needles pass at tuck height taking and holding the yarn fed at the right hand feed. Since the intervening and all succeeding needles were lowered by cam 62, they pass under the cam 40 and the right hand feed so as to miss the yarn at this feed. All of the needles of the group 102 are brought together at cam 50. As this occurs the needles which have not taken yarn at the right hand feed rise to provide interlacing and then all of the needles are raised first by cam 50 to its upper end and then by

cam 52 to clear and take yarn and then knit at the left hand feed to form single feed fabric.

The trailing end of yarn from the right hand feed is, therefore, taken and tucked by several alternate needles while the intervening needles miss it completely, and as all needles are raised to meet at the left hand feed the end is interlaced and knit with the yarn fed at this feed forming a complete and effective eyelet closure. The yarn finger at the right hand feed is raised as soon as the last needle has taken yarn and the inactive yarn is then clamped and cut by the conventional clamp and cutter.

Soon after the pattern jacks have been raised by cam 80 and their intermediate jacks have passed the cam 74, the former is withdrawn, and the latter is introduced in readiness for the selective clearing of needles as may be later required.

Just prior to the time the first needle of the group 96 reaches the bottom of stitch cam 60, this cam is lowered to start the loopers' loose course, and it remains in lowered position for slightly more than one revolution of the needle cylinder, when it is raised to its original position after having completed the loose course entirely in single feed fabric. If desired, the loose course may be delayed 180°, being started on the leading needle of the group 86 or further delayed if required. After a few courses of single feed fabric, following the loose course, is knit, the machine may again return to two feed knitting as follows:

The yarn finger at the right hand feed may be lowered, placing the yarn in position to be taken by the first needle elevated to knit at this feed. Cam 62 may be moved partially out during passage of the last of the long butt needles so as to miss the short butt needles of the group 90, and while they are passing, it may be fully withdrawn, so that the first needle of the group 90 and succeeding needles will approach stitch cam 46 at tuck height, thus failing to take yarn at the right hand feed. At the point where two feed knitting is to begin cam 81 is moved into action to rock out the lower ends of jacks 8 causing their butts 85 to engage and be elevated by cam 83, their corresponding needles being raised to clear height as jacks 6 are raised by cam 74. The leading cleared needle will then seize the waiting yarn at the right hand feed which will be taken and knit by all succeeding needles. An eyelet formed when the right hand feed is thus introduced is of no consequence as the fabric is unravelled or cut off and discarded when the stocking is looped.

If, on the other hand, it is desired to continue single feed knitting until the completed stocking is released from the needles by press-off, the yarn finger at the right hand feed would not then be lowered nor would cam 81 be operated to rock out jacks 8.

The various cams are moved in and out under the usual pattern control in conventional fashion and as will be evident from the disclosure of my prior patent, so that the operating connections for the movable cams need not be shown or described.

It will be evident that in accordance with the foregoing a loopers' loose course is provided by single feed knitting following the completion of a toe which is knit multifeed, with avoidance of an eyelet by reason of the interlacing of the trailing end of the removed yarn. It will be ob-

vious that various details of the invention may be varied without departing therefrom as defined in the following claims.

What is claimed is:

1. A circular knitting machine comprising needles and devices cooperating therewith for the formation of stitches, said devices comprising means for effecting multifeed knitting of the toe of a stocking during reciprocary knitting and means for effecting single feed rotary knitting of a loopers' course following completion of the toe.

2. A circular knitting machine comprising needles and devices cooperating therewith for the formation of stitches, said devices comprising means for effecting multifeed knitting of the toe of a stocking during reciprocary knitting and means for effecting single feed rotary knitting of a loopers' course following completion of the toe, the last mentioned means comprising means for effecting elimination of eyelet formation in the transition from multifeed knitting of the toe to single feed knitting involving the formation of the loopers' course.

3. A circular knitting machine comprising needles and devices cooperating therewith for the formation of stitches, said devices comprising means for effecting multifeed knitting of the toe of a stocking during reciprocary knitting and means for effecting single feed rotary knitting following completion of the toe, the last mentioned means comprising means for effecting elimination of eyelet formation in the transition from multifeed knitting of the toe to said single feed knitting.

4. A knitting machine according to claim 2 in which the means for effecting elimination of eyelet formation effects seizure by a group of alternate needles of the trailing end of a yarn going out of action while intermediate needles miss said trailing end, thereby providing interlacing of said trailing end.

5. A knitting machine according to claim 3 in which the means for effecting elimination of eyelet formation effects seizure by a group of alternate needles of the trailing end of a yarn going out of action while intermediate needles miss said trailing end, thereby providing interlacing of said trailing end.

6. A knitting machine according to claim 2 in which the means for effecting elimination of eyelet formation effects seizure by a group of uncleared alternate needles of the trailing end of a yarn going out of action while intermediate needles miss said trailing end, thereby providing interlacing of said trailing end.

7. A knitting machine according to claim 3 in which the means for effecting elimination of eyelet formation effects seizure by a group of uncleared alternate needles of the trailing end of a yarn going out of action while intermediate needles miss said trailing end, thereby providing interlacing of said trailing end.

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