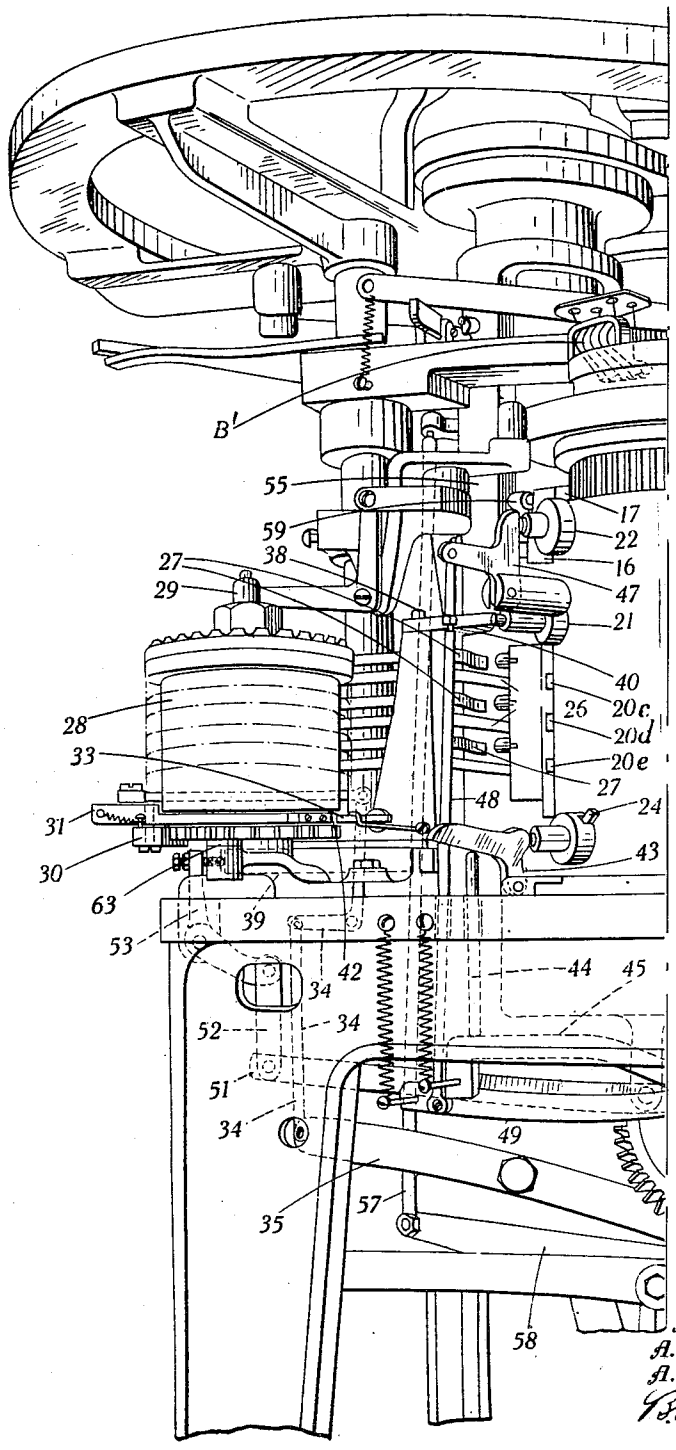
Dec. 10, 1940. A. V. CLARKE ET AL 2,224,473

KNITTING MACHINE

Filed June 16, 1939 8 Sheets-Sheet 1

Fig. 1.



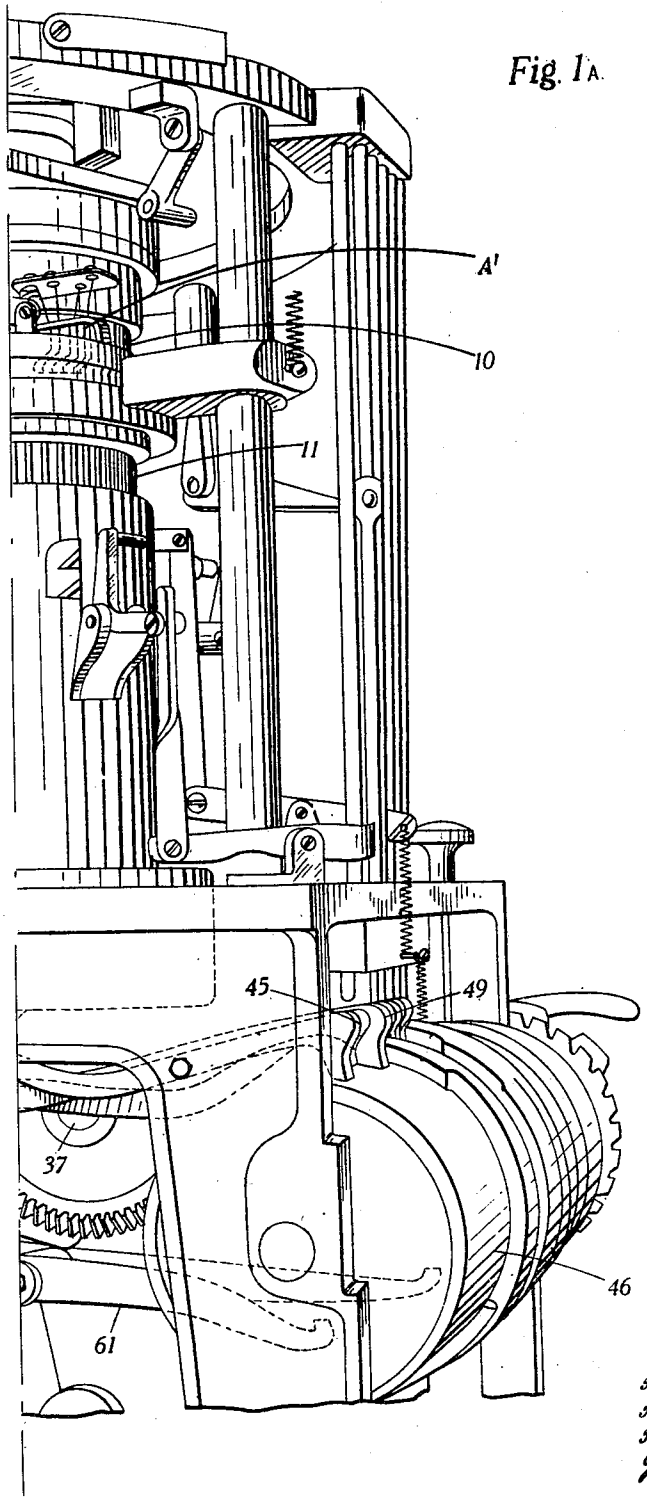
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KNITTING MACHINE

Filed June 16, 1939 8 Sheets-Sheet 2

Fig. 1A.



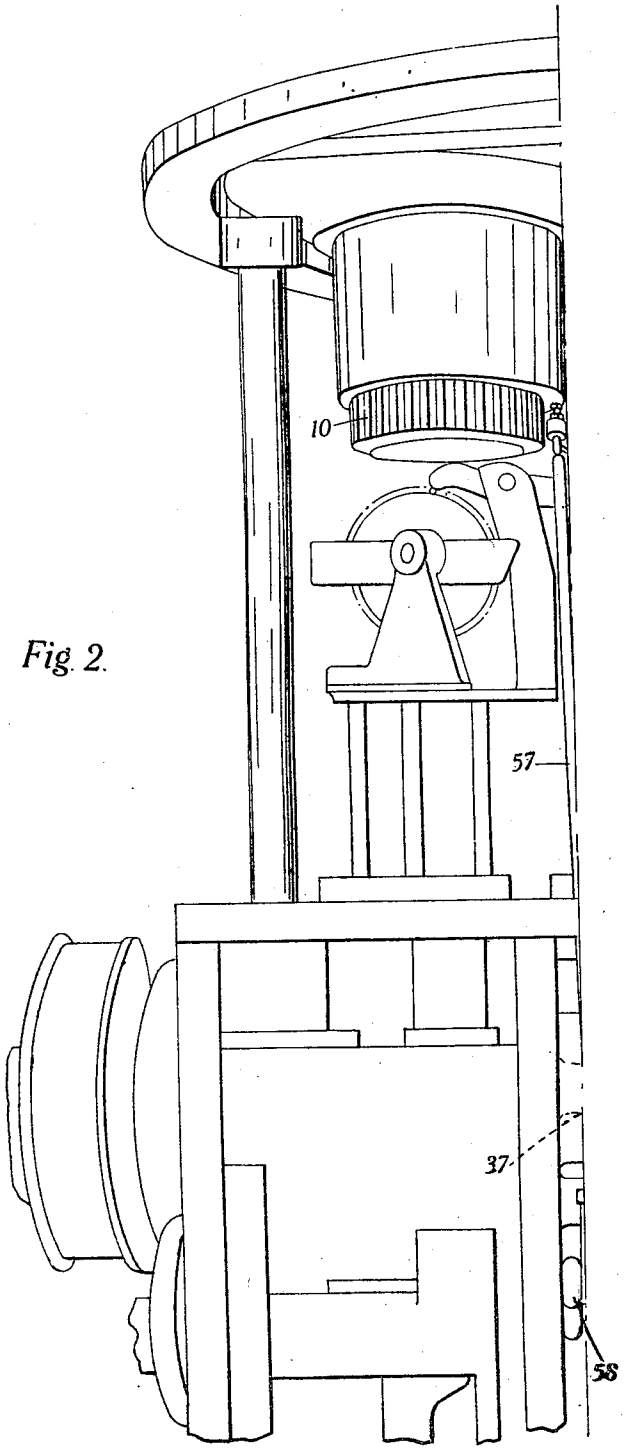
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KNITTING MACHINE

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Fig. 2.



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KNITTING MACHINE

Filed June 16, 1939 8 Sheets-Sheet 4

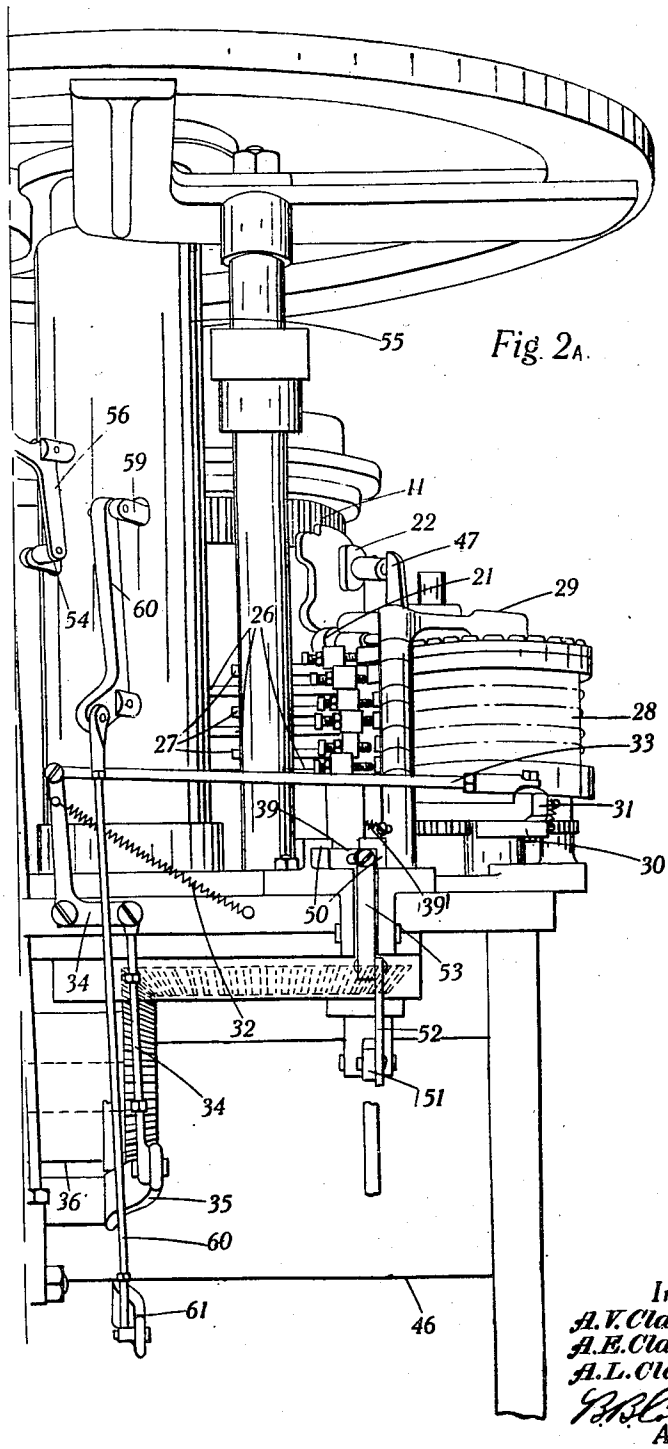


Fig. 2A.

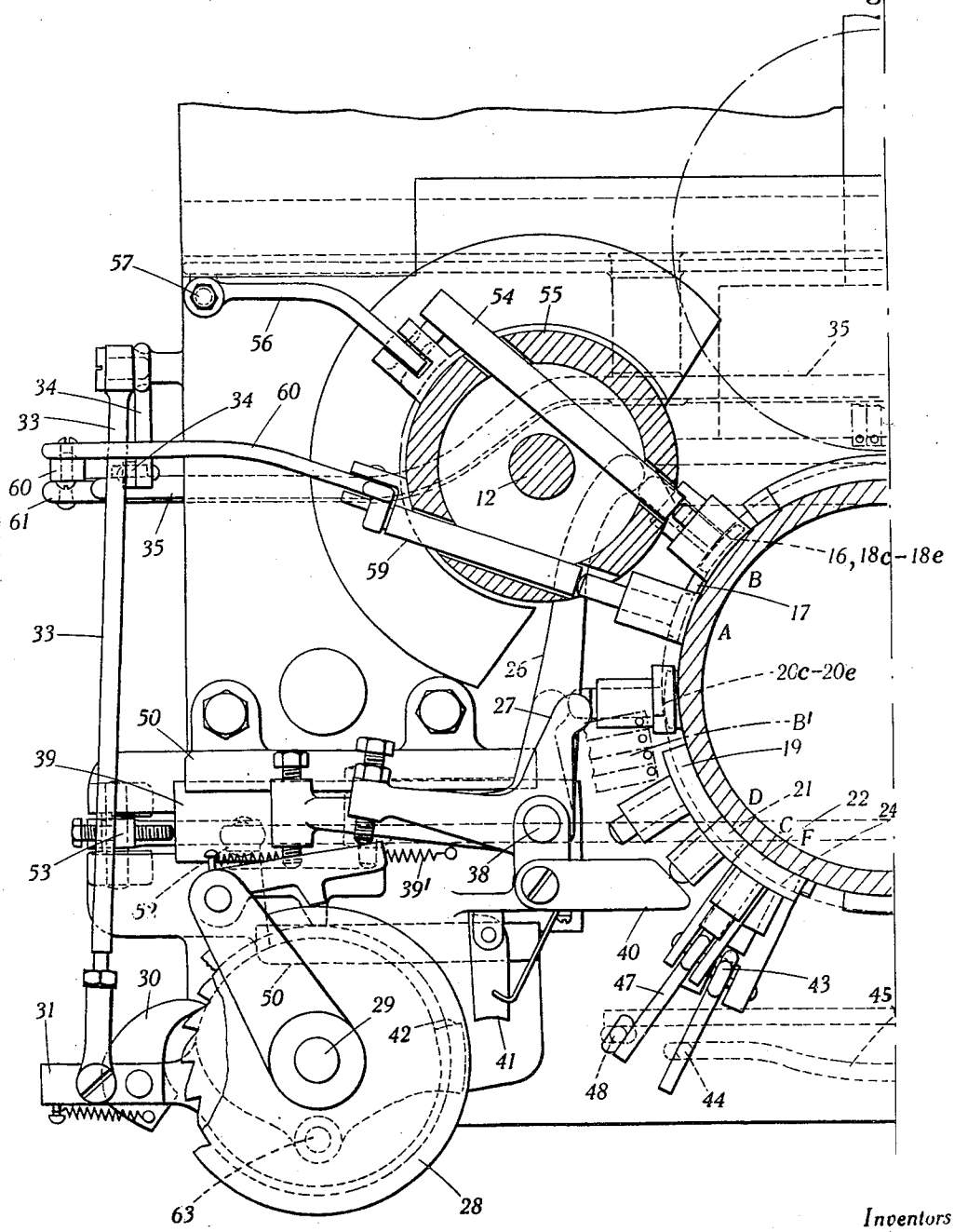
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KNITTING MACHINE

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Fig. 3.



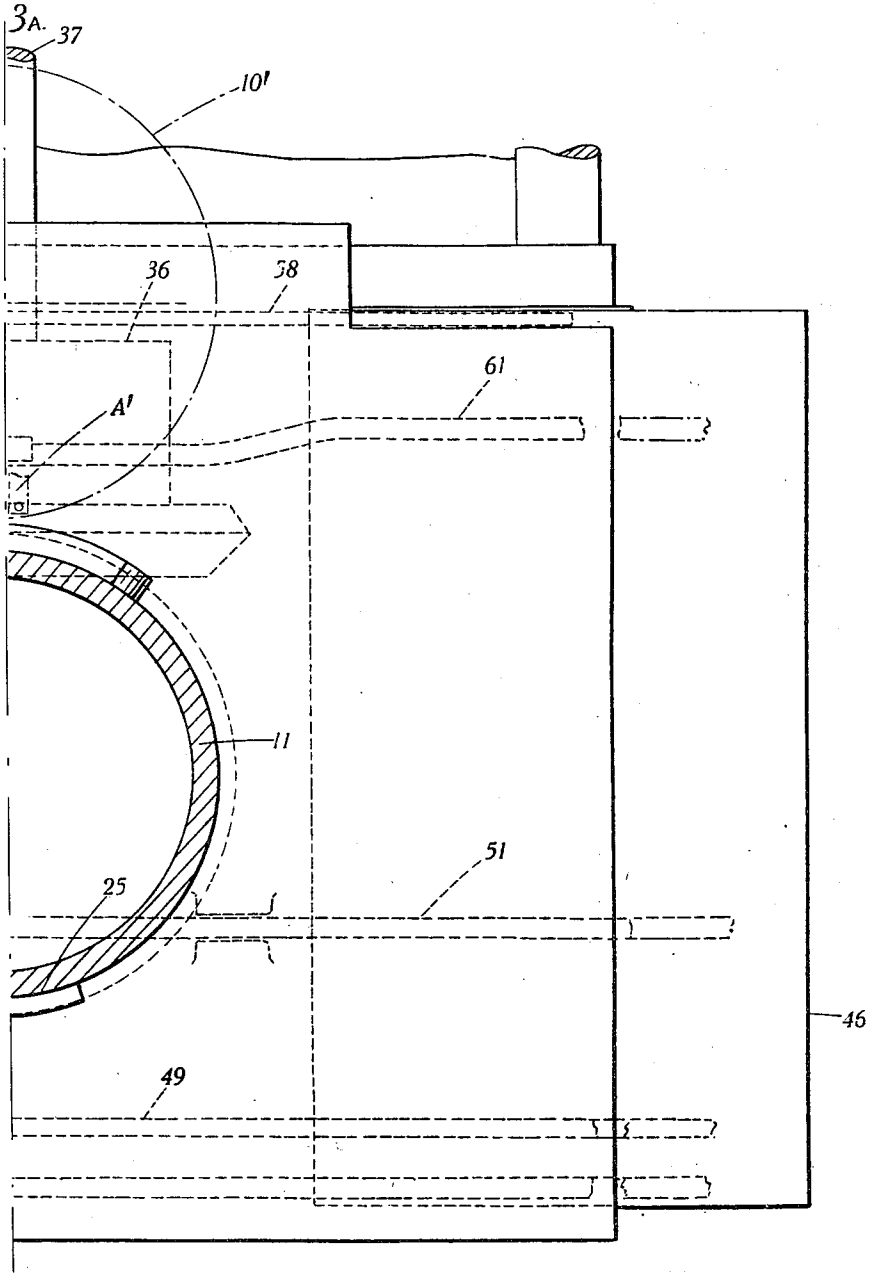
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Fig. 3A.



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KNITTING MACHINE

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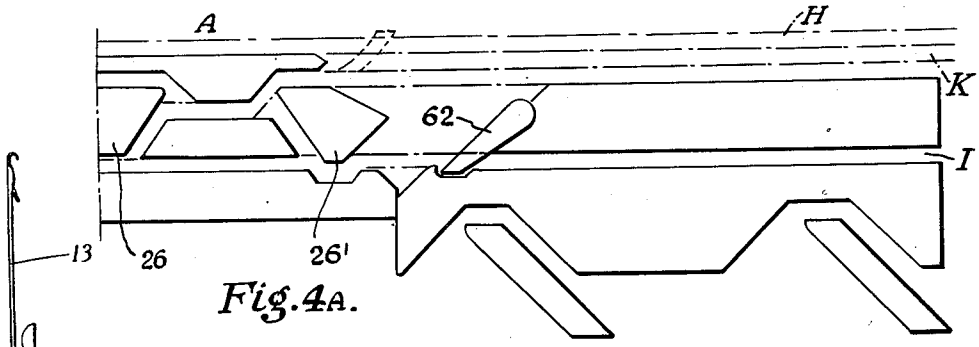


Fig. 4A.

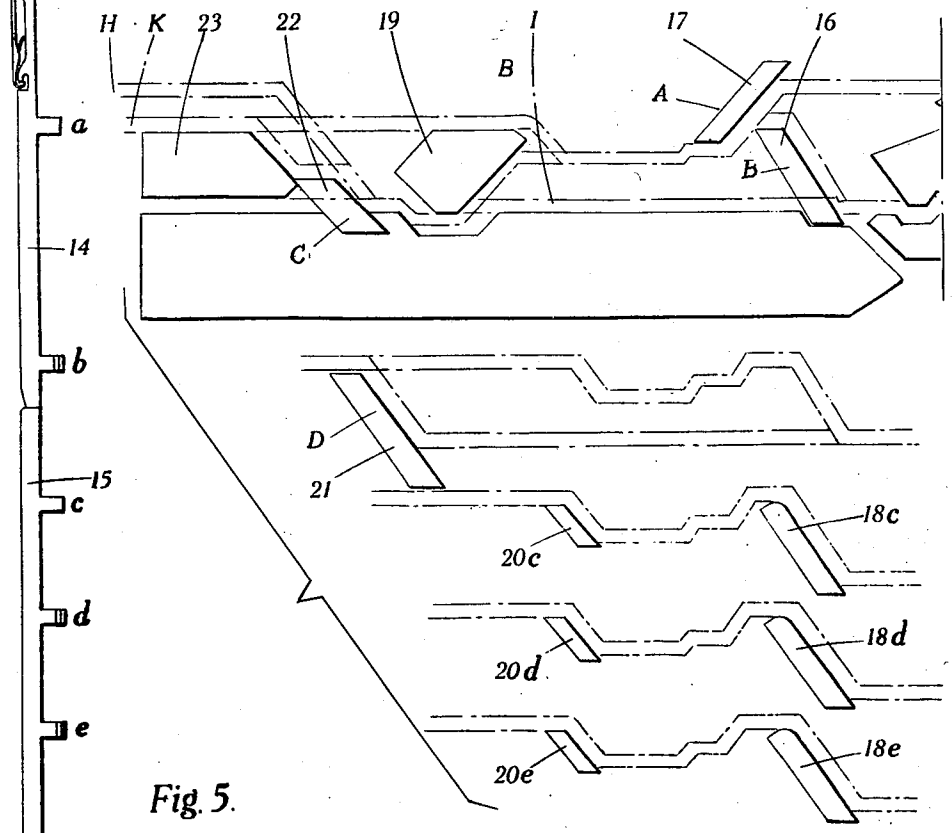


Fig. 4.

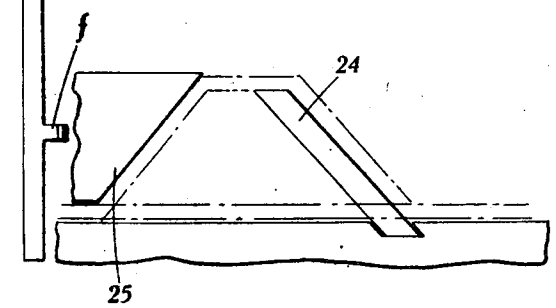


Fig. 5.

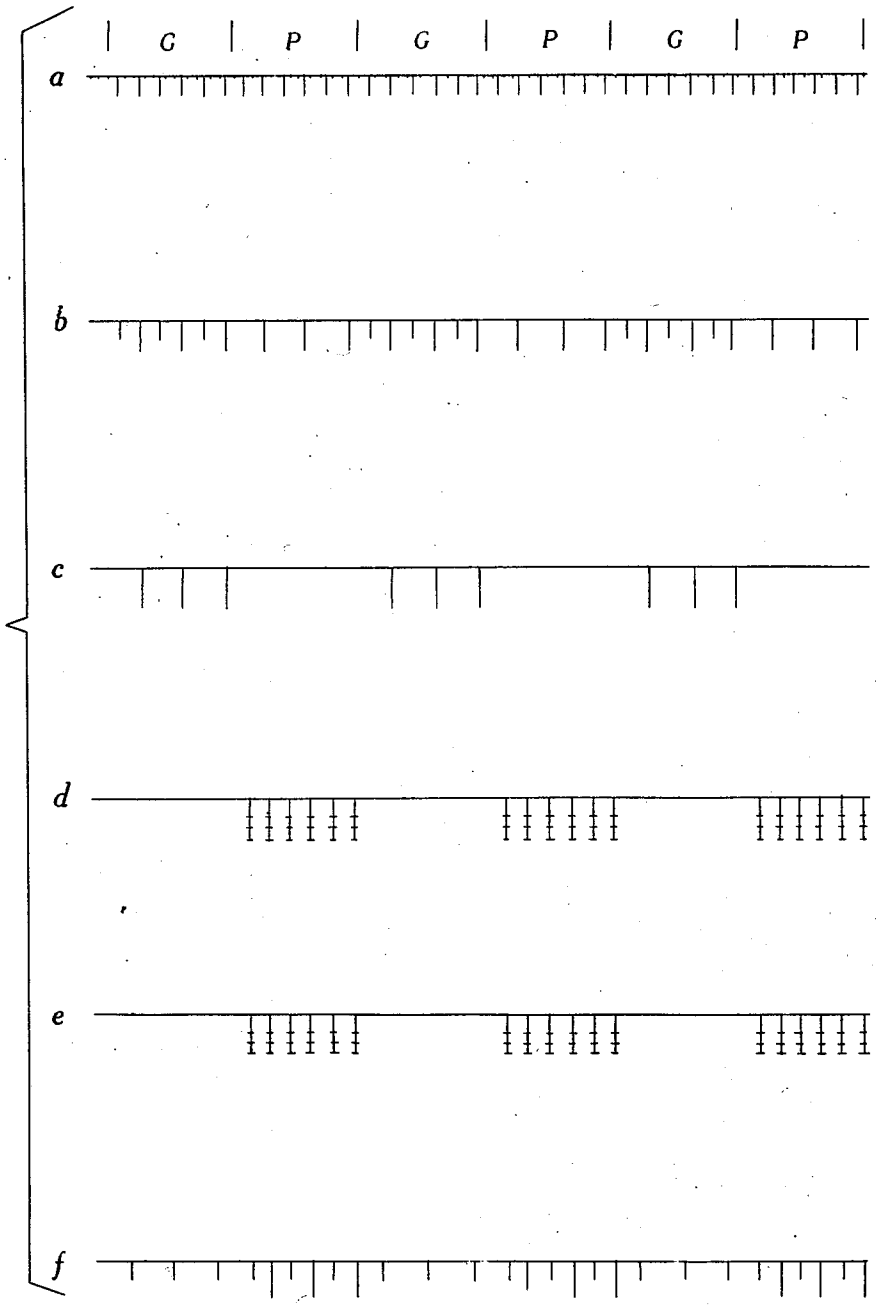
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KNITTING MACHINE

Filed June 16, 1939 8 Sheets-Sheet 8

Fig. 6.



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Patented Dec. 10, 1940 2,224,473

UNITED STATES PATENT OFFICE

2,224,473

KNITTING MACHINE

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Application June 16, 1939, Serial No. 279,548
In Great Britain June 21, 1938

10 Claims. (Cl. 66—14)

This invention is for improvements in circular knitting machines of the opposed cylinder type, which machines have two opposed cylinders equipped with double ended needles which may be transferred from one cylinder to the other according to the nature of the stitch required to be produced. Machines of this type, particularly seamless hose and half-hose machines, are under a disability in so far as the production of patterned fabric is concerned, and an object of this invention is to effect such improvements in machines of the opposed cylinder type as will facilitate the production of patterned fabric thereon, particularly fabric patterned in yarns of contrasting colours or shades.

According to this invention a knitting machine of the opposed cylinder type is provided with two circumferentially spaced feeding positions, thread feeding means and knitting cams (or their equivalent needle operating means) at each position, means for causing predetermined or selected needles to knit the thread fed at one position and for causing the remainder to knit the thread at the other position, and means for floating the thread fed at one position alternately in front of and behind the needles that knit at the other position. A 1 and 1 alternation of the needles is preferred. Thus for example assuming that two different coloured threads are fed at the two positions and it is desired to produce striped fabric in which bands six (or any other number) wales wide knitted of one thread alternate with stripes one wale wide knitted of the other thread, the said other thread is floated behind every odd needle and in front of every even needle of each of the groups of six needles (or alternatively it is floated in front of every odd needle and behind every even needle). The floats therefore lie within the thickness of the fabric and are not exposed. A particularly clear pattern definition results and the spaced single wales are thrown into prominence. It will also be appreciated that if it is desired to produce, for example, alternating broad stripes in the two colours each six (or any other number) wales wide, every second group of six needles will knit one thread at one feeding position and will have the thread fed at the other position floated alternately in front of and behind the needles of each said group, while the needles of the intervening groups will knit the thread fed at said other position and will have the thread fed at the first position floated alternately in front of and behind the needles of each said intervening group. It will of course be understood that the invention is not restricted to the production of simple stripes, for means may be provided for selectively varying the number of needles knitting at either feeder.

Desirably, the means whereby the thread is caused to float in front of and behind alternating needles comprises dividing means for effecting a division among the needles that knit at each position and for raising spaced needles among them to receive in a clearing position, or receive and clear, the thread fed at the other position and for subsequently raising the intervening needles in front of the thread laid across said spaced needles.

In order that the invention may be better understood reference will now be made to the accompanying drawings, in which

Figures 1 and 1A together constitute a perspective view of the relevant parts of a knitting machine of the superimposed needle-cylinder type incorporating this invention.

Figures 2 and 2A together constitute a further perspective view thereof;

Figures 3 and 3A together constitute a plan view illustrating the controls for the movable cams hereinafter referred to;

Figures 4 and 4a together constitute an interior elevation of the cams for the lower needle cylinder;

Figure 5 shows a needle, a slider below it, and a selecting jack below the slider; while

Figure 6 is a diagram showing one arrangement of butts that may be provided at various levels on groups of bottom sliders and jacks, said groups being alternately arranged to knit ground and pattern areas in the fabric.

In Figures 1 to 3A the invention is illustrated as being applied to a seamless hose or half hose machine of the superimposed needle cylinder type adapted to knit by rotation and by oscillation. More specifically, the invention is illustrated as applied to a machine of the said type in which the upper needle cylinder 10 together with its cams is capable of being swung out of register with the bottom cylinder 11 into the attitude shown in chain-dotted lines at 10' in Figure 3A the machine being then organised to produce non-rib fabric upon the needles which are all housed in the bottom cylinder. This movement takes place about the axis of the vertical drive shaft 12 by which the two cylinders are connected together. For a further description of this machine reference is to be had to U. S. patent application No. 175,943 filed November 22, 1937, and in the accompanying drawings

only sufficient of the machine is illustrated to permit of an adequate understanding of the application of the present invention thereto.

It will be appreciated that in common with all machines of the superimposed needle cylinder type the present machine is equipped with double-ended needles as indicated at 13 in Figure 5, arranged to be operated by and transferred from one needle cylinder to another by sliders. In the said figure only the lower slider 14 is shown, for the construction of the upper sliders and their operation forms no part of the present invention and is well understood. Beneath each bottom slider 14 (and in the same trick therewith in the bottom cylinder 11) or beneath any required number of them there is a jack 15. The bottom sliders 14, as is customary in superimposed needle cylinder machines, have knitting butts at level *a* and transfer butts at a lower level *b*. As is also customary these knitting butts *a* are longer in that half of the circumference of the needle cylinder whereat the instep is to be produced than they are in the other half of the circumference whereat the heel and toe pouches are produced. The transfer butts *b* are of contrasting lengths and while every second slider 14 is provided with a long transfer butt the odd or intervening sliders are either without transfer butts or have shorter transfer butts. This contrast at level *b* permits the production of a 1 x 1 welt in the customary manner and also facilitates the needle movements hereinafter described.

The jacks 15 are provided with butts at four different levels *c, d, e, f*, whereby a selective control over the movements of the associated needles may be established. In Figure 6 there is shown one arrangement of the butts upon the sliders and jacks for six consecutive groups of needles, each group consisting of six needles. The odd groups are intended to produce the ground work of the fabric; they are indicated in Figure 6 by the letter G and are intended to knit at feeding position A (Figure 4A) while the even groups of needles indicated at P in Figure 6 are intended to produce what may be considered as the pattern areas in the fabric by knitting at the position indicated at B in Figure 4. It will be appreciated, however, that as is customary in patterning the arrangement of the butts may be varied according to the pattern which it is desired to produce, and that which is illustrated is only one possible arrangement.

It will be seen that the odd sliders 14 of the ground groups are provided with short transfer butts at level *b*; the even sliders are provided with long transfer butts at level *b*. Likewise the even sliders 14 of the pattern groups are provided with long transfer butts at level *b*, but the odd sliders of the pattern groups are without transfer butts.

The upper butts on the jacks 15 at level *c* are termed clearing butts, the jacks of the pattern groups are void of butts at this level; in the illustrated arrangement jacks 15 are provided beneath odd needles of the ground groups G and these odd jacks have butts at level *c*. By way of contrast, at levels *d* and *e*, it is only the jacks 15 of the pattern groups P that are provided with butts. The jack butts at levels *d* and *e* are utilised for patterning purposes and are therefore of contrasting lengths. For example three different lengths of butts may be employed in an arrangement determined by the pattern dictates. At the lower level *f* contrasting lengths of butts are again employed. In the arrangement illustrated the odd jacks 15 of the pattern groups (i. e. those having sliders 14 without transfer butts) and odd jacks of the ground groups are provided with short butts at level *f*, while the even jacks are provided with long butts at said level *f*. These short butts at level *f* are employed for guard purposes only.

The machine is provided with two feeding positions indicated at A and B respectively in Figure 4, and at each position there may be a plurality of interchangeable yarn feeders; such feeders are indicated at A' and B' in Figure 3. At the feeding position A the conventional cams are provided (including stitch cams 26 and 26' and switch cam 62) to permit of rotational and oscillatory knitting, although it may be mentioned that the widening and narrowing pickers have been omitted in Figure 4, since their operation in a seamless hose or half hose machine is well understood and forms no part of this invention. Immediately following the knitting cams of position A there are two bolt cams, an upthrow cam 16 and a downthrow cam 17. It will also be noted that below the upthrow cam 16 there is a battery of three movable upthrow cams 18*c*, 18*d* and 18*e* for operating on the jack butts at levels *c, d, e*. At feeding position B there is a stitch cam 19 adapted to operate on the knitting butts *a* of the bottom sliders 14 only during rotational knitting. Slightly in advance of this stitch cam 19 there is a battery of three movable cancelling cams 20*c*, 20*d*, 20*e* adapted to operate on the jack butts at levels *c, d, e*. Likewise following this stitch cam 19 there is a movable clearing cam 21 arranged to operate on the transfer butts at level *b* and a movable upthrow cam 22 arranged to operate on the knitting butts at level *a* and to bring them from a lower track into engagement with an upthrow cam 23. Below these cams 21 and 22 there is a movable heeling cam 24 which is arranged to engage with the long jack butts at level *f* and to elevate the associated needles to a heeling height. This movable cam 24 is followed by a jack-lowering cam 25 which, engaging with the jack butts at level *f*, lowers such jacks 15 as may have been raised by cam 24. Since the jacks 15 are not connected directly to the sliders 14 each jack 15 may be lowered independently of the associated slider 14 and needle 13.

In the production of patterns all needles are assembled, in a manner well understood, in the bottom cylinder so that non-rib fabric may be produced. Knitting takes place during rotation at both of the feeding positions A and B. Certain groups of needles knit at one position and miss at the other, and other groups miss at the first position and knit at the other, but at each position whereat a group of needles does not knit the thread fed at that position is laid in front of and behind alternate needles of said group. Thus considering the lay-out of butts for the sliders 14 and jacks 15 shown in Figure 6, which is primarily intended for the production of vertical stripes in the fabric, all the needles of the ground groups G knit at feeding position A. That is to say their knitting butts *a* enter upon the knitting track K and pass down the stitch cam 26. The up-throw cam 16 is inoperative but the clearing cam 18*c* of the first battery of cams is operative so that every second needle in each ground group is caused to clear by said cam 18*c* because the associated slider 15 has a long butt at level *c*. These ground needles that are thus cleared are slightly low-

ered by the depressing cam 17 so that they take the thread fed at the second position B and are then slightly raised by the cam 20c of the second battery, so that they pass over the stitch cam 19 at a clearance height and do not knit the thread fed at feeder B. The old needles of the ground groups are not raised to clear by cam 18c since their jacks are without butts at level c. They therefore continue round in the inactive track I beneath the second stitch cam 19 until their jacks 15, which have short transfer butts at level b, meet the clearing cam 21. By this cam they are raised to clearing position so that their butts are brought to the knitting track K. In this upward movement the said odd needles of the ground groups G are raised in front of the thread which has been fed at feeding position B and has been laid in front of the even needles of said groups G.

All the needles of the pattern groups P take the thread fed at feeding position B and, as their knitting butts a descend the stitch cam 19, knit said thread. The even jacks 15 of the patterning groups have long butts at level f. These butts are engaged by the heeling cam 24 (which occupies such a position that it misses the short butts) and are raised to the heeling height in which their knitting butts a are positioned in the heeling track H. It will therefore be appreciated that even needles of each pattern group pass over the knitting cams at feeding position A and do not knit, but have the thread fed at position A laid across them below their open latches. Such needles are subsequently lowered by the depressing cam 17 to knit again at feeder B. The odd needles 13 of the pattern groups are neither equipped with transfer butts at level b, nor with clearing butts at level c, nor with long butts at level f. Having knitted at position B, they therefore continue around in the inactive track I and pass beneath the switch cam 62 and the stitch cam 26 at feeding position A. They are then caused to clear by cam 18d or cam 18e.

It will be understood that a division is effected from among the needles knitting at position A by means of cam 18c. Unless this selection is subsequently modified the raised needles would knit again at feeder B. The required modification is made by one or more of the "cancelling" cams 20c—20e, according to the lay-out of butts. In the arrangement illustrated this modification is made by cam 20c, because the jacks 15 of the ground groups are only provided with butts at level c. Likewise a division is effected from among the needles that knit at feeder B by means of the heeling cam 24.

In addition to the selection hereinbefore described, wherein all the ground needles knit at feeder A and all the pattern needles knit at feeder B, other selections may be achieved with the arrangement of butts shown in Figure 6.

All the needles may be made to knit at feeder A. For this purpose only the up-throw cam 22 is operative, the cams of the two batteries (18c—18e and 20c—20e) and cams 16, 17 and 24 being retracted. Therefore all the needles which pass down the stitch cam 26 at position A are cleared into the knitting track by cams 22 and 23. If in addition the heeling cam 24 is introduced every even needle of the pattern groups will be caused to tuck at feeder A.

All the even pattern needles, in addition to the ground needles, may knit at position A, the odd pattern needles continuing to knit at position B. For this purpose the upthrow cam 22 and the heeling cam 24 are retracted. Hence the ground needles knit at position A and are divided as before. Since the even needles of the pattern groups have long transfer butts at level b, they clear at cam 21 and knit at position A, but the odd needles of the pattern group pass this cam 21 because they have short transfer butts. The said odd pattern needles are selected to knit at position B by bolt cams 18d and 18e. If this last mentioned selection is omitted for a predetermined period, said odd pattern needles continue in the inactive track I.

All the odd pattern needles, in addition to the ground needles, may knit at position A, the even pattern needles continuing to knit at position B. For this purpose the cams 22 and 24 are inserted. The ground needles knit at position A and divide as before. Since the cam 24 is in, the even pattern needles will be raised to heeling height after having knitted at position B and will pass over the cams at A until lowered by cam 17 to knit again at B. The odd pattern needles are without long butts at level f, so they are not affected by cam 24 but, like all the other needles, they will be cleared by upthrow cams 22, 23 and will be raised to the knitting level to knit at position A.

All the needles may knit at both positions. For this purpose only cams 16, 17 and 22 of the various bolt cams are operative.

In the production of patterns on a knitting machine, it is customary to provide butts on the needles or other instruments, in an arrangement which is determined by the pattern which it is desired to produce. Quite obviously, by following this common practice, numerous differing needle selections may be achieved with the mechanism herein described and illustrated, and it is unnecessary and impracticable to describe them all. It may be mentioned, however, that if it is required to vary, course by course or at predetermined courses, the number (or the location in the needle cylinder) of the needles that knit at position B, the following general remarks will apply. Needles required to knit at position B (whether said needles have knitted at position A or have passed said position in the idle track I) are selected up by means of the first battery of cams 18c—18e. Among the needles raised by these cams there will in most instances be included needles that are not required to knit at position B. For example, if it is desired to raise by means of cam 18d, for the purpose of knitting at position B, certain needles the jacks 15 whereof have medium length butts at level d, the said cam 18d must be inserted half-way, and will therefore engage the long butts at that level and will raise needles associated with the long butt jacks. This selection, of needles that are not required to knit at position B, must therefore be cancelled, and this cancellation is effected by the second battery of cams 20c—20e. For example, cam 20d may be arranged to raise the long butt jacks raised by cam 18d, so that the needles associated with said long butt jacks pass over stitch cam 19 and do not knit at position B.

It is likewise possible to add to the needles knitting at position A, either by selecting up, by means of the first cam battery, needles that have passed the position A in the low inactive track I, or by "cancelling" by means of the second cam battery certain needles that have passed position A in the heeling track H, and have been lowered by cam 17. That is to say, said certain needles are raised by a cam of the battery 20c—

20e to pass over the stitch cam 19 and to continue in the knitting track K.

It will be appreciated that it will in some instances be desirable to provide patterning butts on jacks beneath certain or all of the needles (e. g. needles of the ground groups) that knit at position A.

It will be appreciated that by appropriately arranging the butts at levels c, d and e a wide scope of selection is obtained. It will furth r be appreciated that more than three levels of jack butts and more than three cams in each battery may be provided, although it has been elected to illustrate three only. Further, that instead of the illustrated method of selection any other known selecting mechanism may be employed.

The cams 18, 17, 18c to 18e, 20c to 20e, 21, 22 and 24 are all bolt cams. That is to say they are capable of movement in towards, and away from, the cylinder. Therefore not only may they be rendered operative and inoperative, but according to their position of adjustment they may engage butts of contrasting lengths. Referring now to Figures 1, 2 and 3 the two batteries of cams 18c to 18e and 20c to 20e are controlled through respective sets of bell-crank-levers 26 and 27 from a pattern drum 28 rotatable upon a vertical axis 29. This pattern drum is rocked by a clawker 30 pivoted upon a lever 31 which oscillates about the axis 29. The said clawker and lever 31 are biased in an anti-clockwise direction as viewed in Figs. 3 and 3A by a bias spring 32, and are moved positively to rack by an arrangement of links and bell-crank-levers, indicated generally at 34, from a cam lever 35 which is operated by a suitable cam on a cam drum 36 itself attached to the horizontal shaft 37 by which the needle cylinders 10, 11, are driven. Therefore according to the pattern dictates of this drum the levers 26, 27 are rocked about their pivot 38 to insert the cams of the two batteries to varying extents.

The said levers 26, 27, are pivotally mounted upon a slide 39 which is slidable horizontally towards and away from the lower needle cylinder 11. In Figure 3 this slide 31 is shown in its operative position in which it is near the cylinder 11 and the levers 26 and 27 are in co-operation with the cams of the two batteries. In this position an arm 40 on the slide 39 engages the clearing cam 21 and holds it in an operative position. When the slide 39 moves outwards to the left in Figure 3 (under the influence of spring 39') the levers 26, 27, are rendered inoperative so that the cams of the two batteries move outwards under the influence of springs (which are not shown). Likewise the clearing cam 21 moves outwards. This outward movement of the slide 39 also causes a bluff 41 with which it is provided to engage a lug 42 on the clawker lever 31. Thereby said clawker 30 is prevented from making its anti-clockwise return movement under spring influence and racking of the drum 28 is interrupted. The slide 39, suitably guided in guides indicated at 50, is moved towards the cylinder 11 by a cam-lever 51 which is operated by a cam on the drum 46 and moves said slide 39 through the medium of a link 52 and bell-crank-lever 53. Reverse rotation of the drum 28 is prevented by a frictioning device 63.

The heeling cam 24 is operated by a bell-crank-lever 43, push rod 44 and cam lever 45 from a cam on the main drum 46 of the machine. The upthrow cam 22 is operated in a similar manner by bell-crank-lever 47, push rod 48, cam lever 49, and a cam on the drum 46.

The upthrow cam 16 is operated by a push rod 54 which extends through the housing 55 of the vertical drive shaft 12 and is connected by a bell-crank-lever 56, and push rod 57, to a cam lever 58 also operated by a cam on the drum 46. The depressing cam 17 is operated in a similar manner by push rod 59, bell-crank-lever 60, and a cam lever 61.

These controls are those necessary for the various bolt cams hereinbefore referred to. The various other controls, such as for transferring the needles from one cylinder to another to change the character of the stitches being produced, are well understood in opposed needle cylinder machines and need no description herein. Insofar as the invention may be applied to a machine in which the top cylinder may be swung out of register with the bottom cylinder, reference is directed to U. S. patent application No. 175,943 for the controls necessary to effect such movements but it may here be mentioned that the knitting process herein described may be effected while the top cylinder is in register and that the invention is equally applicable to opposed cylinder machines wherein the top cylinder is incapable of movement out of register with the bottom cylinder.

We claim:

1. In a circular knitting machine of the opposed needle cylinder type, the combination with a needle cylinder, needles, sliders for moving them, thread feeding means at a knitting position, and knitting cams at said position, of thread feeding means at a second knitting position spaced circumferentially from the first, means for causing a proportion of the needles to knit the thread fed at one position and for causing others of the needles to knit the thread fed at the other position, selective mechanism for exercising a selection over the needles knitting at either position, and means for floating the thread fed at one position, alternately in front of and behind the needles that knit at the other position.

2. In a circular knitting machine of the type having opposed needle cylinders equipped with double-ended needles which may be transferred from one cylinder to the other according to the nature of the stitch to be produced, the combination of thread feeding means at each of two circumferentially spaced feeding positions, cams defining a knitting track and including a stitch cam at each position for acting on the needles to cause them to knit the thread fed at that position, dividing means for acting on the needles lowered by each stitch cam to divert and to pass alternating needles over and below the next stitch cam, and means between successive stitch cams to collect said diverted needles again into the knitting track.

3. In a circular knitting machine of the type having opposed needle cylinders equipped with double-ended needles which may be transferred from one cylinder to the other according to the nature of the stitch to be produced, the combination of thread feeding means at each of two circumferentially spaced feeding positions, cams defining a knitting track and including a stitch cam at each said position, selective means following each stitch cam for effecting a selective division among the needles descending the preceding stitch cam and for diverting alternate needles above and below the next stitch cam, and means following each stitch cam for collecting

the needles that have passed above and below the preceding stitch cam and for delivering them to the next stitch cam to knit thereat.

4. In a circular knitting machine of the type having two opposed needle cylinders equipped with double ended needles transferable from one cylinder to the other to vary the character of the stitches produced, the combination of thread feeding means at two circumferentially spaced knitting positions, knitting means at each position, means for effecting a selective division among the needles to cause some to knit at one position and others to knit at the other position, means for dividing the needles that have knit at either position, before they reach the next position, and for causing them to pass said next position some in a high inactive track and others in a low inactive track whereby the thread fed at said next position is laid in front of the needles that pass it in the high track but is not knitted thereby, means for raising the needles from the low track in front of said fed thread, and means for reuniting the needles from the two tracks to knit at the next knitting position reached.

5. In a circular knitting machine of the type having two opposed needle cylinders equipped with double ended needles transferable from one cylinder to the other to vary the character of the stitches produced, thread feeding means and a knitting cam at a first knitting position, thread feeding means and a knitting cam at a second feeding position spaced circumferentially from the first, means following the first knitting position to pass alternating needles that have descended the first knitting cam above and below the knitting cam at the second position, means following the second position to raise said lowered needles to join the high needles and to deliver said re-assembled needles to the knitting cam at the first position, means following the second position to pass alternating needles that have descended the second knitting cam above and below the knitting cam at the first position, and means following the first position to raise said lowered needles to join the high needles and to deliver said re-assembled needles to the knitting cam at the second position.

6. In a knitting machine according to claim 5, selective means for varying the proportion of needles knitting at each position.

7. In a circular knitting machine of the type having opposed needle cylinders equipped with double ended needles which may be transferred from one cylinder to the other according to the nature of the stitch to be produced, the combination of thread feeding means at each of two circumferentially spaced feeding positions, needle-guiding means including a stitch cam at each position and providing a high inactive track above and a low inactive track below each stitch cam, each of which stitch cams leads down to said low track, means following one stitch cam for (*a*) dividing such needles as may have knitted at it and passing alternate ones of such needles over the next stitch cam and the remainder of such needles in the low track below said next stitch cam, and (*b*) for raising such needles as may have passed below said one stitch cam in the low track and for delivering them to the next stitch cam to knit thereat, and means following said next stitch cam and preceding said one stitch cam for (*a*) dividing such needles as may have knitted at said next stitch cam and passing alternate ones of such needles over the said one stitch cam and others of such needles in the low track below said one stitch cam, and (*b*) for raising such needles as may have passed in the low track below said next stitch cam to join such needles as may have passed in the high track above said next stitch cam and for delivering them to said one stitch cam.

8. In a circular knitting machine of the type having opposed needle cylinders equipped with double ended needles which may be transferred from one cylinder to the other according to the nature of the stitch to be produced, the combination of thread feeding means at each of two circumferentially spaced feeding positions, needle-guiding means including a stitch cam at each said position and providing a low non-knitting track below each stitch cam, a knitting track leading to each stitch cam, and a high track over each stitch cam, a cam following one stitch cam for elevating alternate needles from the low track to join the knitting track but permitting other needles to continue therein, another cam following said stitch cam for lowering needles from the high track to the knitting track, selective means following said one stitch cam for elevating selected needles from the low track to join the knitting track, selective means, following the first said selective means and said raising and lowering cams but preceding the other stitch cam, for diverting selected alternate needles from the knitting track into the inactive track above said other stitch cam but permitting other needles to descend said stitch cam into the low track, and cam means following said other stitch cam for (*a*) raising needles that have passed below said other stitch cam in the low track to join those which have passed above it and for delivering said united needles to the stitch cam first mentioned, and (*b*) elevating alternate needles that have descended said other stitch cam to the high track to pass over the first said stitch cam and permitting other needles that have descended said other stitch cam to remain in the low track to pass the first said stitch cam.

9. In a seamless hose or half hose knitting machine having opposed needle cylinders equipped with double ended needles arranged to be transferred from one cylinder to the other, which machine is arranged to knit by rotation and by oscillation, the combination of a set of knitting cams, including two oppositely disposed stitch cams, for knitting at one of said stitch cams during rotational knitting and at said stitch cams in alternation during oscillating knitting, thread feeding means for said set of cams, an auxiliary stitch cam following said set of cams for knitting only during rotational knitting, thread feeding means for said auxiliary stitch cam, means for causing at least one group of needles to knit during rotational knitting at said set of cams, and for causing others of the needles to knit at the auxiliary stitch cam, means for passing alternate needles of said group over the auxiliary stitch cam to receive but not to knit the thread fed thereat, means for passing intervening needles of said group below said auxiliary stitch cam, means for raising the last said needles in front of said thread to join the said alternate needles, means for delivering said reunited needles to the set of cams, means for effecting a division among the needles that descend and knit at the auxilairy stitch cam and for passing certain of them past the set of cams at a low non-knitting level and for passing others of them past said set of cams at a high non-knitting level, and means following

said set of cams and preceding said auxiliary stitch cam for reuniting the needles, thus divided and inoperative at the set of cams, and for delivering them to said auxiliary stitch cam to knit thereat.

10. In a circular knitting machine of the type having two opposed needle cylinders, double ended needles transferable from one cylinder to the other to vary the character of the stitches produced, and sliders in each cylinder for actuating the needles, which sliders have knitting butts for engagement by knitting cams, the combination of a transfer butt on each alternate slider in one cylinder, clearance butts associated at one level with said alternate sliders of spaced groups of the sliders, the intervening sliders of said groups and the other sliders interposed between said groups being without said clearance butts, contrasting patterning butts associated with said interposed sliders at a plurality of levels, dividing butts associated at another level with alternate sliders of said interposed sliders, two circumferentially spaced stitch cams for engaging the knitting butts of the sliders in said one cylinder, a thread feeder for each stitch cam, a low track for the knitting butts below and a high track for the knitting butts above each stitch cam, each of which stitch cams leads down to said low track, a radially-movable upthrow cam following one stitch cam to elevate the knitting butts from the low track, a radially-movable clearing cam below said upthrow cam for engaging with the said clearance butts and for elevating the knitting butts of associated needles from the low track to an upper track, radially-movable patterning cams below said upthrow cam for co-operating with the patterning butts and for effecting a selective elevation of the knitting butts of the associated needles from the low track to said upper track, a radially-movable depressing cam above and following said upthrow cam for engaging the knitting butts of needles travelling over the said one stitch cam and for lowering them to said upper track, said upper track being of a height to deliver the knitting butts therein to the other stitch cam, a series of radially-movable cancelling cams, following the aforesaid radially-movable cams but preceding the other stitch cam, for co-operating with the patterning butts and for thereby elevating the knitting butts of selected needles from said upper track to pass over the said next stitch cam, a second radially-movable clearance cam following said next stitch cam for engaging knitting butts arriving at it in the low track and for elevating said butts to clear, a third radially-movable clearance cam below said second clearance cam for engaging the transfer butts aforesaid and for elevating the knitting butts from the low track to clear, a radially-movable dividing cam for engaging the dividing butts aforesaid and for elevating the knitting butts of the associated needles to pass over the said one stitch cam for engagement by the depressing cam, which dividing cam is below the second clearance cam, means for directing to said one stitch cam the knitting butts that pass over the other stitch cam and those that are elevated by the second and third clearance cams, and control means for said radially-movable cams.

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