Sept. 29, 1959 T. D. EFLAND 2,906,109

KNITTING MACHINE

Filed Dec. 19, 1957 2 Sheets-Sheet 1

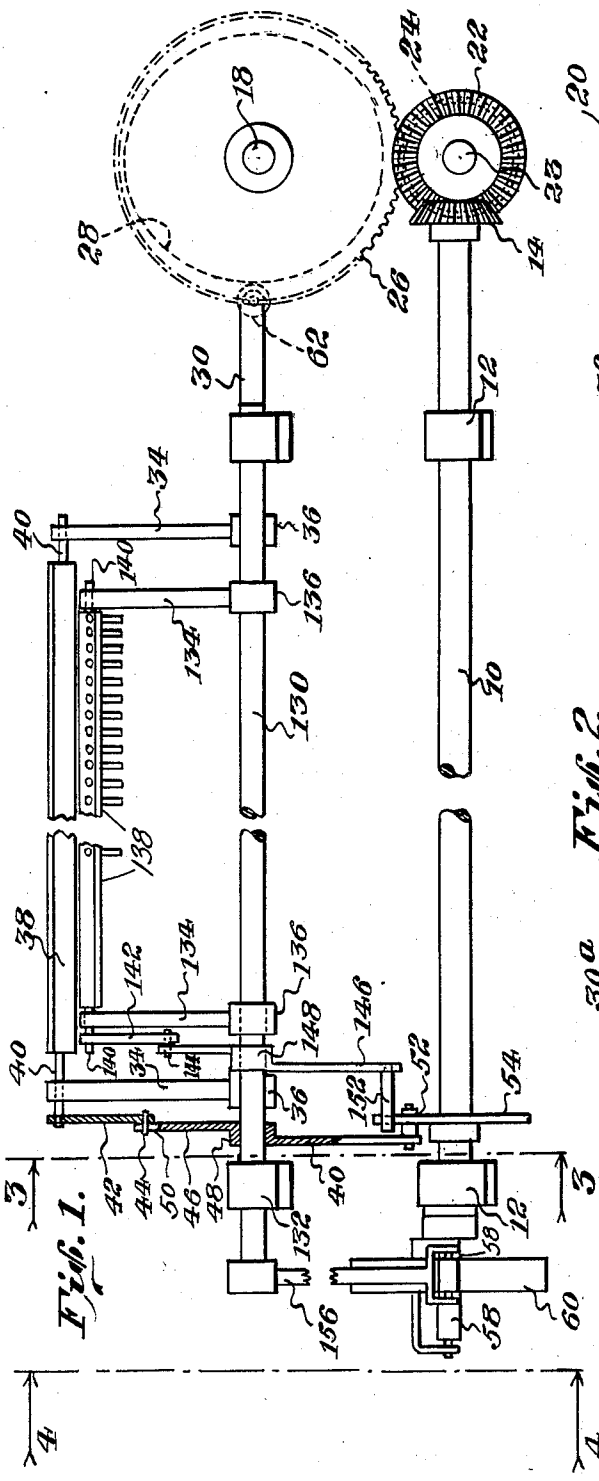


Fig. 1.

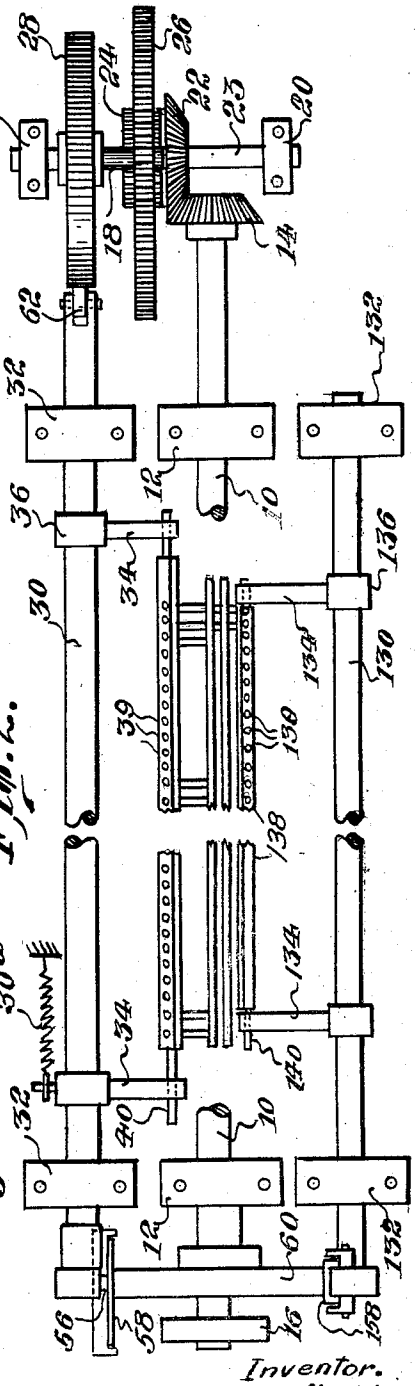


Fig. 2.

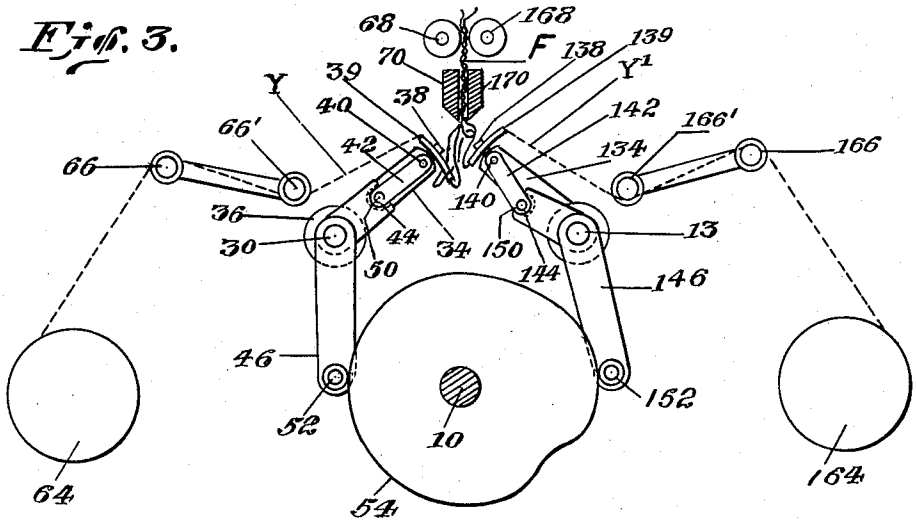
Inventor.
BY Thomas D. Efland.
Ralph B. Stewart
Attorney.

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Fig. 3.



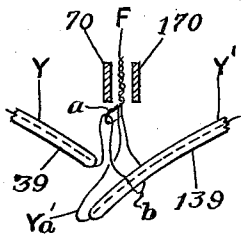


Fig. 5a

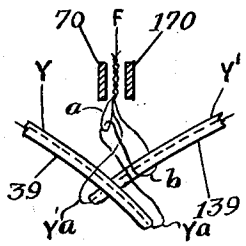


Fig. 5b

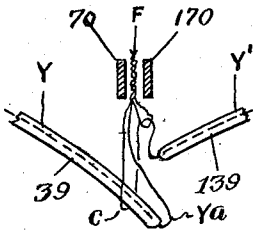


Fig. 5c

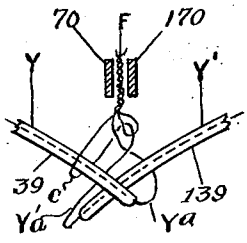


Fig. 5d

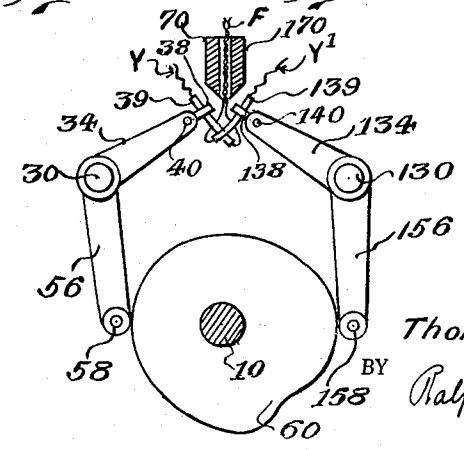


Fig. 4.

INVENTOR.
Thomas D. Efland.
BY
Ralph B. Stewart
Attorney.

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KNITTING MACHINE

Thomas D. Efland, Clemson, S.C., assignor to Clemson Agricultural College of South Carolina, Clemson, S.C., a corporation of South Carolina

Application December 19, 1957, Serial No. 703,954

3 Claims. (Cl. 66—1)

This invention relates to knitting machine for knitting yarns into fabric, the operation of the machine being relatively simple and there being relatively little likelihood of parts getting out of order.

Among other features of the invention is the construction of a knitting machine adapted to produce various kinds of fabrics with different designs without the use of conventional knitting needles. With this machine, chain or cross-loop stitches may be used to produce the desired fabric and various filler threads may be incorporated as desired.

The present invention is an improvement upon the knitting machine disclosed in the co-pending application of Hugh M. Brown, Serial No. 687,152, filed September 30, 1957. The machine involves two sets of hollow thread-conducting guides carried by two parallel knitting bars which are mounted upon rock-shafts to oscillate about the axis of the shafts so as to move the sets of guides towards and away from a knitting plane, the arrangement being such that each set of thread guides intersects the knitting plane at an angle thereto and the two sets of thread guides are in interleaved relation when intersecting the knitting plane. The operation is such that one set of guides forms thread loops over the guides of the other set, and threads of the second set are drawn through the loops and used to form loops over the first set of guides.

To produce a fabric, rather than a chain of loops, the guides of one set are shogged laterally relative to those of the other set, one or more guide spaces, as desired, to produce the desired fabric pattern.

In the present invention, provision is made to tilt each set of thread-guides about an axis parallel with the supporting knitting bar in such manner that upon withdrawing each set of guides from knitting position the guides are tilted towards the knitted fabric.

The following specification taken with the accompanying drawings forming a part thereof constitutes a full disclosure of the present invention.

In the drawings:

Fig. 1 is a fragmentary partly diagrammatic front elevation of the machine;

Fig. 2 is a corresponding top view, with parts omitted.

Fig. 3 is a fragmentary schematic end view taken substantially on the line 3—3 of Fig. 1 and showing essential features of the invention, including the arrangement for tilting the thread-guides during operation.

Fig. 4 is a partly diagrammatic end view showing the arrangement for oscillating the knitting bars about the axis of the supporting rock-shafts.

Figs. 5*a*, 5*b*, 5*c*, and 5*d* are diagrammatic views of a pair of guides, showing the steps of forming loops to make a chain of loops.

Referring to the drawings, a drive shaft **10** journalled in bearings **12** having bevel gear **14** thereon is driven in any suitable manner, as by means of a pulley **16** belted to a source of power. A cam shaft **18** arranged at right angles to the shaft **10** and mounted in bearings **20**, is

driven from shaft **10** through gearing including a bevel gear **22** meshing with bevel gear **14** and mounted on shaft **23** arranged below and parallel with shaft **18**, and a pinion **24** on shaft **23** drives a gear **26** on shaft **18**. Shaft **18** drives a cam **28** for shifting one set of thread guides, as will be described below.

A rock shaft **30** is slidably mounted substantially parallel to the drive shaft **10** in bearings **32**, for oscillating movement about the shaft axis and reciprocating movement along the shaft axis.

A pair of arms **34**—**34**, having hubs **36**—**36** fixed on the rock shaft **30**, carry at their free ends a knitting bar **38** having one set of curved knitting guides tubes **39** mounted transversely thereon and equally spaced along the length of the bar. The rock-shaft **30** is provided with an arm **56** fixed at one end thereon, and having a roller **58** at its other end engaging a cam **60** mounted on the shaft **10**, whereby the shaft **30** may be rocked to give the bar **38** an oscillating movement about the axis of shaft **30**.

The bar **38** is mounted to rock about an axis parallel with shaft **30** and parallel with bar **38** by means of rod-like pivot extensions **40**, **40** provided at the ends of the knitting bar **38** and extending through suitable bearing openings adjacent the free ends of the arms **34**, **34**. A lever arm **42** is fixed at one end to one of the pivots **40** and is provided adjacent its other end with a transversely extending pin **44**. A two-arm bell-crank lever **46** having a hub **48** rockably mounted on the shaft **30** is provided at one end of one arm with a slot **50** receiving the pin **44**. The other arm of lever **46** is provided with a roller **52** engaging a cam **54** mounted on the drive shaft **10**. By this arrangement, the set of tubular thread-guides **39** are tilted about the axis of pivot portions **40**—**40** in timed relation with the rocking of the bar **38** about the axis of shaft **30**.

On the opposite side of the shaft **10**, relative to the rock-shaft **30**, is a second rock-shaft **130** which is mounted in bearings **132** parallel with shaft **30**. A pair of arms **134**, **134** are fixed on the rock shaft **130** and carry at their upper ends the knitting bar **138** having a second set of curved knitting guide tubes **139** supported thereon in the same manner as set **39** is supported on bar **38**. The knitting bar **138** is rockably mounted on the free ends of the arms **134** by means of a pivot extension **140** at either end of the bar engaging in suitable bearing openings adjacent the free ends of the arms **134**.

The rock-shaft **130** is provided with an arm **156** at one end thereon, and a roller engaging the cam **60** whereby the shaft **130** may be rocked to give the bar **138** an oscillating movement about the axis of shaft **130**.

A lever arm **142** is fixed at one end to one of the pivots **140** and carries at its other end a transverse pin **144**. A two-arm bell-crank lever **146** having a hub **148** rockably mounted on the shaft **130** is provided at one end of one arm with a slot **150** receiving the pin **144**. The other arm of the lever **146** carries a roller **152** which engages the cam **54** to rock the bar **138** about the axes of pivot portions **140**—**140** in timed relation with the rocking of bar **138** about the axis of shaft **130**.

In Figure 2 the elements **42** to **54** and **152** to **152** have been omitted for clearness of showing of other parts.

A cam follower **62** mounted at one end of the rock-shaft **30** engages the rim of cam **28** which imparts reciprocating movement to the rock-shaft **30** to effect lateral shifting of the set of thread guides **39**, as will appear more fully below.

A suitable spring, such as that represented by the tension spring **30***a* in Figure 2, applies a biasing force to the rock-shaft **30** to maintain the cam follower **62** in contact with the cam **28** at all times. The cam followers **52**, **58**, **152**, and **158** may be urged toward their respective

cams by any suitable biasing means normally used for this purpose.

As shown in Figure 3, yarns or threads Y, Y' are supplied to tubular guides **39** and **139** respectively from a pair of beams **64** and **164**. A pair of parallel guide bars **70** and **170** are arranged immediately above the point where the paths of oscillatory movement of the two sets of thread guides intersect each other, or immediately above the point where the fabric is formed or knitted. The plane passing between fabric guide bars **70** and **170** and through the point of intersection of the two sets of tubular knitting elements may be called the knitting plane. The completed fabric F is drawn between these guide bars by a pair of draw-offrollers **68** and **168** arranged above the frabric guide bars **70** and **170**.

In passing from the beams **64** and **164** to the two sets of thread guides **39** and **139** respectively, the yarns Y and Y' pass over fixed guide rods **66** and **166**, and then under movable guide rods **66'** and **166'** which are mounted for pivotal turning about the axes of rods **66** and **166** respectively and serve to maintain the yarns under tension during knitting operation.

In operation of the machine, yarns Y, Y' are led through the guides **39** and **139** and are clamped by the fabric take-up rolls **68** and **168**, and are kept under tension by bars **66'** and **166'** as explained above. The cam **54** is arranged to operate followers **50** and **56** in cycles approximately 180° apart, so that the tubular guides **39** and **139** alternately execute identical angular movements about the axes of rock-shafts **30** and **130** respectively.

The operation is such that one set of thread guides remains substantially stationary in its lower position, intersecting the knitting plane, while the other set moves into interleaved relation with the first set, and then on the next portion of the knitting cycle the second set of guides is held stationary in a position intersecting the knitting plane while the first set is moved into interleaved relation with the guides of the second set.

The knitting opertaion may be explained by reference to Figures *5a* to *5d*. As represented in Figure *5a*, guides **139** are in a lower position intersecting the knitting plane, while guides **39** are in an upper position ready to move downwardly and across the knitting plane. Yarns Y from guides **39** pass through loops (*a*) previously formed in yarns Y' but which have not yet been pulled up tight, and then pass in the form of loops (*b*) around guides **139** up to the fabric F. The yarns Y' from the ends of guides **139** pass up to the fabric F where they form the loops (*a*) which will be pulled up tight by the further downward movement of the guides **139**, or by the tension rod **166'**.

Guides **39** move downwardly until the tips enter into the spaces between yarn sections Y'*a*, but not far enough to enter into the spaces between the guides **139**. At this point, rock-shaft **30** is moved or shogged to shift the guides **39** laterally against yarn sections Y'*a* a distance sufficient to allow the guide **39** to enter into the spaces between guides **139**, and then the guides **39** are moved further downwardly and across the knitting plane towards the position shown in Figure *5b*, thus looping the yarn sections Y'*a* about the guides **39**. Following this, guides **139** are moved upwardly and backwardly to drop or cast-off the loops (*b*) which then are drawn up tight by the further downward movement of the guides **39**, leaving loops (*c*) in yarns Y' remaining on the guides **39**.

Guides **39** now remain stationary while the set of guides **139** are moved downwardly and forwardly into overlapping relation with the yarn sections Y*a* and then guides **39** are shogged in the proper direction to permit the guides **139** to enter into the spaces between the guides **39** and the yarn sections Y*a*. Following this, the guides **39** are withdrawn to drop or cast-off the loops (*c*).

The operation just described forms loops in each yarn. For the purpose of connecting the loops in adjacent yarns to form a fabric, shogging cam **28** is formed so that thread guides **39** are shogged first in one direction and then in the other on alternate cycles, and the resulting pattern in the fabric can be varied by controlling the amount of such shogging movement to cover two or more thread-guide spaces. Such movement causes an interconnection of the individually formed chains of loops.

It will be noted that two sets of knitting tubes are mounted on knitting bars **38** and **138** in such position that they are inclined to the knitting plane by an acute angle when they move across that plane. This ensures that yarn sections Y*a* and Y*a'* running from the tips of the knitting tubes to the fabric F will be angularly spaced from the supply tubes so that these sections may be engaged by the end portions of the other set of tubes and moved laterally without mechanical interference or contact between the two sets of tubes.

It will be understood that the yarns in Figures *5a* to *5d* are shown in loose loops and reaches for the purposes of explanation. In actual operation the loops would be pulled up tight and the reaches would be straight.

During the time that the kniting bars **38** and **138** are being oscillated to and from knitting position by the cam **60** throughout a complete knitting cycle, the cam **54** mounted on the same shaft with the cam **60** oscillates the bars **38** and **138** about the axes of the pivoting extensions **40** and **140**. By proper design of cam **54**, it is possible to control the angle at which the thread guides enter the knitting plane, and the angle at which they are withdrawn from the knitting plane. It is desirable to design cam **54** to tilt the thread guides upwardly towards the fabric guides **70** and **170** during the time that the thread guides are being withdrawn from the knitting plane and pulled out of the yarn loops formed about them.

In Figure 4, the cam **54** and other parts for tilting the bars **38** and **138** about the axes **40—40** and **140—140** have been omitted to avoid confusion in the showing of the parts which are operated by cam **60**.

I claim:

1. A knitting machine comprising a pair of fabric guide-bars supported in spaced parallel relation for guiding knitted fabric in a knitting plane passing between said bars, a pair of knitting-bars arranged parallel with said guide-bars on opposite sides of said knitting plane, each knitting-bar carrying a row of tubular thread-guides mounted in spaced parallel relation on each knitting-bar and being directed towards said knitting plane, means mounting said knitting-bars for oscillatory movement towards and away from knitting positions adjacent said knitting plane, the arrangement being such that each set of thread-guides intersects said knitting plane and said two sets of thread guides are in interleaved relation when intersecting said knitting plane, means pivotally mounting each knitting bar for tilting about a pivotal axis parallel with the bar to vary the angle of the thread-guides with respect to the knitting plane, cam means for oscillating said knitting bars in timed relation to hold one set of thread guides in knitting position while moving the other set of thread guides into knitting position and then withdrawing the first set of thread guides from knitting position, and second cam means operated in timed relation with said first cam means for tilting said knitting bars about their pivotal axes in timed relation with the oscillation of said bars into and out of knitting position.

2. A knitting machine comprising a pair of rock-shafts mounted for rocking movement in spaced parallel relation, a pair of knitting bars mounted upon said rock-shafts respectively in parallel relation to each other and to said rock-shafts and being subject to the rocking movements of said shafts to move into and out of knitting positions, a row of tubular thread-guides mounted in spaced parallel relation on each knitting bar and being positioned so that the two sets of thread guides intersect a knitting plane in interleaved relation when said bars move into knitting positions, means pivotally mounting each knitting

bar for tilting about a pivotal axis parallel with the bar to vary the angle of the thread-guides with respect to the knitting plane, cam means for rocking said rock-shafts in timed relation to hold one set of thread-guides in knitting position while moving the other set of thread-guides into knitting position and then withdrawing the first set of thread-guides from knitting position, and second cam means operated in timed relation with said first cam means for tilting said knitting bars about their pivotal axes in timed relation with the oscillation of said bars into and out of knitting position.

3. A knitting machine comprising a drive shaft, a pair of rock shafts arranged parallel with said drive shaft, a pair of spaced arms mounted one at each end of each rock shaft, means for operating said rock shafts from said drive shaft to oscillate said arms toward and from each other, a knitting bar for each pair of arms having a set of tubular thread-guides mounted thereon in spaced parallel relation, pivot means mounting each bar between

the free ends of the respective pairs of arms so that each bar may tilt about a pivotal axis parallel with the bar and spaced from the supporting rock-shaft, oscillating lever means journalled for oscillation on each rock-shaft, means on said drive shaft for operating said oscillating lever means, and a lever fixed at one end on each of said knitting bars, the other end thereof engaging the oscillating lever means carried by the corresponding rock-shaft and being oscillated thereby.

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