Nov. 23, 1971 R. H. MARKS ET AL 3,621,677

APPARATUS FOR PRODUCING A KNITTED FABRIC INCLUDING INTERLACED INSERT ELEMENTS

Filed Aug. 6, 1969 6 Sheets-Sheet 1

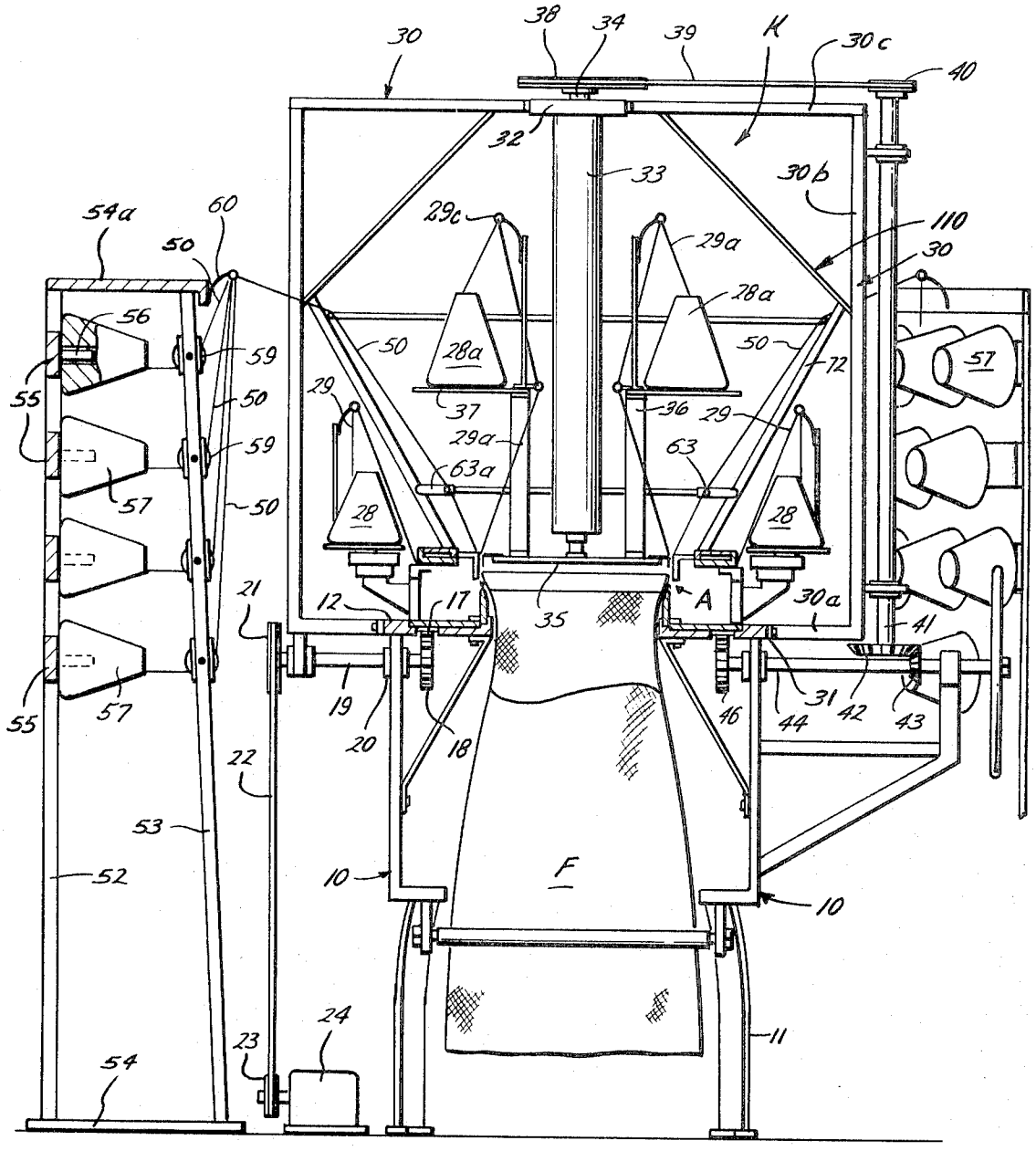

Fig. 1

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Fig. 2

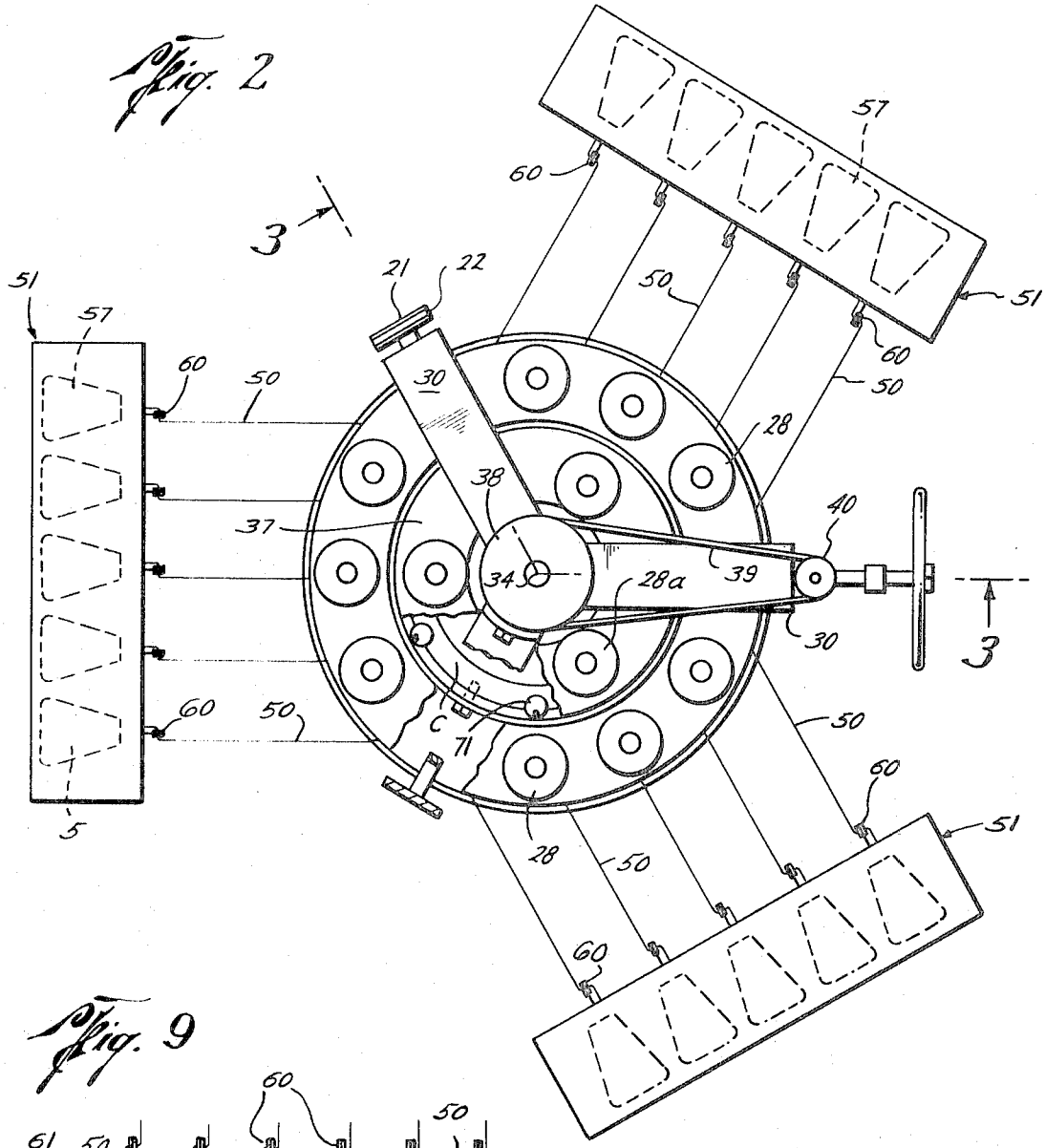
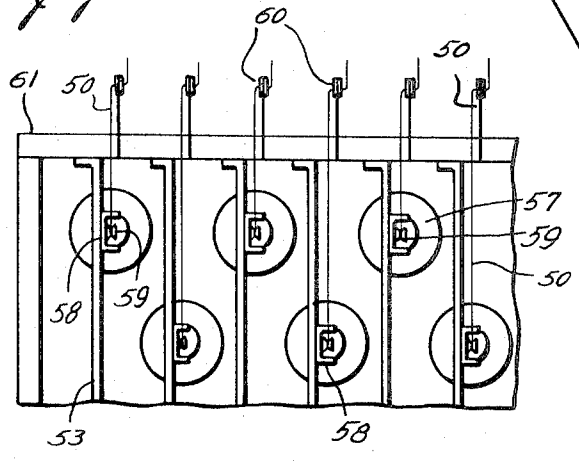


Fig. 9



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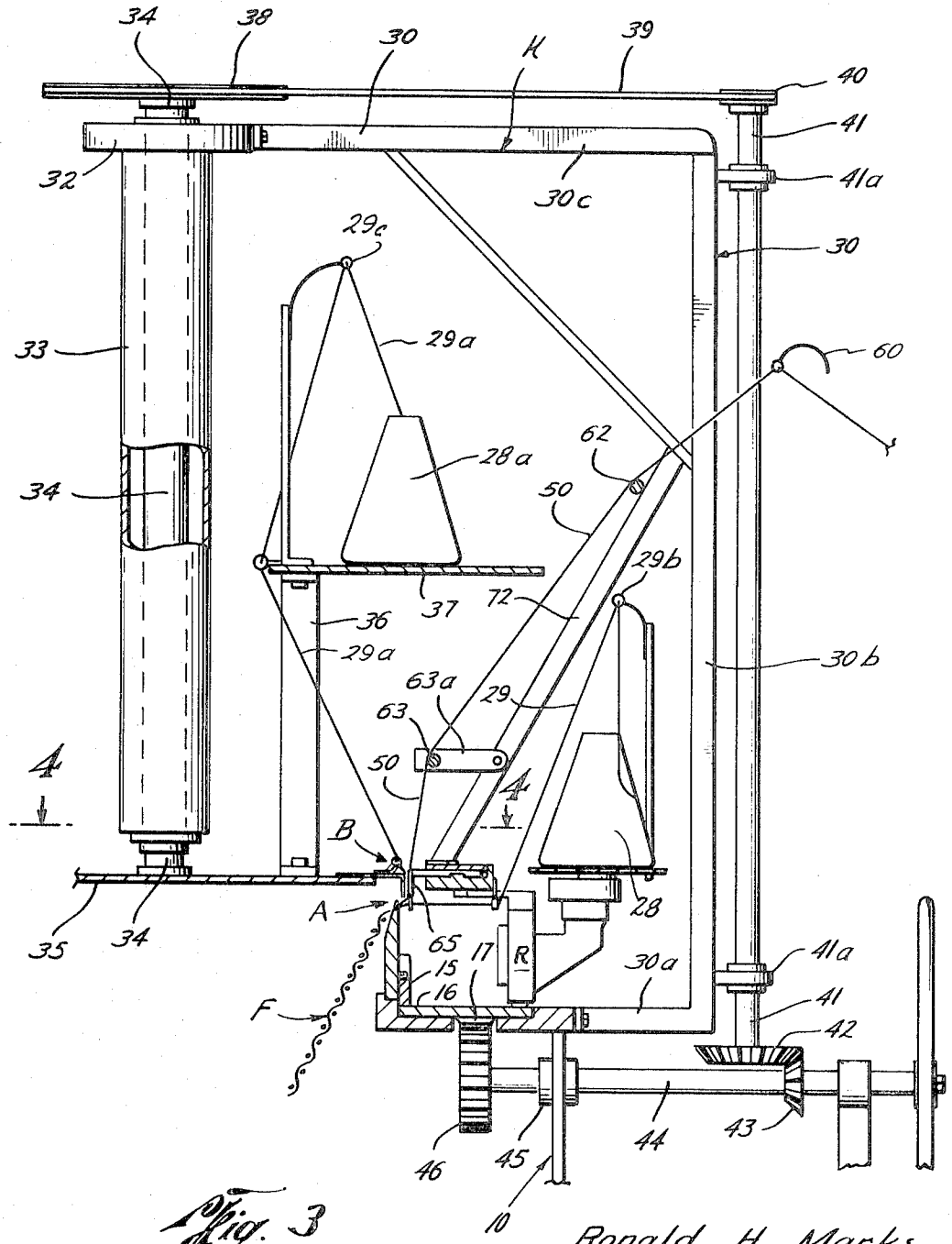

Fig. 3

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APPARATUS FOR PRODUCING A KNITTED FABRIC INCLUDING INTERLACED INSERT ELEMENTS

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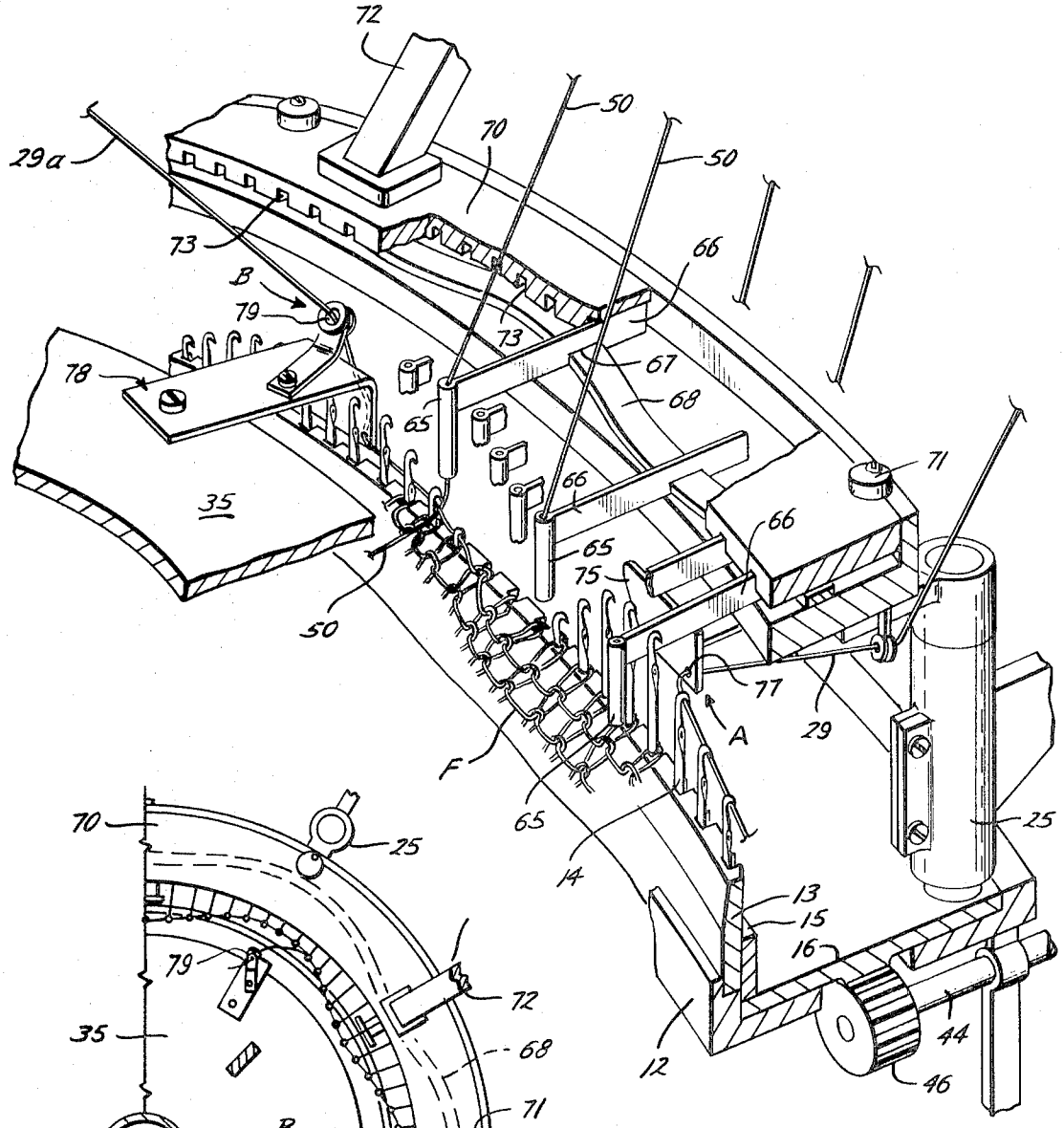

Fig. 5

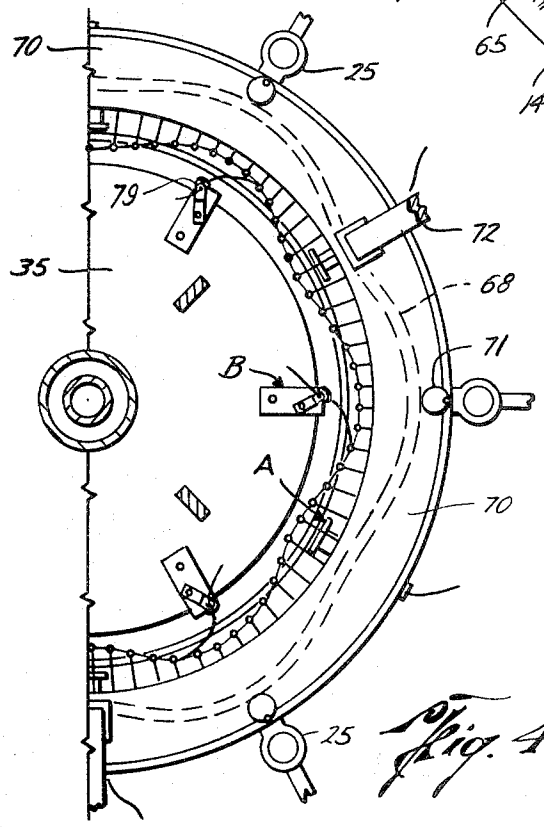

Fig. 4

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APPARATUS FOR PRODUCING A KNITTED FABRIC INCLUDING INTERLACED INSERT ELEMENTS

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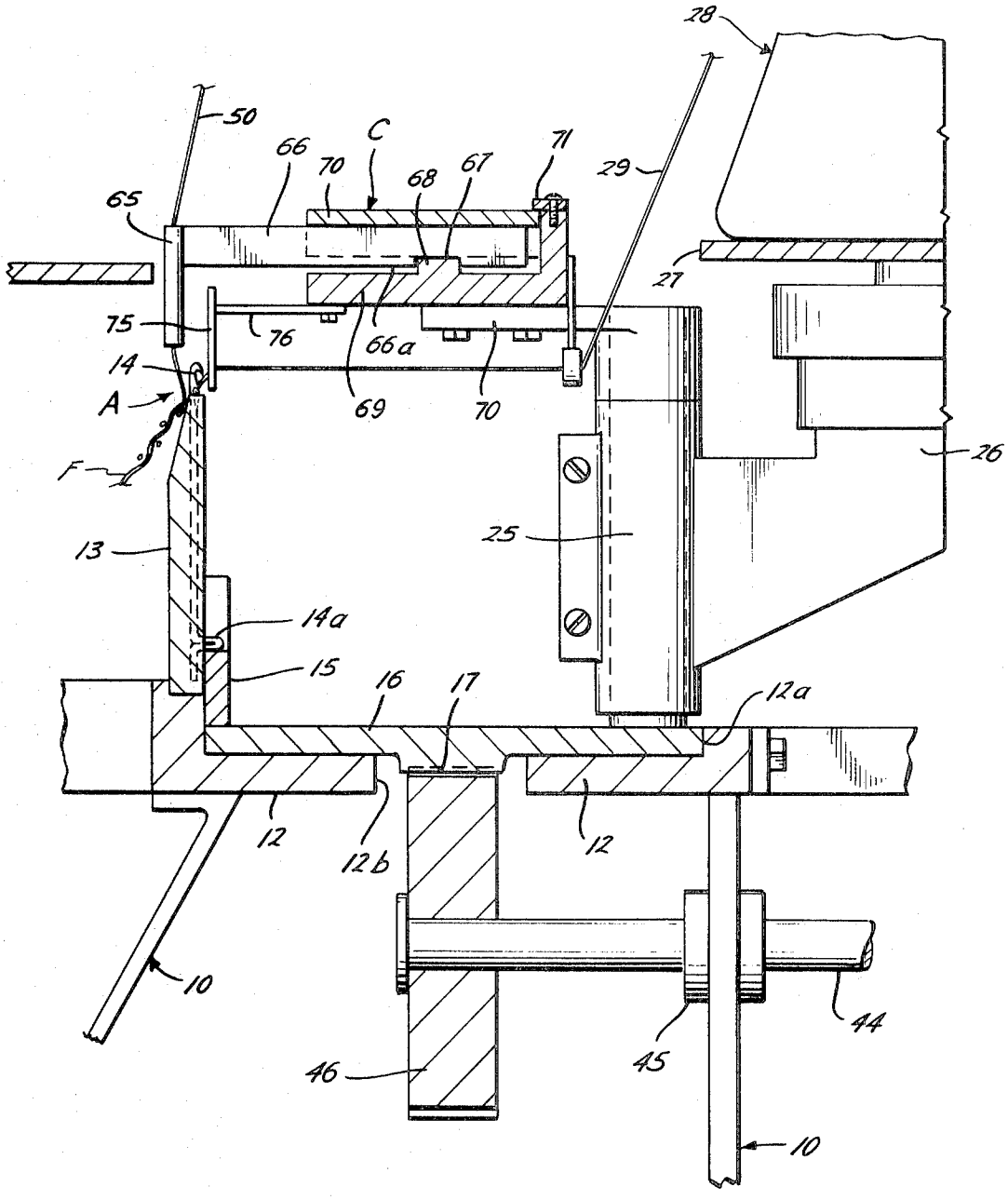

Fig. 6

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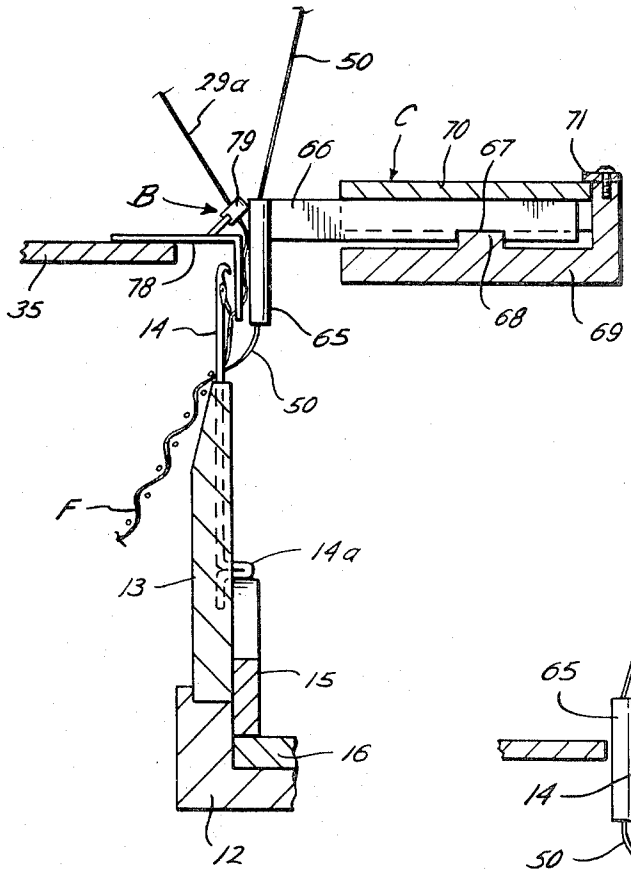


Fig. 7

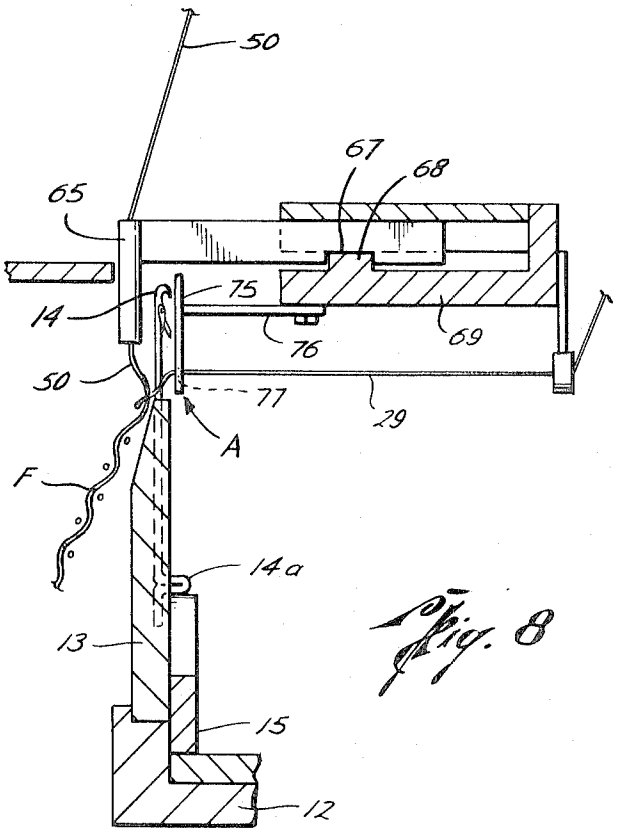
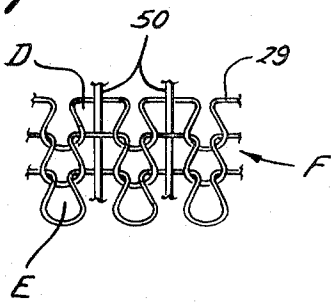


Fig. 8

Fig. 10



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United States Patent Office 3,621,677 Patented Nov. 23, 1971

3,621,677

APPARATUS FOR PRODUCING A KNITTED FABRIC INCLUDING INTERLACED INSERT ELEMENTS

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Filed Aug. 6, 1969, Ser. No. 847,982
Int. Cl. D04b 9/16
U.S. Cl. 66—9 R 9 Claims

ABSTRACT OF THE DISCLOSURE

The invention relates to an apparatus for producing a fabric in which knitted yarn or yarn-like elements have a plurality of insert elements interengaged or interlaced therewith; said apparatus having an improved guide means which positively guides the insert elements and maintains them in proper relationship to the courses of fabric as said courses are being knitted. The apparatus also includes an improved actuating and control means for actuating and controlling movement of the guide means, which actuating and control means is disposed exteriorly of the knitting needles of the knitting machine whereby a maximum number of insert elements in relationship to knitting machine size may be inserted and also whereby the central area or interior of said knitting machine is made more accessible.

IMPROVEMENT

The invention herein disclosed is an improvement upon the apparatus shown in the co-pending application of Ronald H. Marks et al., Ser. No. 687,540, filed Dec. 4, 1967, and now U.S. Pat. No. 3,507,130, granted Apr. 21, 1970.

BACKGROUND OF THE INVENTION

As is well known, knitted and woven fabrics have different inherent characteristics which result in certain advantages and disadvantages either in manufacture or in the final fabric product. Knitted fabrics may be produced on a knitting machine at a faster rate than woven fabrics can be woven on a loom but knitted fabrics usually require more material and have a stretch characteristic in all directions. Woven fabric may utilize elements of larger surface area and in many uses, the nonstretch characteristic of woven material is desirable.

In the above referred to co-pending application, Ser. No. 687,540, and also in the prior Great Britain patent to Takaoka, No. 450,156, issued July 8, 1936, apparatus for producing a composite fabric consisting of knitted yarn elements and insert elements is illustrated. Such fabric has the insert elements interengaged, somewhat in the manner of an interweaving operation, in a direction transversely of the courses formed by the knitting of the yarn elements. Such a composite fabric has some of the desirable features of both knitted and woven fabric, since the insert elements will limit the stretch of the fabric in one direction and said insert elements may also have a relatively large surface area to reduce the total amount of material necessary to produce a given amount of fabric.

Although the apparatus shown in said co-pending application, Ser. No. 687,540, operates quite satisfactorily to produce the fabric, the guide means for the insert elements and the actuating and control means for controlling motion of the insert elements is rather complicated in construction as well as expensive in manufacture; furthermore, it is located interiorly of or within the outer circular margin of the knitting machine so that it interferes with access to the central area of said knitting machine and also reduces the number of insert elements which may be used on a given size knitting machine.

The apparatus shown in the Great Britain Pat. No. 450,156 attempts to impart the required back-and-forth motion to the insert elements by a direct engagement of a rotating cam-type apparatus with the insert elements; such direct engagement causes a displacement of the insert elements in a circumferential path with respect to the yarn elements being knitted, with the result that the insert elements are not retained in their intended path and their proper insertion into the fabric is not accomplished. Furthermore, the actuating and control means in this prior patent is located within the confines of the knitting machine which creates the disadvantages above mentioned, i.e., difficulty of access and reduction in the number of insert elements which may be employed.

OBJECTS OF THE INVENTION

It is one object of this invention to provide an apparatus for producing a composite fabric consisting of knitted yarn elements and interengaged insert elements, wherein each insert element is directed through a generally tubular-type guide member and wherein the member is positively controlled in its movement to thereby maintain each insert element in proper position relative to the yarn being knitted to assure the desired interengagement of said insert elements with the fabric as said fabric is being formed by the knitting operation.

Another object is to provide an apparatus, of the character described, wherein the actuating and control means for moving the guide for each insert element comprises a cam track disposed circumferentially outside the confines of the knitting machine and a cam bar for each guide coacting with said cam track; the disposition of said actuating and control means allowing a maximum number of guides and, therefore, a maximum number of insert elements to be employed and also making the interior area of the knitting machine more accessible.

Still another object is to provide a cam track mounted on a rotatable member and a plurality of nonrotatable cam bars coacting with said track and mounted so as to be moved in a substantially horizontal plane when the member and cam track are rotated relative to the bars; each cam bar being notched to span, engage and ride upon the cam track so that the weight of each bar is carried by the cam track whereby there is relatively small surface contact between the rotating member and its cam track and the nonrotating cam bars. The small surface contact between the cam track and cam bars, together with the movement of the cam bars in a horizontal plane, minimizes the wear on the rotating and nonrotating surfaces which are in contact with each other.

A further object is to provide a guide means for each insert element which comprises an elongate guide tube having its axis located in a vertical plane and having the insert element extending completely therethrough, said guide tube being of sufficient length to protect the yarn element against contact or engagement with any part of the knitting machine prior to its passage to the knitting area for insertion into the fabric being knitted, whereby the maintenance of the proper position of the insert element with respect to said fabric is assured throughout the knitting operation.

DESCRIPTION OF DRAWINGS

These and other objects and advantages of the present invention are hereinafter set forth and explained in detail in reference to the drawings wherein:

FIG. 1 is a view partly in section and partly in elevation of an apparatus constructed in accordance with the present invention.

FIG. 2 is a plan view of the apparatus illustrated in FIG. 1.

FIG. 3 is a partial vertical sectional view taken on the lines 3—3 of FIG. 2.

FIG. 4 is a horizontal cross-sectional view taken on line 4—4 of FIG. 3.

FIG. 5 is a partial isometric view illustrating the cam track assembly and the manner in which it controls operation and movement of the insert element guide members.

FIG. 6 is an enlarged partial vertical sectional view taken through the cam track assembly and the actuating ring to illustrate the relationship of the various parts.

FIG. 7 is a detailed sectional view of one of the inner yarn feeding stations and showing the relationship of the insert element guide relative thereto.

FIG. 8 is a detailed sectional view of one of the outer yarn feeding stations and also illustrating the relationship of the insert element guide member with respect thereto.

FIG. 9 is an enlarged partial view of the mounting for the supply rollers which carry the insert element.

FIG. 10 is an enlarged partial view of the fabric which is formed by the improved apparatus.

DESCRIPTION OF APPARATUS

In the drawings, the letter K generally indicates a circular knitting machine which is modified, as hereinafter described, to provide an apparatus which will knit the improved fabric. The basic circular knitting machine includes a lower supporting framework **10** which is carried by suitable supporting legs **11**. The upper end of the framework **10** carries an annular support **12**, a portion of which is shown in enlarged section in FIG. 6. The annular support **12** has the annular knitting cylinder **13** supported thereon and the usual knitting needles **14** are mounted to reciprocate vertically within said cylinder. The needles are reciprocated by cams **15** which are attached to and extend upwardly from a rotatable actuating ring **16**, which actuating ring is rotatably supported in an annular recess **12***a* formed in the upper surface of the support **12**. As the actuating ring is rotated, the cams **15** are rotated with respect to the stationary cylinder **13** and needles **14** and engage projections **14***a* on said needles to reciprocate them vertically in the usual and well-known manner, whereby a knitting operation is performed.

The actuating ring **16** has a gear ring **17** extending downwardly therefrom and the teeth of said ring are movable within an annular slot **12***b* formed in the support **12**. The teeth of the gear ring **17** are engaged by a driving gear **18** mounted at one end of a drive shaft **19** (FIG. 1) which is supported in a bearing **20** carried by the framework **10** of the machine. The outer end of the shaft **19** has a driven pulley **21** over which a driving belt **22** passes; the belt is driven by a drive pulley **23** secured to the shaft of a suitable motor **24** located at the base of the machine. Operation of the motor rotates the gear **18** and actuating ring **16** and the cams **15** attached to said ring are rotated to thereby reciprocate the knitting needles vertically within the cylinder **13**.

A plurality of vertical posts **25** are mounted on the outer peripheral portion of the actuating ring **16** and each post is formed with an outwardly projecting and upwardly extending supporting bracket **26**. An annular carrier **27** is supported on the upper end of the brackets and has a plurality of yarn spools **28** mounted thereon. The yarn **29** from each spool **28** is guided through tension spring members **29***b* to an outer feeding station generally indicated at A. Since the spools **28** are carried by the posts **25** mounted on the actuating ring, said spools are rotatable therewith.

An upper framework, generally indicated at **110**, consists of a trio (FIG. 2) of angular support members **30**. The lower horizontal portion **30***a* of each member is connected at **31** (FIG. 1) to the support **12**; the upright or vertical portion **30***b* terminates in an upper lateral leg **30***c* which extends inwardly to the center of the machine. Said upper lateral leg is bolted, or otherwise secured, to the outer periphery of a circular flange **32** formed on a vertically extending tubular housing **33** located at the center of the knitting machine (FIG. 3).

Extending downwardly through and rotatably supported by the tubular housing is a central shaft **34** which has its lower end secured to a circular plate **35**. By means of upright bars **36**, a second annular carrier **37** is mounted above the plate **35**. Spools **28***a* are mounted on the carrier **37** and the yarn **29***a* from each spool extends through a spring tension loop **29***c* to an inner yarn station generally indicated at B (FIGS. 3 and 5). The upper end of the central shaft **34** which has its lower end connected to the plate **35** and upright bars **36** and therefore to the carrier **37**, has a pulley **38** secured to its upper end. A drive belt **39** connects the pulley **38** to a driven pulley **40** which is carried on the upper end of a shaft **41** mounted in bearings **41***a* secured to one of the upper framework members **30**. The lower end of the shaft has a bevel gear **42** engaged with a complementary bevel gear **43** secured on a shaft **44** mounted in suitable bearings **45** in the lower framework **10**. A gear **46** mounted on the end of the shaft **44** is in constant engagement with the gear rack **17** on the lower end of the actuating ring **16** and, as the actuating ring **16** is rotated by means of the driving gear **18**, the actuating ring imparts rotation to the central shaft **34** and spool carrier **37** through shaft **44**, bevel gears **42**, **43**, shaft **41**, belt **39** and pulleys **38** and **40**.

From the foregoing, it is apparent that when the actuating ring **16** is rotated, this same rotation is imparted to the yarn spools **28** and **28***a*, so that the yarn elements **29** and **29***a* which are fed to the inner and outer yarn stations A and B are simultaneously rotated. At the same time, the cams **15**, which are secured to the rotatable actuating ring, coact with the projections **14***a* on the knitting needles to impart vertical reciprocation to said needles **14** and thereby cause the needles to perform the knitting operation.

As has been previously noted, one of the main objectives of the present invention is to provide a simple and efficient type apparatus for directing a plurality of insert elements **50**, which may be in the form of a yarn or a flat strip, into an interengagement with a knitted fabric being formed, said fabric being generally indicated by the letter F (FIG. 1). As will be explained, each insert element is interengaged into the knitted structure which is formed by the yarn elements **29** and **29***a* and becomes an integral part of the final fabric. Each insert element may be of any material but as shown herein, is a yarn, similar to the yarns **29** and **29***a*. The material of the insert element may have a nonstretch characteristic or may be stretchable. If in the form of a flat strip, the element would have a relatively large surface area compared to the surface area of the yarns **29** and **29***a*. Materials, such as plastic and paper, have been found satisfactory for use as the insert elements and for pattern design may be of different material or of different colors.

For supplying the insert elements **50** to the knitting machine, it is preferable to employ a number of supply racks **51** which may be spaced around the knitting machine K, as shown in FIG. 2. Each rack includes a frame formed of vertically extending supports **52** and **53**, a base **54** and an upper frame bar **54***a*. A plurality of crossbars **55** extend between the uprights **52** and have spindles **56** extending forwardly therefrom for receiving a supply spool **57**. To facilitate the feeding off of each yarn element **50** from its spool **57**, a generally U-shaped guide bracket **58** (FIG. 9) is secured to the upright supports **53** and is located in alignment with one of the supply spools **57**. A roller **59** is mounted in the bracket and each insert element **50** passes around the guide wheel **59**, and is threaded through a tension spring member **60** mounted on the top crossbar **54***a* of the rack.

From the spring member, each insert element **50** is directed over a pair of stationary guide rings **62** and **63** which are secured within the upper framework **110** of the knitting machine. From the guide ring **63**, each element

50 extends downwardly (FIGS. 1 and 3) and through a guide sleeve or tube 65 which, as will be explained, is adapted to reciprocate in a radial direction so that it will guide or direct each yarn element 50 to one side or the other of the fabric F which is being knitted. By so directing said insert elements, each element is interengaged with the knitted fabric while the knitting operation is being performed. The insert elements become a part of the final fabric and are retained in position by the actual knitting of the yarns 29 and 29*a* into the final fabric structure. Preferably, the elements 50 are disposed in a position so that each element extends transversely with respect to the courses of the knitted material.

For controlling the movement of each guide tube 65, each tube is provided with an actuating bar 66 which extends into and is actuated by a cam track assembly generally indicated by the letter C. Each bar 66 has a notch or recess 67 in its lower edge portion and this notch or recess is engageable with a cam track 68 which projects upwardly from an annular base member 69 of the assembly C. The base member 69 is secured by a bracket 70 to the upper end of each supporting post 25, which posts are carried by the rotatable actuating ring 16. In this manner, rotation of the actuating ring also rotates the base member 69 of the assembly C.

The actuating bar 66 of each guide tube 65 is confined against upward of movement by an annular cover 70 which overlies the base member. Each actuating member is slideable within a radially directed groove 73 formed in the underside of said cover so that each guide tube 65 is confined to movement in a radial plane. The annular cover 70 is nonrotatable and is held so by a plurality of inclined braces 72 which connect the cover 70 to the upper framework 110 of the knitting machine; the cover is maintained in overlying position on the base member 69 by a plurality of retaining washers 71.

The height or vertical extent of each actuating bar 66 is less than the space between the upper surface of the base 69 and the underside of the cover 70, so that the bar engages the cam track only throughout the upper surface and vertical side edges of said track; this provides for a minimum frictional contact between the bar 66 and the rotating cam track assembly. As is clearly shown in FIG. 6, a space 66*a* is formed between the lower edge of the bar 66 and the upper surface of the base 69. This minimum friction assures that the guide sleeve 65 will be reciprocated in a radial direction in a free manner to assure proper guiding of the insert elements 50.

The cam track 68 is designed to follow a generally undulating path or curvature along the upper surface of the base member 69, whereby the guide tubes move inwardly and outwardly with respect to the circumferential path in which the knitting needles are located. As the base 69 of the cam track assembly C rotates, the movement of the guide sleeves is along the path shown in FIG. 4. By reason of this radial reciprocating motion of the guide sleeves, the yarn elements 50 are alternately placed on either side of the circumferential path in which the knitting needles operate and are, therefore, alternately disposed on opposite sides of the fabric. This results in an interlacing or interengaging of the insert elements with the fabric being knitted by the yarn elements 29 and 29*a*.

As has been noted, a plurality of outer stations A for feeding the yarn 29 to the knitting needles, as well as a plurality of inner stations B for feeding the yarn 29*a* to said needles, have been provided. A pair of these stations A and B is illustrated in FIG. 5 and as shown therein, the stations are in substantially the same circumferential path but are spaced circumferentially from each other, that is, they are in different radial planes.

Each station A includes a plate-like guide member 75 which is attached by an arm 76 to the underside of the rotating base 69 of the cam track assembly. The member 75 has a guide opening 77 which is so located that the knitting needle 14 will engage the yarn extending from the opening and pull it downwardly to perform a knitting operation.

Station B includes an angular supporting member 78 having a yarn guide member 79 secured thereto; the latter has an opening through which the yarn 29*a* is directed downwardly and through a hole in the carrier into the path of the knitting needles. The supporting member 78 of the inner yarn guide is attached to the rotating plate 35 which, as previously explained, rotates at the same speed as the actuating ring 16 which controls rotation of station A. The cam track is so arranged that the guide tubes 65 are moved inwardly and outwardly with respect to the plate 75 of the station A so that said plate will clear the various tubes as it undergoes rotation.

Referring specifically to FIG. 8, which illustrates the operation at station A, when the knitting needle 14 has moved upwardly, the guide tube 65 and its insert element 50 have been moved to the left in this figure by reason of the coacting between the cam track 68 and the actuating bar 66. This places the insert element 50 on the inner side of the fabric F which is being knitted. At the same time, this movement locates the tube 65 out of circumferential alignment with the guide member 75 of station A and out of alignment with the knitting needles 14 so that member and the knitting needles may pass the guide tubes. As the needle moves downwardly to form the stitch, or loop, the timing is such that the cam track 68 moves the guide tube 65 across the circumferential path of the needle and places said guide tube on the other side of the fabric being knitted, in the position shown in FIG. 7.

In this position, the insert element 50 is guided to the opposite side of the fabric (FIG. 8) and as the knitting operation proceeds, the guiding of the insert elements is coordinated therewith so that the insert element is placed on one side or the other of the knitted structure. Thus, each insert element is disposed between the loops formed during the knitting operation in what might be referred to as an interweaving or interlacing operation.

The number of insert elements, and whether or not such elements extend between each row of yarn loops, is subject to variation. As shown in FIG. 10, the insert elements 50 extend through the fabric in a direction transverse to the cross-links or courses D, between the rows E of yarn loops. The yarn loop rows form the wales or ribs of the knitted structure.

OPERATION

The operation of the apparatus is obvious from the foregoing description. The knitting stations A and B rotate simultaneously to feed the yarn elements 29 and 29*a* to the knitting needles which reciprocate vertically but which are stationary in a circumferential direction. The insert elements 50 are also nonrotatable and each insert element is located between two adjacent needles, as illustrated in FIG. 5. By reason of the insert elements extending through the guide tubes 65, said insert elements are moved back and forth in a lateral or radial direction with respect to the knitting needles so that as the knitting of the material proceeds, each insert element is inserted on opposite sides of the knitted structure F. The knitting operation may proceed at the usual normal speed of a circular knitting machine, and simultaneously with the knitting operation, the elements 50 are directed into position between the loops and placed therein in what might be termed an interweaving operation. Thus, the fabric, even though having insert elements interwoven or interlaced into the structure, is formed at the speed of operation of a circular knitting machine, which greatly reduces the cost of manufacture because production proceeds at a high rate.

The movement of the guide tubes 65 is efficiently accomplished by the coaction of the cam track 68 with the actuating bars 66 of said guide tubes. The particular shape of the cam track 68 may be varied to give the proper

radial or lateral movement to each guide tube, and, of course, the number of guide tubes may also be varied.

Of importance is the minimum contact area which is present between the cam track **68** and the notch or recess in the actuating bar **66** of each guide tube. As shown in FIG. 6, the entire weight of the bar **66** is carried by the cam track and since this is a minimum amount of contact, friction is reduced to a minimum. This assures that the guide tubes **65** will be positively moved radially as the cam track base **69** rotates with respect to each of the bars **66**. Also, with the particular construction shown, the actuating bars which carry the guide tubes **65** are moved in a true horizontal direction, as distinguished from being at an incline; this assures positive extension and retraction of the guide tubes without any binding action as they are actuated by the cam track.

An important feature of the apparatus is the location of all of the operating mechanism for the guide tubes **65** outside of the outer periphery of the working parts of the knitting machine. As clearly shown in FIGS. 3 and 5, the cam track assembly C is disposed outside the circumferential path of the knitting needles and also outside of the knitting cylinder **13**. This facilitates access to the central or interior portion of the machine. Additionally, since the cam track assembly is on a larger diameter than is the cylinder, more insert elements **50** may be used than would be possible if the insert elements were being fed from a point inside the circumference of the knitting cylinder. This is of particular advantage in knitting fabrics with the finer yarn elements. The cam track **68** and the positive interengagement with notches in the actuating bar **66** of the guide tubes **65** provide for a very positive movement of the guide tubes so that proper insertion of the elements **50** into the fabric being knitted is assured.

With respect to applicant's prior application Ser. No. 687,540, attention is called to the fact that in such structure the control mechanism for moving guide elements inwardly and outwardly of the fabric being knitted is located inwardly of the knitting cylinder. This interferes with the accessibility to the interior of the machine and, additionally, limits the number of insert elements which may be placed into the fabric. Where the operating mechanism which controls the lateral movement of the guides is located exteriorly of the machine, it permits a greater number of insert elements to be employed and also makes the mechanism more accessible for repair, if such be necessary.

The apparatus shown in the prior patent, Great Britain No. 450,156, discloses a cam groove within which a depending lug on each actuating bar is engaged. In this construction, the entire lower edge of the actuating bar is in frictional contact with the surface of the rotating member in which the groove is mounted so that there is an excessive amount of friction between each bar and the rotating member. Additionally, the actuating bars are disposed at an angle from the horizontal, and such disposition creates undue wear between the parts and particularly on one vertical edge of the lug and cam groove. None of these disadvantages are present in the construction disclosed herein. It might also be noted that this prior British patent has the major disadvantage of attempting to move the insert elements back and forth relative to the needles by a direct contact with a cam-like rotating surface; this causes the insert elements to be displaced circumferentially relative to the wales or yarn loop rows so that proper placement of said insert elements can not be accomplished. In the present apparatus, the guide tubes are maintained in radial alignment and are positively confined against circumferential displacement at all times, whereby proper insertion of said insert elements into the fabric is assured.

What is claimed is:

1. In an apparatus for producing a fabric wherein the apparatus includes a circular knitting machine having knitting needles and a knitting cylinder and also having inner and outer yarn feeding stations alternately disposed and spaced from each other along a circumferential path so that yarn which is delivered to the needles may be knitted into a fabric, the improvement comprising means for interengaging a plurality of insert elements with the fabric as it is being knitted, said means including

a guide tube for each insert element and located in vertical alignment with the space between selected wales of the fabric being knitted,

a cam bar secured to each guide tube and reciprocable in a horizontal plane to move the guide tube and its insert element inwardly and outwardly of the fabric being knitted, the lower end of each guide tube moving in a substantially horizontal plane,

a rotatable annular support,

a cam track on said rotatable support engageable by each of the cam bars, and

means mounting the cam bars for movement only in a path radially of the knitting machine, whereby rotation of the support and cam track relative to said cam bars reciprocates said bars along said radial path to reciprocate each guide tube and its insert element with respect to the fabric being knitted,

the lower end of each of said guide tubes being located closely adjacent at all times to the knitting area in which the needles engage the yarn being knitted to thereby deliver each insert element to preselected positions relative to the inner and outer yarn feeding stations during the knitting operation,

the guide tubes each having sufficient length to protect the insert elements from contact with the rotating parts of the knitting machine and also to maintain the vertical alignment of the insert elements with respect to the space between selected wales.

2. The improvement as set forth in claim **1**, wherein said cam track is mounted on the upper surface of the rotatable support to locate the upper surface of said track in a plane above the support,

each cam bar having a notch in its lower surface of a size and shape to span and engage the track, the surfaces which define the sides of the notch engaging the sides of the track so that rotation of the cam track will reciprocate said cam bar in accordance with the shape of said cam track.

3. The improvement as set forth in claim **1**, wherein the annular support, the track and the cam bars are mounted exteriorly of the circumferential path in which the knitting needles are located.

4. An apparatus for producing a fabric from a plurality of yarns and a plurality of insert elements, comprising

a knitting machine having knitting needles and a knitting cylinder,

a plurality of inner yarn feed stations,

a plurality of outer yarn feed stations,

said inner and outer yarn feed stations being alternately disposed and spaced from each other along a circumferential path,

means for delivering yarn to each of said inner and outer yarn feed stations for engagement by the knitting needles,

means for operating said knitting needles to kit said inner and outer yarns into a fabric,

a tubular guide member for each insert element having said element extending therethrough,

each tubular guide member being positioned in a vertical plane in alignment with the space between selected wales of the fabric being knitted and having its lower end located closely adjacent at all times to the knitting area in which the needle engages the yarn being knitted to thereby deliver its insert element to preselected positions relative to the inner and outer yarn feed stations during the knitting operation,

the guide tubes each having sufficient length to protect the insert elements from contact with the rotating parts of the knitting machine, and

means for reciprocating each guide member in a substantially horizontal plane as well as radially in a path inwardly and outwardly of the fabric being knitted to cause its insert element to interengage the courses of the fabric in a manner which locates portions of the insert element on opposite sides of the finished fabric.

5. An apparatus as set forth in claim 4, wherein each tubular guide member and the means for reciprocating the same comprises,

a vertically disposed sleeve through which the yarn element extends,

a horizontally disposed cam bar having one end secured to the sleeve,

a rotatable support encircling the knitting needles of the knitting machine,

a cam track on said support and having engagement with each cam bar,

means for mounting said cam bars for movement only in a radial path relative to the knitting machine, whereby upon rotation of the support and cam track, a reciprocating movement is imparted to the cam bars and guide sleeves to properly guide the insert elements with respect to the fabric being knitted and thereby assure desired interengagement of the elements with said fabric.

6. In an apparatus for producing a fabric wherein the apparatus includes a circular knitting machine having knitting needles and a knitting cylinder and also having inner and outer yarn feeding stations alternately disposed and spaced from each other along a circumferential path so that yarn which is delivered to the needles may be knitted into a fabric, the improvement comprising means for interengaging a plurality of insert elements with the fabric as it is being knitted, said means including,

a guide tube for each insert element and located in vertical alignment with the space between selected wales of the fabric being knitted,

a cam bar secured to each guide tube and reciprocable in a horizontal plane to move the guide tube and its insert element inwardly and outwardly of the fabric being knitted,

a rotatable annular support,

a cam track on said rotatable support engageable by each of the cam bars, and

means mounting the cam bars for movement only in a path radially of the knitting machine, whereby rotation of the support and cam track relative to said cam bars reciprocates said bars along said radial path to reciprocate each guide tube and its insert element with respect to the fabric being knitted,

said cam track being mounted on the upper surface of the rotatable support to locate the supper surface of said track in a plane above the support,

each cam bar having a notch in its lower surface of a size and shape to span and engage the track, the surfaces which define the sides of the notch engaging the sides of the track so that rotation of the cam track will reciprocate said cam bar in accordance with the shape of said cam track,

the surface which defines the upper end of the notch in each cam bar riding upon the upper surface of the track while the lower edge of each cam bar is spaced from the surface of the rotating support, whereby friction is minimized between the rotating support and its track and the nonrotating cam bars.

7. The improvement as set forth in claim 6, wherein the annular support, the track and the cam bars are mounted exteriorly of the circumferential path in which the knitting needles are located.

8. An apparatus for producing a fabric from a plurality of yarns and a plurality of insert elements, comprising

a knitting machine having knitting needles and a knitting cylinder,

a plurality of inner yarn feed stations,

a plurality of outer yarn feed stations,

said inner and outer yarn feed stations being alternately disposed and spaced from each other along a circumferential path,

means for delivering yarn to each of said inner and outer yarn feed stations for engagement by the knitting needles,

means for operating said knitting needles to knit said inner and outer yarns into a fabric,

guide means for guiding each insert element into preselected positions relative to the inner and outer yarn feed stations,

each guide means comprising a relatively elongated vertical member having sufficient rigidity to maintain its insert element in a vertical plane which is in alignment with the space between selected wales of the fabric being knitted whereby said insert element is delivered into said space,

each guide member having its lower end located closely adjacent at all times to the knitting area in which the needles engage the yarns being knitted and being constructed to protect the insert elements from the rotating parts of the knitting machine, and

means for reciprocating each guide member in a horizontal plane as well as radially in a path inwardly and outwardly of the fabric being knitted to cause its insert element to interengage the courses of the fabric in a manner which locates portions of the insert element on opposite sides of the finished fabric.

9. An apparatus according to claim 8, wherein

the means for reciprocating said guide members is mounted exteriorly of the circumferential path in which the knitting needles are located.

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