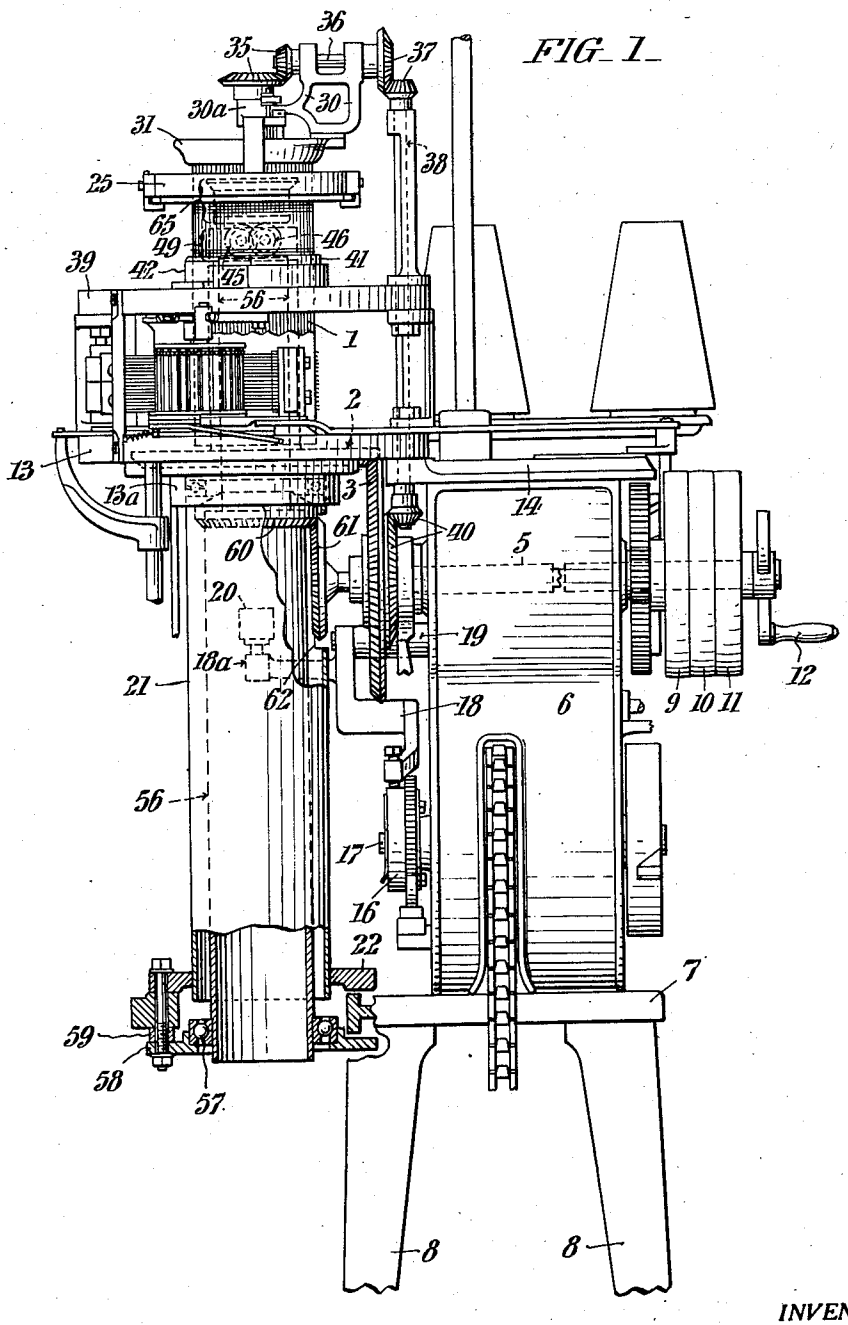
July 7, 1953 J. G. HANES, JR., ET AL 2,644,325

CIRCULAR KNITTING MACHINE

Filed May 10, 1950 3 Sheets-Sheet 1

FIG. 1.



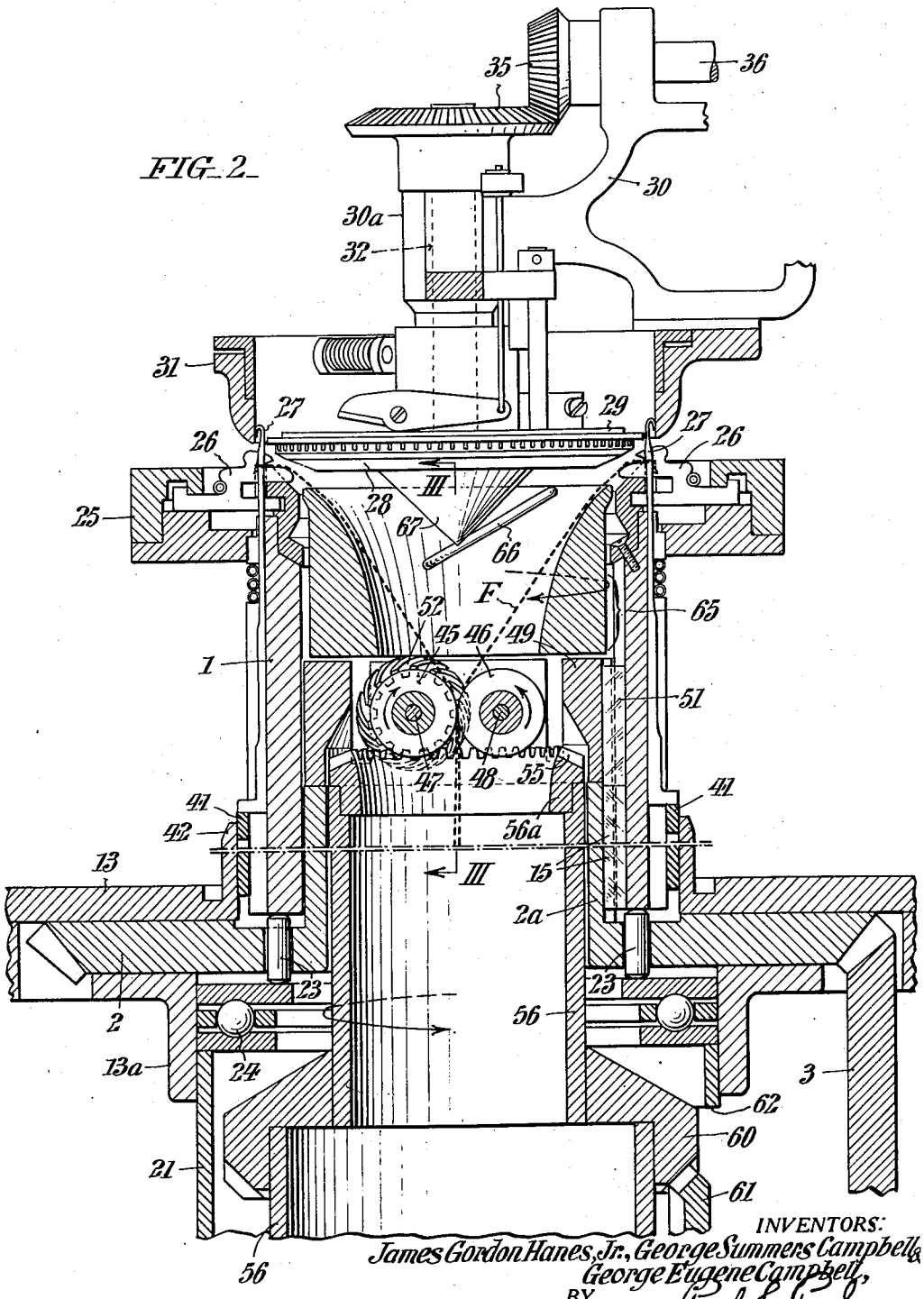
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CIRCULAR KNITTING MACHINE

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FIG. 2.



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CIRCULAR KNITTING MACHINE

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FIG. 3

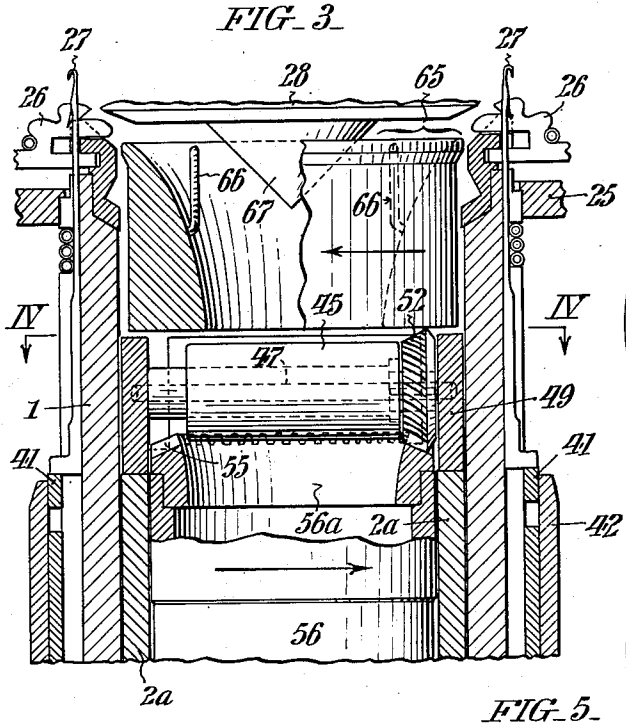


FIG. 7

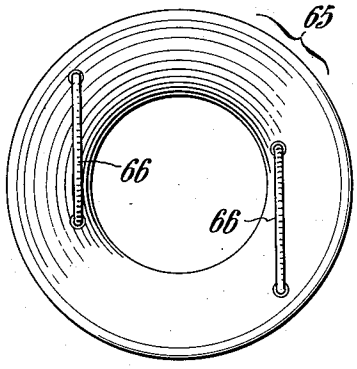


FIG. 5

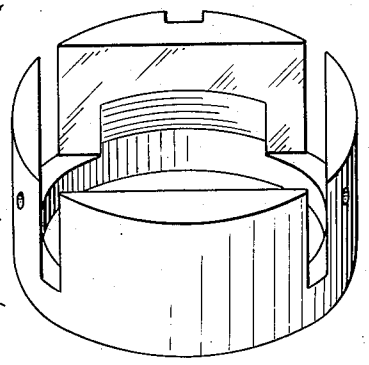


FIG. 4

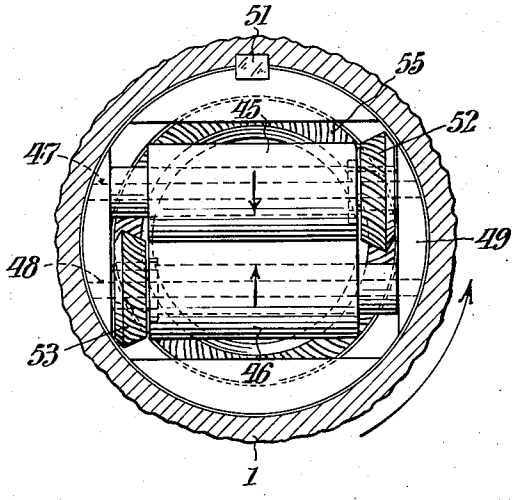
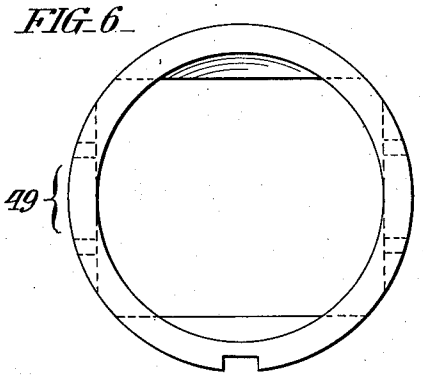


FIG. 6



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UNITED STATES PATENT OFFICE

2,644,325

CIRCULAR KNITTING MACHINE

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Application May 10, 1950, Serial No. 161,076

11 Claims. (Cl. 66—150)

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This invention relates to circular knitting machines. More particularly, it is concerned with circular knitting machines of a commercial type designed for the successive production of individual detached articles such as seamless stockings and the like, including long hose with welt tops. In knitting articles of the kind referred to from "nylon" or other yarns which are inherently springy, difficulty is experienced in securing uniformity in the size of loops in individual courses of the fabric, with consequent formation of objectionable rings, streaks or other detracting irregularities in the articles.

The chief aim of our invention is to overcome the above mentioned difficulty. This desideratum is realized in practice, as hereinafter more fully disclosed, through provision of a simple and reliable draw-off mechanism comprising a pair of rotated cooperative take-up or draw-off rolls which are disposed within the needle cylinder of the machine immediately below the knock over level for capacity to receive between them, the start end of each article after a short length of the same has been formed, and to thereafter draw the fabric slowly and continuously downward away from the needles and maintaining it under uniform tension until completion, with the result that the loops are equalized incident to the knitting of each course of the fabric.

In connection with take-up mechanism having the above attributes, we further aim to provide auxiliary means by which the start end of each article is positively worked down into the nip of the take-up rolls for assurance of early engagement thereby, and so prevent undue accumulation of the fabric in the top of the cylinder.

Still other objects and attendant advantages of our invention will appear from the following detailed description of the attached drawings, wherein: Fig. 1 is a more or less diagrammatic view in front elevation, of a circular knitting machine with portions broken away and others shown in section, embodying our invention.

Fig. 2 is a fragmentary view, in axial section, of the knitting head of the machine.

Fig. 3 is a similar view taken as indicated by the angled arrows III—III in Fig. 2.

Fig. 4 is a fragmentary view in horizontal section taken as indicated by the angled arrows IV—IV in Fig. 3; and

Figs. 5, 6, 7 are views showing the details of certain of the component parts of the draw-off mechanism.

The circular knitting machine chosen for con-

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venience of illustration herein to exemplify our invention, is of the well known commercial Scott and Williams "Spiral" type designed for the successive production of detached individual welt top full length seamless ladies' stockings. The needle cylinder of the machine, designated by the numeral 1, receives its rotary motions as ordinarily through a pair of intermeshing miter gears 2 and 3, from a horizontal main shaft 5 which is suitably journalled in a frame 6 having a base plate 7 sustained by four legs 8. By mechanism (not illustrated) the shaft 5 is rotated or oscillated as required in seamless hosiery production from the usual slow and high speed pulleys 9, 10 between which a drive belt (not illustrated) is shiftable. A loose pulley 11 is also provided for idling purposes, as well as a hand crank 12 whereby the machine can be manually operated when necessary. Likewise as usual, the bevel gear 2 is recessed into an overhanging bed 13 supported from the top plate 14 of the frame 6, and said gear provided with an upward hub projection 2a (Fig. 2) which fits into the needle cylinder 1, and to which said cylinder is connected by a key 15 (Fig. 2) with capacity for slight up and down movement for stitch length variation in shaping the boot or leg portions of the stocking. Such up and down movements are imparted to the needle cylinder in the known manner under control of a cam drum 16 on one end of a jack shaft 17 in the lower part of the frame 6, said jack shaft being intermittently turned through a complete rotation during each knitting cycle by mechanism (not shown) actuated from the main shaft 5. The intermediate connections include a lever arm 18 which is fulcrumed at 19 on the frame, and which has a finger 18a under-reaching a lug 20 on a non-rotating tube 21 axially aligned with the needle cylinder 1 below the bed 13. The upper end of the tube 21 is slidingly engaged in a pendent counter-bored boss 13a on the bed 13, and its lower end is similarly engaged in an apertured plate 22 affixed to the base plate 7 of frame 6. The needle cylinder 1 is supported from beneath by vertical pins 23 (Fig. 2) which are axially free in guide apertures in the miter gear 2, and which bear upon the upper ring of a ball bearing 24 whereof the lower ring rests on the top of tube 21. Surrounding the needle cylinder 1 at the top is the usual radially-slotted guide annulus 25 for the web holders 26; and axially disposed above the cylinder within the circle of latch needles 27 is the dial 28 for the usual welting instrumentalities which are actuated by cams

(not shown) on a superposed plate 29 stationarily supported by a bracket 30 on the latch guard ring 31 of the machine. The shaft 32 of the welting dial 28 extends upward through a bearing boss 30a on bracket 30. The dial shaft 32 is driven in unison with the needle cylinder 1, through a pair of bevel gears 35, from a short horizontal shaft 36 connected by another pair of bevel gears 37 to a vertical shaft 38 which passes down through the upper bed 39 of the machine and the top 14 of frame 6, and which, at the lower end, is connected by still another bevel gear couple 40 to the main shaft 5. The needles 27 are actuated in the usual manner by cams 41 on a stationary cam cylinder 42 (Fig. 2) surrounding the needle cylinder at the bottom.

The means which we have devised for incorporation in a knitting machine, such as briefly described above, to constantly draw off the stockings as the successive fabric courses are formed and thereby insure size equalization in the fabric loops of such courses, comprises a pair of cooperative take-up rolls 45, 46 which are transversely disposed within the upper part of the needle cylinder at a level somewhat below the knock over ledge level of the web holders 26, see Figs. 2 and 3. The rolls 45, 46 have coverings of comparatively soft rubber or the like so that the fabric will not be marred by them, and are rotatively free on rods or pins 47, 48 whereof the opposite ends are engaged in axially aligned apertures in an annular supporting block or tube 49. As shown in Figs. 2 and 3, the tube 49 rests on the top of the upward hub 2a of gear 2, and is connected to the needle cylinder 1 by a key 51 and accordingly caused to rotate therewith. Offset bevel gear pinions 52 and 53 commonly known as hypoid pinions, respectively on opposite ends of take-up rolls 45, 46 mesh with a ring of similar gear teeth 55 at the top of the diametrically reduced upper portion 56a of a tube 56 which extends axially down through the non-rotating tube 21 with its diametrically reduced upper end extending into the needle cylinder 1. If desired, other means such as cone friction drive means could be used in the place of the pinions 52 and 53 to drive take-up rolls 45 and 46. From Figs. 5 and 6 it will be observed that the tube 49 is appropriately machined at the interior to snugly accommodate take-up rolls 45, 46 with the pinions 52, 53. Adjacent its lower end, the tube 56 is rotatably sustained by a ball bearing 57 (Fig. 1) which is supported by a bearing retainer 58 bolted fast to the underside of the base plate 7 of the machine frame. Adjustment of the tube 56 vertically within the non-rotating tube 21 is obtained by interposition of a spacer or spacers, such as indicated at 59, or other equivalent means between the plate 22 and the bearing retainer 58. Affixed to the tube 56 adjacent its upper end is a bevel gear 60 which meshes with a companion bevel gear 61 affixed to the shaft 5 beyond the bevel gear 3. As shown, the non-rotating tube 21 is provided, according to our invention, with a lateral opening 62 to clear the bevel gear 61. The gears 60, 61 are designed to rotate the tube 56 at a speed slightly different from that of the needle cylinder 1.

To prevent excess accumulation of the fabric within the top of needle cylinder 1 at the start of each stocking, we have provided means for guiding and at the same time working the fabric downward away from the needles 27 and into the nip of the take-up rolls 45, 46. This means comprises a fabric guiding and depressing element 65 in the form of an annulus which is inserted into the needle cylinder from above for support upon the peripheries of the nip roll driving gear pinions 52, 53 which, see Figs. 2 and 3, project slightly above the top of tube 49. From Figs. 2, 3 and 7, it will be observed that the axial bore of element 65 tapers downwardly and is rounded and smooth, its diameter at the bottom being such as to keep the knitted material away from the gear pinions 52 and 53 as it passes between take-up rolls 45, 46. Sloped segmental spiral fins 66 at the inside of the element 65 are relied upon to exert a depressing effect upon the start end of each new fabric as it comes from the needles 27. For the purpose of aiding in this depressing action, we have appended a downward conical axial guide projection 67 to the bottom of the welting dial 28.

Operation

During the knitting of the leg and instep portions of each stocking, the needle cylinder 1 is rotated counterclockwise as indicated by the large arrows in Fig. 4. Through the gears 60, 61, the tube 56 is rotated but at a slightly higher speed from that of cylinder 1. Due to the speed differential between the needle cylinder and the tube 56 and consequent action of the ring gear 55 upon the pinions 52, 53, take-up rolls 45, 46 will be turned contrariwise in the directions indicated by the arrows thereon in Figs. 2 and 4 by a small amount during each rotation of the cylinder, and hence during the formation of each course of the fabric. This same contrariwise motion of take-up rolls 45, 46 can be achieved equally well by placing the pinions 52, 53 on the opposite ends of the rolls from the arrangement shown in Fig. 4, and, with such change, rotating the tube 56 at a slightly lower speed. By using gears 60 and 61 of other ratios, it is of course possible to vary the speed differential between the tube 56 and the needle cylinder 1 and so regulate the extent by which take-up rolls 45, 46 are turned during each rotation of the cylinder. By the action of the gear pinions 52, 53 on take-up rolls 45, 46, the funnel element 65 will be rotated clockwise in relation to the needle cylinder 1 as shown by the arrows thereon in Figs. 2 and 3, and independently of the tube 56 in performing its fabric depressing function.

As is characteristic of the performance of knitting machines of the type illustrated, each stocking is begun on bare needles, the first course being taken from the needles by the transfer instrumentalities in the welting dial 28 and held by them until the completion of the welt fabric, whereupon the held loops are transferred back to the needles and the knitting proceeds to form the stocking boot. As the start or welt end of the stocking indicated by the letter F in Fig. 2, enters the depressing element 65, it is worked downward by action of the segmental fins 66 until eventually caught in the nip of take-up rolls 45, 46, it being thereafter gradually drawn off slowly and evenly with the result that the fabric loops are equalized in the successive courses of the knitting during the formation of the stocking boot. In this connection it will be understood that the pendent conical projection 67 on the welting dial 28, by cooperation with the depressing fins 66 on the element 65 which revolves clockwise or in the opposite direction to the tube 56, aids in guiding the start end of the fabric

downward to insure its entry into the nip of take-up rolls 45, 46.

Gradual tapering of the stocking boot toward the ankle, is effected as ordinarily by progressive lowering of the needle cylinder 1 under control of the intermittently rotated cam 16 to vary the length of the fabric loops drawn by the needles. The total distance through which the needle cylinder is moved during this phase of the knitting is however so slight as to have no effect whatever upon the operation of take-up rolls 45, 46.

During the knitting of the heel pocket of the stocking which immediately follows upon completion of the boot, the needle cylinder 1 is of course oscillated as required, the mechanism for effecting this motion being of the usual construction and having therefore been omitted from the drawings as previously stated. Incident to heel pocket formation, the tube 56 will be oscillated with the needle cylinder and the take-up rolls 45, 46 turned slightly first in one direction and then in the other by the same amount during each oscillation and so fail to advance the fabric during this phase of the knitting. The operation of the draw-off mechanism incident to instep and toe pocket formation will naturally be the same as described above respectively in connection with the boot and heel phases of the knitting cycle. After the toe pocket is finished, the stocking will be automatically pressed off the needles in the usual well known way.

Having thus described our invention, we claim:

1. In a circular knitting machine for producing tubular fabrics, a rotary cylinder with needles, a pair of transversely-arranged cooperative take-up rolls in the upper portion of the needle cylinder somewhat below the knock-over level for drawing the fabric down from the needles during its formation; and mechanism for driving the take-up rolls including a pair of coaxial tubes through the inner of which the fabric passes, and means for concurrently rotating the tubes at different speeds.

2. In a circular knitting machine for producing tubular fabric, a rotary cylinder with needles; a pair of transversely-arranged cooperative take-up rolls in the upper portion of the cylinder somewhat below the knock-over level, for drawing the fabric from the needles during its formation; and mechanism for actuating the take-up rolls including a pair of coaxial tubes through the inner of which the fabric passes, and intermeshing hypoid gears whereby the take-up rolls are driven from one of said tubes.

3. In a circular knitting machine for producing tubular fabric, a rotary cylinder with needles; a pair of transversely-arranged cooperative take-up rolls in the upper portion of the cylinder somewhat below the knock-over level, for drawing the fabric from the needles during its formation; and mechanism for actuating the take-up rolls including gear pinions respectively affixed to opposite ends of the rolls, a gear ring coaxially within the cylinder in mesh with the pinions, and means for rotating the gear ring at a different speed from that of the cylinder.

4. In a circular knitting machine for producing tubular fabric, a rotary cylinder with needles; a pair of transversely-arranged cooperative take-up rolls in the upper portion of the cylinder somewhat below the knock-over level, for drawing the fabric from the needles during its formation; and mechanism for actuating the take-up rolls including hypoid gear pinions respectively affixed to opposite ends of the rolls, a coaxial tube extending up into the cylinder and having hypoid gear teeth around its top end in mesh with the pinions, and means for rotating the tube at a different speed from that of the cylinder.

5. In a circular knitting machine for producing individual detached articles such as stockings, in succession, a needle cylinder, a pair of transversely-arranged cooperative take-up rolls within the upper portion of the needle cylinder somewhat below the knock-over level for reception, between them, of the start end of each article as it comes from the needles; means for suitably rotating the rolls to draw the fabric down from the needles at uniform tension during completion of each article; a rotary funnel-like element co-axial with the cylinder above the take-up rolls, said element having an internal configuration to work the fabric downward into the nip of the take-up rolls; and means for driving said element at a speed different from that of the cylinder.

6. In a circular knitting machine for producing individual detached articles, such as stockings, in succession, a needle cylinder, a pair of transversely-arranged cooperative take-up rolls within the upper portion of the needle cylinder somewhat below the knock-over level for reception between them, of the start end of each article as it comes from the needles; means for suitably rotating the rolls to draw the fabric down from the needles at uniform tension during completion of each article; a rotary funnel-like element co-axial with the cylinder above the take-up rolls, said element having a suitably configured inner surface effective to depress the fabric; and means for rotating said element at a speed different from that of the needle cylinder whereby, through action of its inner surface, the start end of each article is worked downward into the nip of the take-up rolls.

7. In a circular knitting machine for producing individual detached articles such as stockings, in succession, a needle cylinder, a pair of transversely-arranged cooperative take-up rolls within the upper portion of the cylinder somewhat below the knock-over level, for reception between them of the start end of each article as it comes from the needles; mechanism for suitably rotating the rolls to draw the fabric down from the needles at uniform tension during completion of each article, including gear pinions affixed respectively to opposite ends of the rolls, a coaxial tube extending up into the cylinder and having a ring of gear teeth around its top end in mesh with the pinions; and means for rotating the tube at a different speed from that of the cylinder.

8. In a circular knitting machine for producing individual detached articles, such as stockings, in succession, a needle cylinder, a pair of transversely-arranged cooperative take-up rolls within the upper portion of the needle cylinder somewhat below the knock-over level, for reception between them of the start end of each article as it comes from the needles; mechanism for actuating the take-up rolls to draw the fabric down from the needles at uniform tension during completion of each article, including driving elements affixed respectively to opposite ends of the rolls, a coaxial tube extending up into the cylinder, a driving element at the top end of the tube contacting the driving elements on the take-up rolls, means for rotating the inner tube at a different speed from that of the cylinder; and a funnel-like element axially within the cylinder having a suitably configured internal surface

effective to depress the fabric, said element bearing on the tops of the driving elements on the take-up rolls, for impartation of rotation to said element independently of the needle cylinder and in the opposite direction, whereby, through the action of its internal surface, the start end of each article is worked downward into the nip of said rolls.

9. In a circular knitting machine for producing tubular fabric, a rotary cylinder with needles; a drive shaft from which the cylinder derives its rotation; a pair of transversely-arranged cooperative take-up rolls within the upper portion of the cylinder somewhat below the knock-over level, for drawing the fabric down from the needles during its formation; mechanism for actuating the take-up rolls including driving elements respectively affixed to opposite ends of the rolls, a coaxial tube extending up into the cylinder, a driving element at the top end of the tube in contact with the driving elements on the take-up rolls, and operative connections with the main drive shaft of the machine for rotating the tube at a different speed from that of the cylinder.

10. In a circular knitting machine for producing tubular fabric, a rotary cylinder with needles; a main shaft from which the cylinder derives its rotation; a pair of transversely-arranged cooperative take-up rolls within the upper portion of the cylinder somewhat below the knock-over level, for drawing the fabric down from the needles during its formation; and mechanism for actuating the take-up rolls including driving elements respectively on opposite ends of the rolls, a coaxial tube extending up into the needle

cylinder and having a driving element at the top in contact with the driving elements on the take-up rolls, and operative connections with the main shaft of the machine, whereby the tube is driven at a slightly different speed from that of the cylinder.

11. In a circular knitting machine for producing tubular fabric, a rotary cylinder with needles; a divided main drive shaft including a section subject to both rotary and oscillatory motion; a pair of transversely-arranged cooperative take-up rolls within the upper portion of the cylinder somewhat below the knock-over level, for drawing the fabric down from the needles during its formation; and mechanism for actuating the take-up rolls including drive elements respectively on opposite ends of the rolls, a coaxial tube extending up into the needle cylinder and having a driving element at the top in contact with the driving elements on the take-up rolls, and operative connections between the tube and the aforesaid section of the main shaft of the machine which is subject to both rotary and oscillatory motion.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,259,478	Bechtel	Mar. 19, 1918
1,825,370	Smith, Jr.	Sept. 29, 1931
1,942,322	Beavers	Jan. 2, 1934
2,574,009	Belford et al.	Nov. 6, 1951