Aug. 23, 1966 G. A. POTEAT 3,267,698

MEANS FOR TURNING FLEXIBLE TUBULAR ARTICLES

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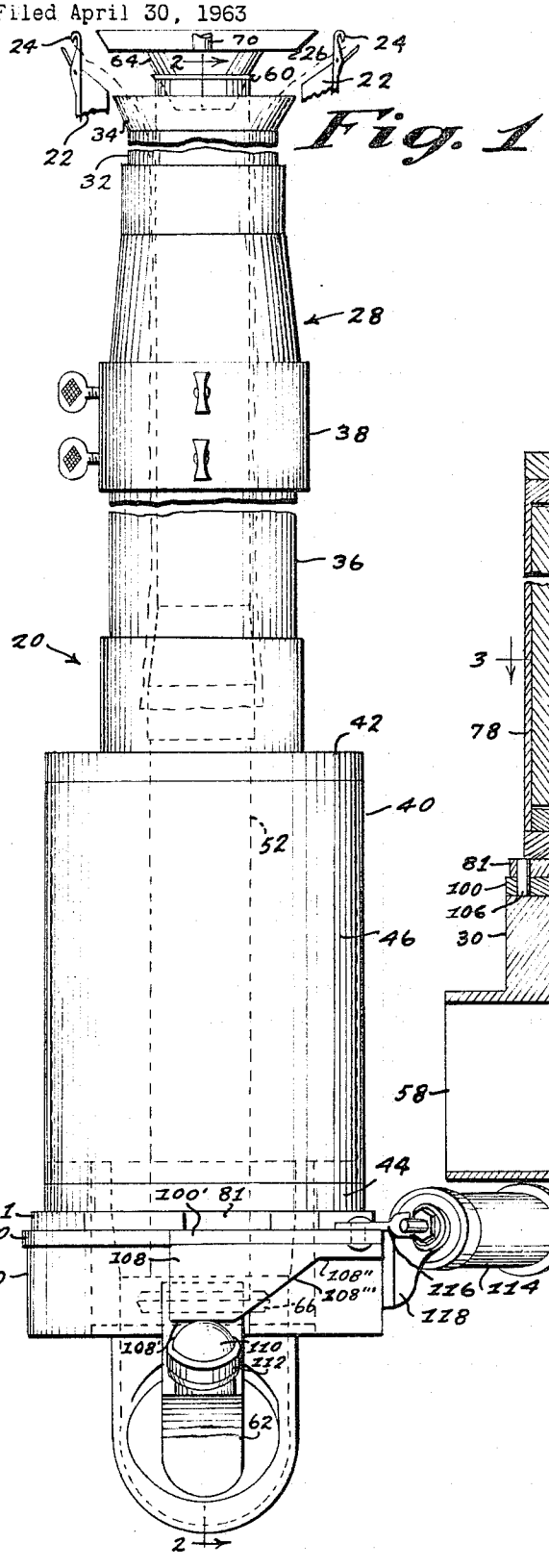

Fig. 1

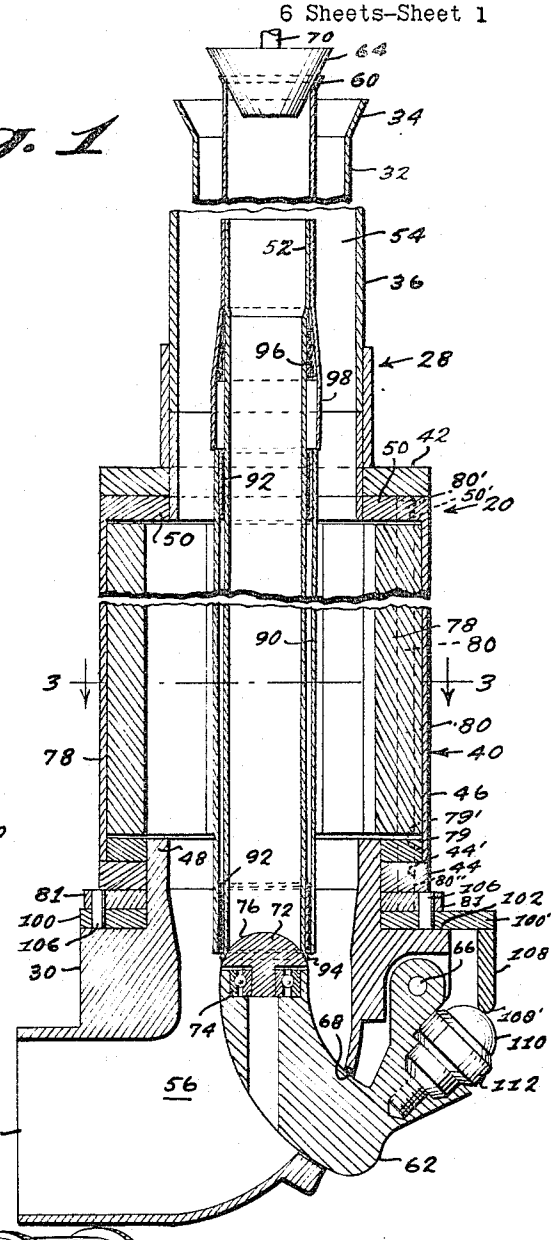

Fig. 2

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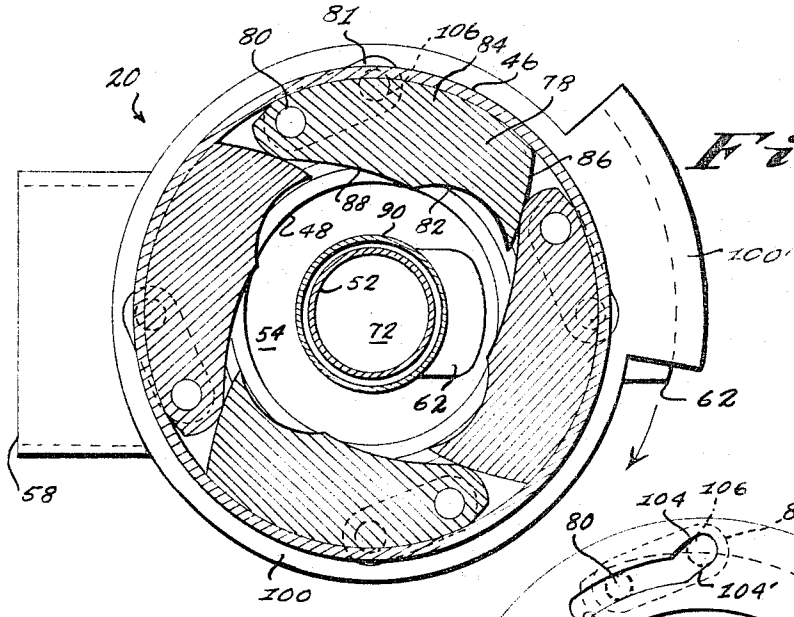

Fig. 7

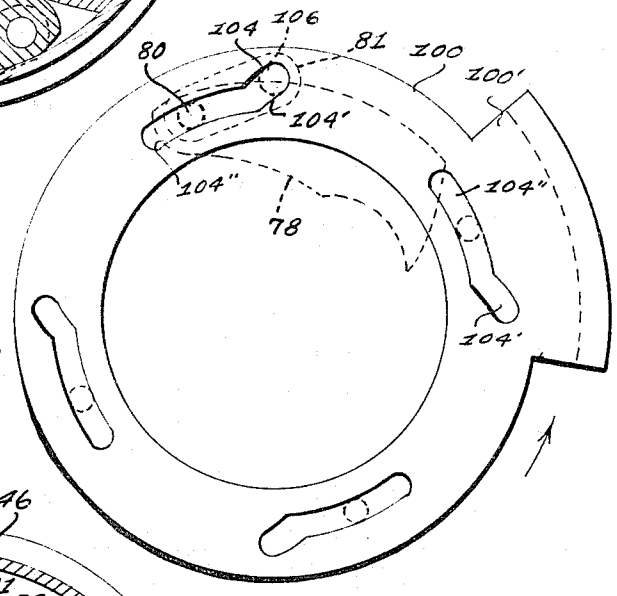

Fig. 6

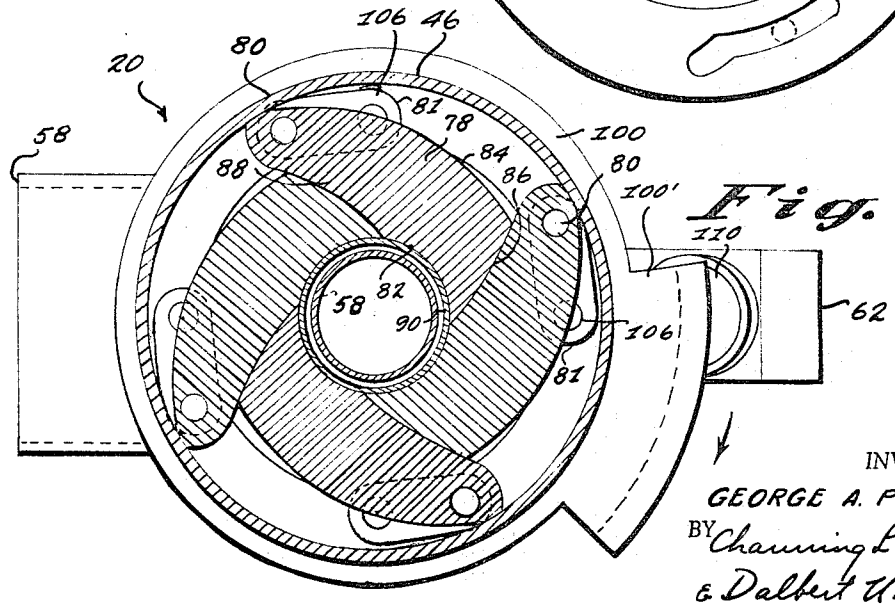

Fig. 5

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Fig. 4

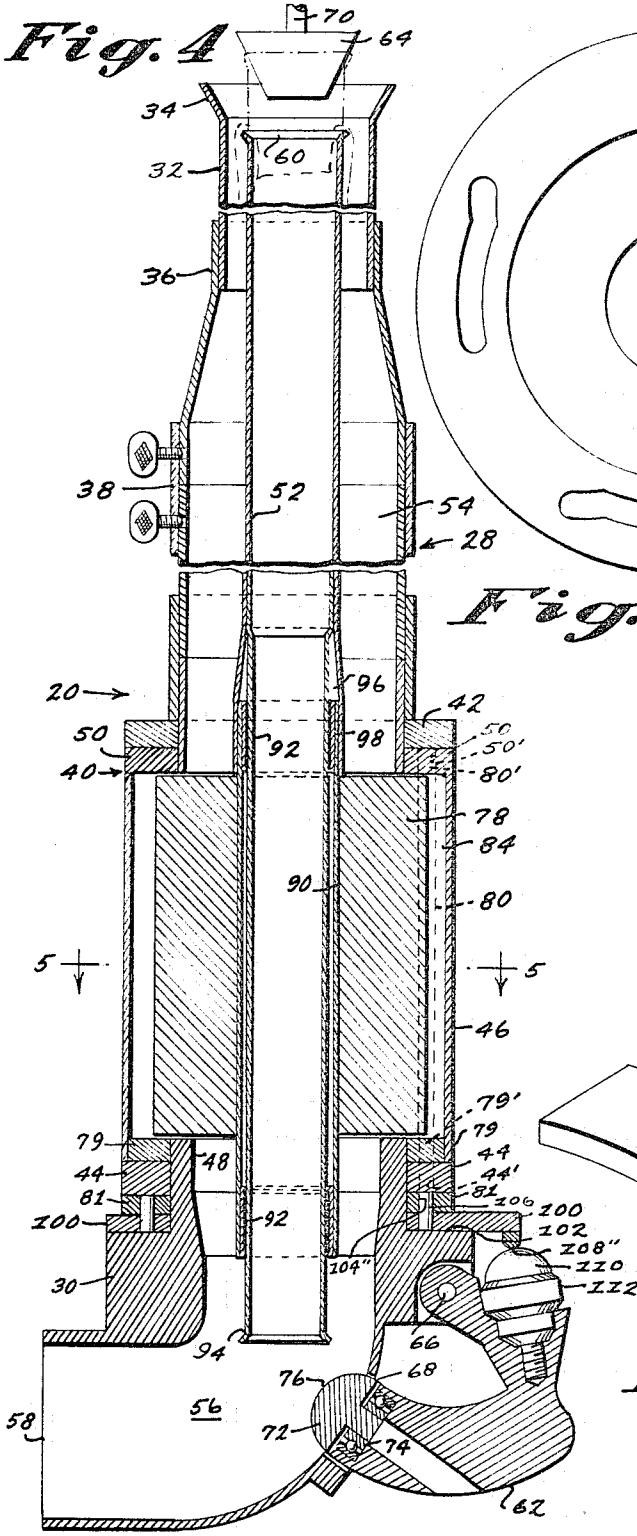


Fig. 7

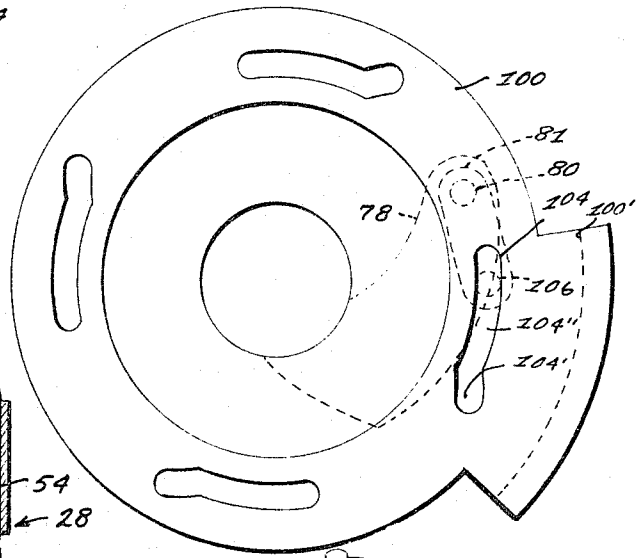
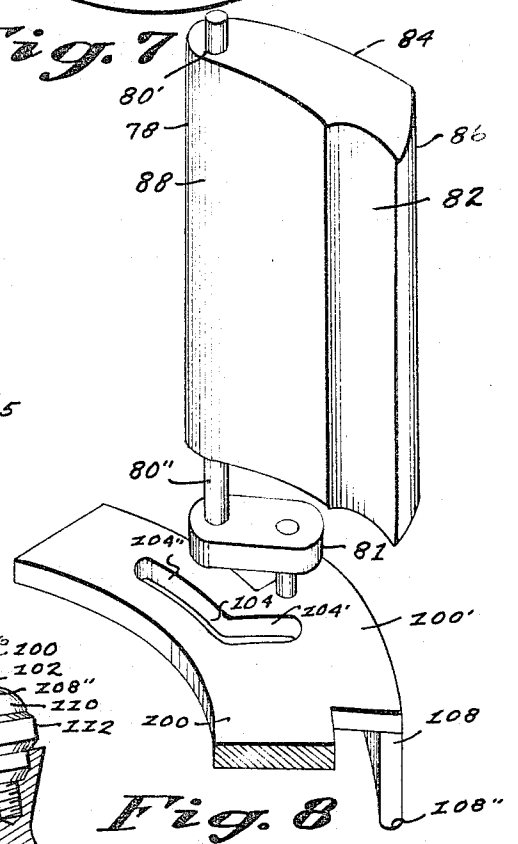


Fig. 8



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MEANS FOR TURNING FLEXIBLE TUBULAR ARTICLES

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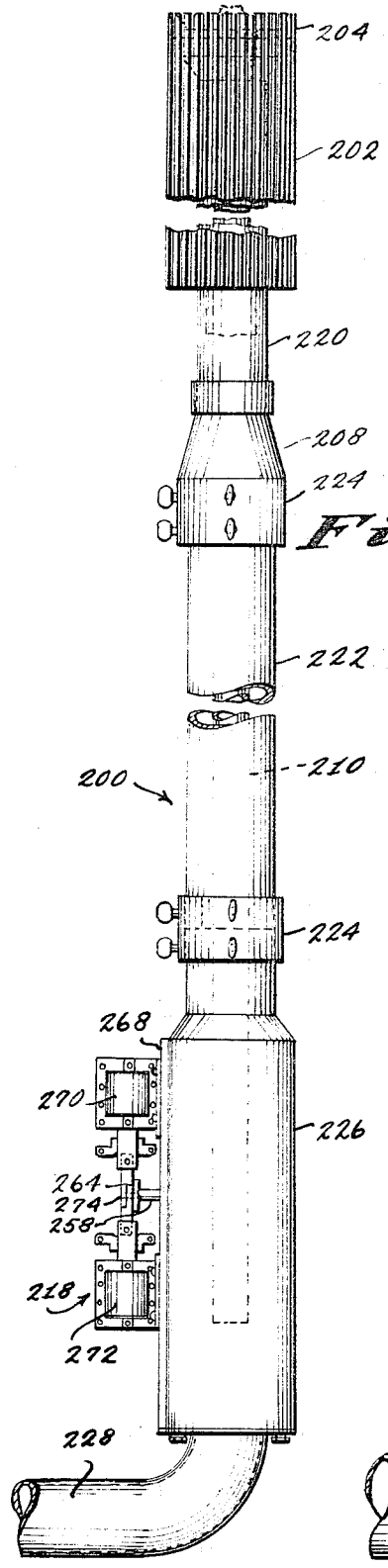

Fig. 9

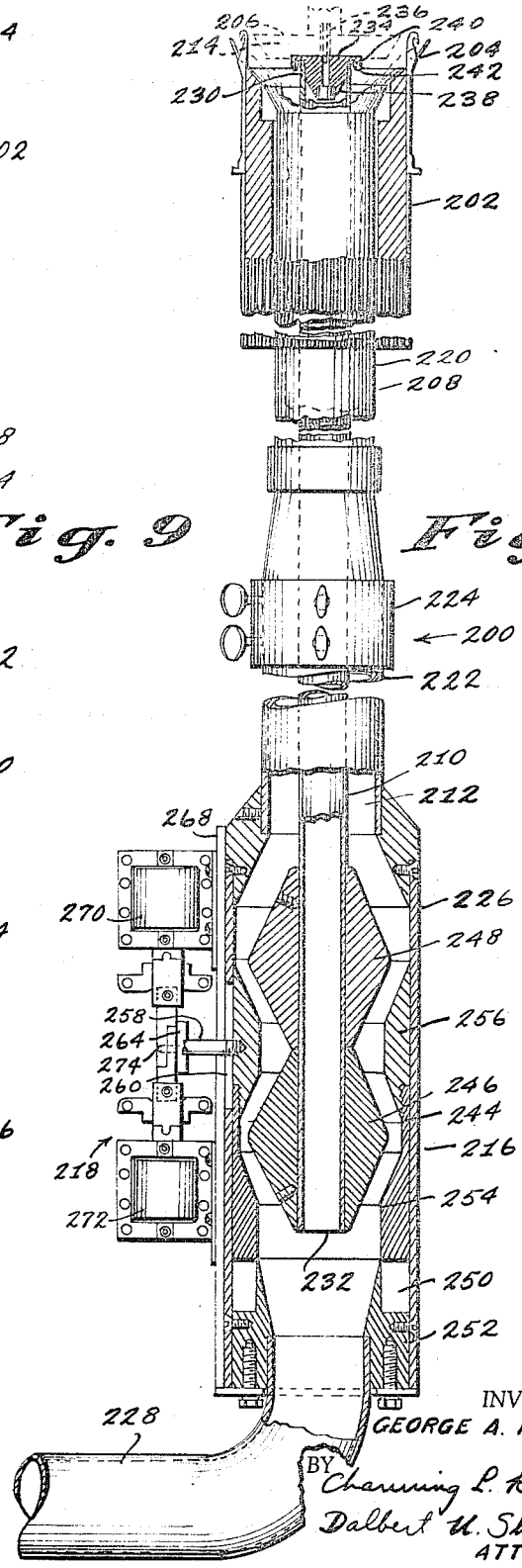

Fig. 10

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MEANS FOR TURNING FLEXIBLE TUBULAR ARTICLES

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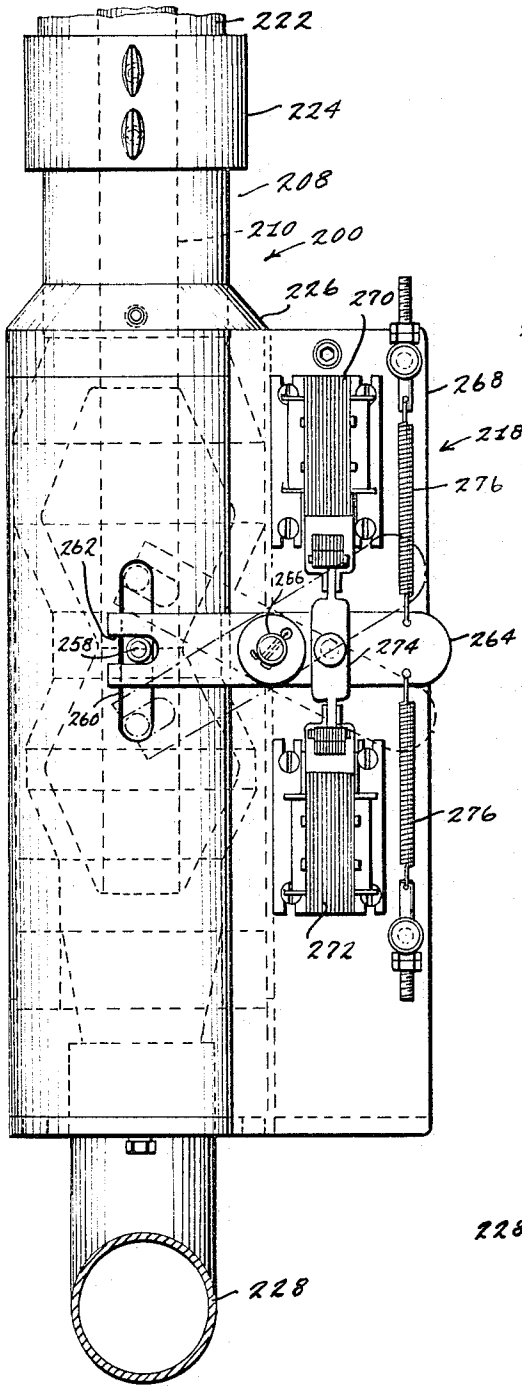

Fig. 11

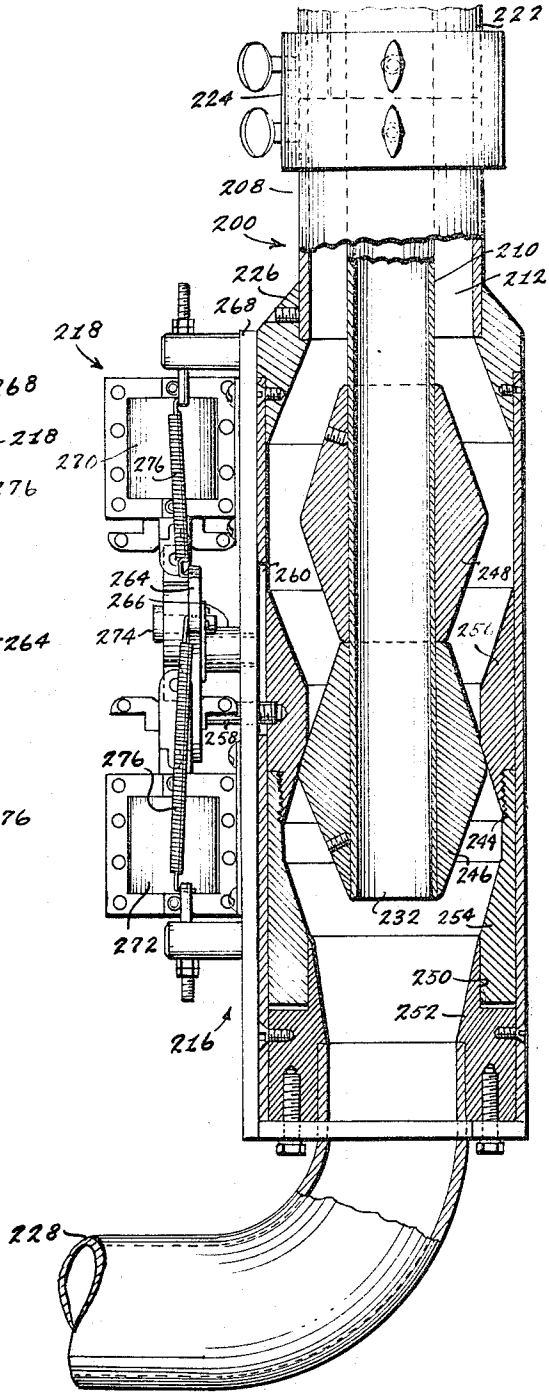

Fig. 12

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Fig. 13

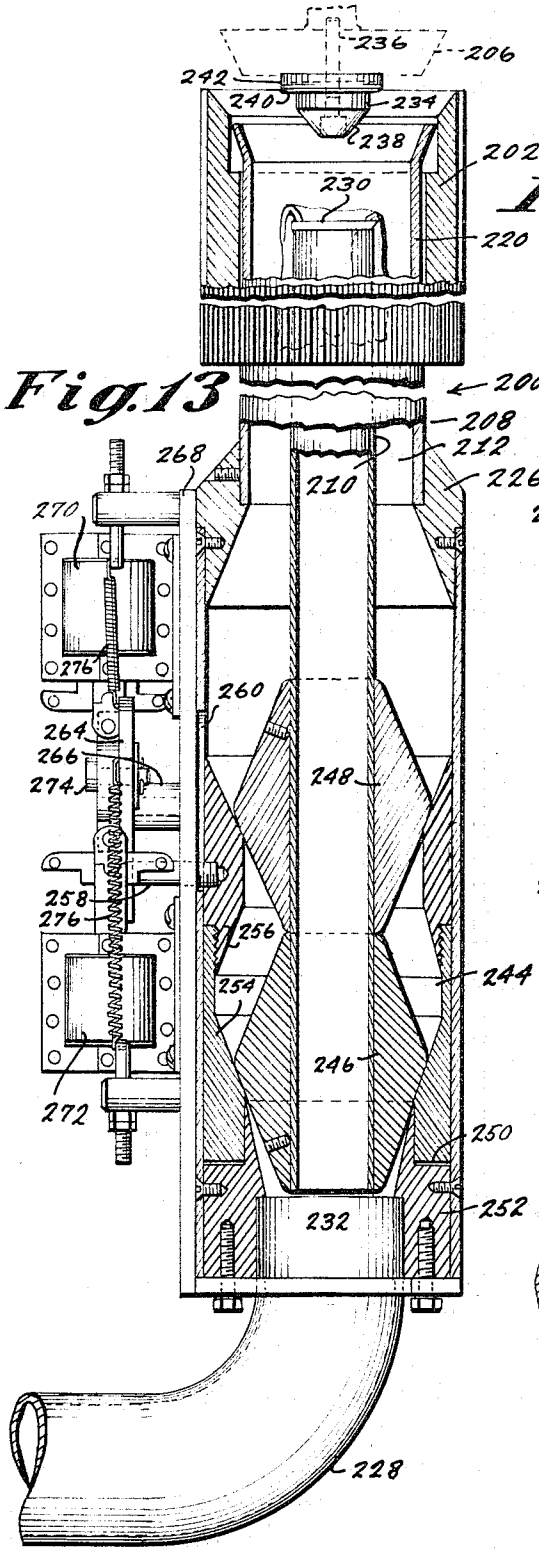
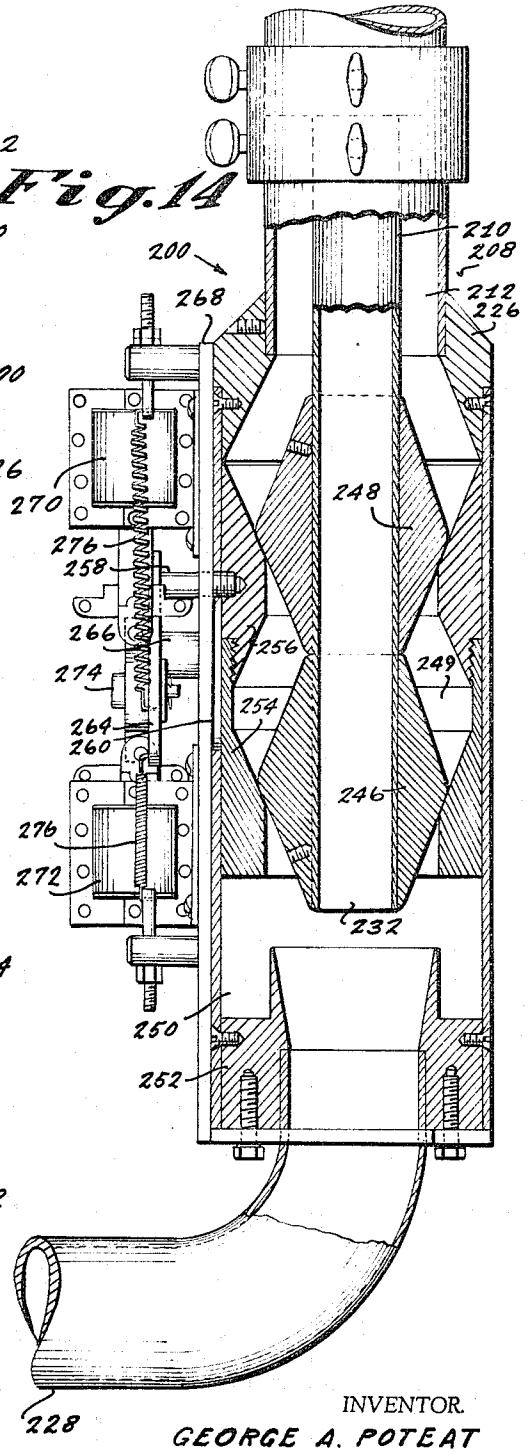


Fig. 14



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United States Patent Office 3,267,698 Patented August 23, 1966

3,267,698
MEANS FOR TURNING FLEXIBLE TUBULAR ARTICLES

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Filed Apr. 30, 1963, Ser. No. 276,918
25 Claims. (Cl. 66—149)

The present invention relates to means for turning flexible tubular articles that, in addition to turning articles, functions inherently to discharge therethrough any unturned articles without interfering with or interrupting the normal turning operation and without requiring any special manipulation or procedure when an unturned article is encountered.

This inherent discharge of unturned articles avoids accumulation in the device of articles which, due to defects in the articles or malfunction of the device or faulty timing of the feed of articles, are not turned and heretofore required removal otherwise than in the normal turning sequence. For example, in turning tubular knit articles at a circular knitting machine, partially completed articles are occasionally discharged by the machine, as when a knitting yarn breaks or there is some other malfunction. These partially completed articles may not be sufficiently formed for turning and are usually discharged out of phase with the cycle of the turning device, such that they are not turned, but must be removed otherwise for continued proper functioning of the mechanism. In prior devices, this removal has been tedious and fairly complex, often requiring undesirable stoppage of the knitting machine as well as stoppage of the turning device.

In the present invention, tubular articles are initially received in an annular space between an outer tubular member and an inner tubular member supported therein, and are intended to be positioned over the inner tubular member for subsequent turning thereinto, with any articles that are incapable of turning or for any other reason pass beyond the turning position being discharged through the annular space notwithstanding the support of the inner tubular member therein. This discharge is accomplished inherently by supporting the inner turning member with two support means that are spaced apart longitudinally along the tubular member and are alternately disengageable therefrom to allow unturned articles to progress completely past the inner turning member and through the annular space for ultimate discharge therefrom.

Another feature of the present invention is the provision for shifting of this inner turning member longitudinally so that it can be disposed advantageously in one position for initially drawing articles into the annular space and in another position for subsequently turning articles. This shifting feature is especially significant in turning articles at a circular knitting machine of the rotating needle cylinder type, particularly when knitting lightweight fabrics, such as ladies' hosiery, and more particularly when knitting lightweight fabrics at high speeds, where the fabric advances into the annular space as it rotates rapidly with the cylinder during knitting. With a stationary inner turning member, this rotation of the fabric twists the fabric about the member causing wrap-up of the fabric on the member and build-up of static charges sufficient to hinder subsequent turning. But with the shifting feature of the present invention, it is possible to shift the inner turning member into driven connection with the dial or other rotating component for rotation of the member with the fabric during drawing so that there is no twisting, while allowing the member to be shifted into proper turning position after an article has been knit and is ready for turning.

This shifting may be performed advantageously by manipulation of the aforementioned means for supporting the inner tubular member, with the result that independent shifting means as such are not necessary.

Further, the support means may themselves serve as valve means for selectively closing the annular space and the inner tubular member from pneumatic means that draw the articles therein so that during drawing into the annular space the inner turning member is closed, and, alternately, during turning of articles from the annular space into the turning member the annular space is closed.

In addition, when the present invention is adapted to turn articles at a circular knitting machine, it not only functions as a turning device, but also performs the function of a conventional take-down device so that no other take-down device is necessary.

Other and further advantages and features of the present invention will be apparent from the following description and the accompanying drawings, in which:

FIG. 1 is an elevational view of a preferred embodiment of the means for turning tubular articles according to the present invention adapted for turning ladies' hosiery at a circular knitting machine;

FIG. 2 is a vertical sectional view of the embodiment of FIG. 1, taken along line 2—2 of FIG. 1, with the elements in position for drawing;

FIG. 3 is a horizontal sectional view of the embodiment of FIG. 1, taken along line 3—3 of FIG. 2;

FIG. 4 is a vertical sectional view similar to FIG. 2, with the elements in position for turning;

FIG. 5 is a horizontal sectional view taken along the line 5—5 of FIG. 4;

FIG. 6 is a plan view of the cam plate of the embodiment of FIG. 1 shown in the drawing position of FIG. 2;

FIG. 7 is a view similar to FIG. 6 showing the cam plate in the turning position of FIG. 4;

FIG. 8 is a partially exploded perspective view of a gripper element, a crank plate, and the associated portion of the cam plate of the embodiment of FIG. 1;

FIG. 9 is an elevational view of an alternate embodiment of the present invention, also adapted for turning ladies' hosiery at a circular knitting machine;

FIG. 10 is a view similar to FIG. 9, partially in section, showing the elements in position for drawing;

FIG. 11 is an enlarged elevational view of the operating mechanism of the embodiment of FIG. 9.

FIG. 12 is an enlarged elevational view, partially in section, of the lower portion of the embodiment of FIG. 9, showing the elements positioned for lowering the inner tubular member from drawing to turning position;

FIG. 13 is an enlarged elevational view, partially in section, of the upper and lower portions of the embodiment of FIG. 9, showing the elements in turning position; and

FIG. 14 is a view similar to FIG. 12, showing the elements positioned for raising the inner tubular member from turning to drawing position.

Referring first to the preferred embodiment illustrated in FIGS. 1–8, the means for turning flexible tubular articles of the present invention is shown in the form of a stocking turner 20 for turning ladies' hosiery at a circular knitting machine of the rotating needle cylinder type. The circular knitting machine may be of any conventional construction, and only the upper portion of a needle cylinder 22, representative needles 24 and the dial plate 26 are shown (FIG. 1) as it is in relation to these elements that the stocking turner functions to receive and turn hosiery knit by the machine.

As seen in the drawings, this stocking turner 20 is mounted in generally the same location as conventional take-down devices to receive the articles as they are being knit by the needles 24 at the top of the needle cylinder 22,

and exerts a take-down pull by conventional pneumatic means (not shown) to draw the articles away from the needles and into the turner.

This stocking turner 20 is composed of a vertically disposed outer tubular member, an inner tubular member shiftably supported in the outer tubular member and defining therewith an intermediate annular space, pneumatic means for drawing articles in the tubular members, first support means for supporting the inner tubular member in a raised position drivingly connected to the dial plate for rotation therewith during drawing of articles into the intermediate space, second support means for supporting the inner tubular member in a lowered position during turning of articles from the intermediate space into the inner tubular member, and operating means for manipulating both the first and second support means in a predetermined operating sequence to effect proper functioning of the turner to take down articles, turn the articles and discharge both the turned articles and any articles in the intermediate space that have passed the turning position without being turned.

The outer tubular member 28 is formed from a plurality of axially aligned tubular sections supported on a base 30 that is attached in any suitable manner to the knitting machine frame or to the floor to position the tubular sections in axial alignment with the needle cylinder 22. The uppermost tubular section 32 extends within the needle cylinder and has a flared upper end 34 at the top of the needle cylinder positioned for receiving hosiery articles as they are progressively knit. This uppermost section 32 is detachably secured endwise to an enlarged middle section 36 by a releasable annular clamp 38 to permit separation and relative adjustment. The middle section 36 is in turn connected endwise to a further enlarged tubular housing 40 that is fixed to the aforementioned base 30 in axial alignment therewith in any suitable manner, such as an exterior bracket (not shown).

The tubular housing 40 has upper and lower annular closure plates 42 and 44, respectively, secured at the ends of a tubular wall 46, with the upper closure plate 42 seated on the lower end of the middle tubular section 36 and the lower closure plate 44 seated on an upstanding annular flange 48 of the base 30. The tubular wall 46 has an inwardly extending annular flange 50 subjacent the upper closure plate 42 for mounting of the second support means as will be described hereinafter.

The inner tubular member 52 is coaxially disposed within the outer tubular member 28 for substantial coextension therewith and is of a lesser diameter so as to define therebetween an annular intermediate space 54 extending continuously from the top of the members into the hollow interior 56 of the base 30, which hollow interior has a discharge end 58 connected to a conduit (not shown) leading to the pneumatic means for drawing articles by air suction downwardly through both the intermediate space 54 for discharge through the base 30 into any suitable collection device.

This inner tubular member 52 is axially shiftable within the outer tubular member 28 between the raised position of FIG. 2, in which articles are drawn from the knitting machine into the intermediate space 54 over the inner tubular member, and a lower turning position at which its upper turning end 60 is positioned in the vicinity of and slightly below the flared upper end 34 of the outer tubular member 28 for turning of hosiery articles from the intermediate space into the inner tubular member 52.

Support of the inner tubular member 52 in its raised drawing position is accomplished by the first support means, which has a retractable support arm 62, engageable with the bottom of the inner tubular member, and a plug portion 64 affixed to the dial plate 26 for seating in the upper turning end 60 of the inner tubular member. The retractable support arm 62 is pivotally mounted on a pivot pin 66 secured to the outside of the outer tubular member base 30. The support arm extends from the pivot pin 66 through an aperture 68 in the base 30 for oscillation between a supporting position (FIG. 2) and a retracted position (FIG. 4) substantially, but not completely, retracted from the aperture 68 so that it is spaced from the inner tubular member out of interference with articles drawn through either the intermediate space 54 or the inner tubular member 52 and permitting any articles previously hung-up on the arm to be pulled off and discharged through the base 30, while substantially occupying the aperture 68 to prevent air being drawn therethrough sufficiently to disrupt the suction in the tubular members.

In moving from retracted to raised position, the support arm 62 engages the bottom of the inner tubular member 52 to raise the member from its lower turning position to its raised drawing position, in which the upper end 60 of the member seats in the plug portion 64, which is concentrically mounted on the dial plate 26 for rotation therewith by affixation to the dial shaft 70. This plug portion 64 has a downwardly tapering frustoconical surface to facilitate seating in the turning end 60 of the inner tubular member and is preferably formed of resilient material, such as rubber, for frictionally driving the inner tubular member rotatably with the dial plate 26, and therefore with the needle cylinder 22. To permit this rotation, the tip 72 of the support arm 62 that supports the bottom of the inner tubular member is mounted in an annular ball bearing 74. The supporting surface 76 of the rotatable tip 72 is spherical to provide full contact with the bottom of the inner tubular member 52 as the arm oscillates and the member reciprocates lineally. This spherical surface 76 also functions to close the interior of the inner tubular member from the suction of the pneumatic means when the member is supported by the support arm 62.

During manipulation of the support arm 62 to raise and lower the inner tubular member 52, the member is retained in proper axial alignment by the second support means, which primarily serves to support the inner tubular member in its lowered turning position. Engagement by the second support means during manipulation of the support arm provides positive firm control of the inner tubular member at all times, assures guidance of the truning end 60 for proper seating on the plug portion 64 as the inner tubular member is raised, and results in the second support means being positioned in readiness for support of the inner tubular member in turning position so that the support arm can be easily retracted away from the inner tubular member.

The second support means is located in the enlarged housing 40 of the outer tubular member and has a plurality of pivoted gripper elements 78 that are laterally movable into and out of supporting engagement with the inner tubular member 52. In the embodiment illustrated, there are four of these gripper elements 78 equally spaced circumferentially about the inner tubular member 52 and coacting as an iris diaphragm to supportingly engage the inner tubular member and close the intermediate space 54 thereabove from the suction of the pneumatic means.

As seen clearly in FIGS. 2, 3, 4, 5 and 8, each of these gripper elements 78 is mounted on a vertical shaft 80 and extends between the flange 50 at the top of the housing wall 46 and an annular spacer or bearing 79 in the bottom of the housing 40 that positions the gripper elements 78 above the top of the upstanding flange 48 of the base 30. Each shaft 80 has an upper end 80' that is retained in a mounting recess 50' in the aforementioned annular flange 50, and a lower end 80'' that extends through an aperture 79' in the spacer 79, through an aperture 44' in the lower plate 44 of the housing 40, and is fixed to a crank plate 81 below the lower plate 44. Thus the shafts 80 are fixed in the housing while being free to be oscillated by the crank plate 81 for manipulation of the gripper elements 78.

The gripper elements 78 have vertical gripping surfaces 82 facing the inner tubular member and arcuately curved to conform thereto when the support members are oscillated into gripping engagement therewith (FIG. 5). These elements have outer vertical side surfaces 84 arcuately curved with the same radius of curvature as the housing wall 46 to seat thereagainst when the gripper elements are in their outer open position (FIG. 3).

The interaction of the gripper elements 78 to function as an iris diaphragm is provided by vertical end surfaces 86 extending between the gripping surfaces 82 and the outer side surfaces 84, and vertical inner side surfaces 88 extending from the gripping surfaces 82 toward the pivots. These end and inner side surfaces, 86 and 88, respectively, are arcuately curved for mating engagement of the end surface of one member with the inner side surface of the adjacent member during closing and opening and with full mating contact of the entire end surface with the inner side surface of the adjacent member when the members are closed, thereby forming a complete seal across the intermediate space. The curvature of these surfaces are such as to interlock the members in closed position so that each assists the other and prevents opening of any one member separately.

As mentioned previously, the second support means is closed during shifting of the inner tubular member 52 by the retractable support arm 62 to provide positive support and to retain the inner tubular member in axial alignment. To permit shifting of the inner tubular member 52 with the second support means in supporting position, the inner tubular member is provided with a seating portion in the form of a cylindrical sleeve 90 for engagement by the gripper elements 78. This sleeve 90 is slidably mounted on the inner tubular member by bearings 92, preferably nylon, at each end of the sleeve and is retained on the inner tubular member in proper alignment with the open gripper elements 78 when the inner tubular member is being supported in drawing position by a slight taper 94 at the bottom of the member, and with downward sliding of the inner tubular member within the sleeve when the support arm 62 is retracted and the gripper elements 78 are supporting the sleeve being restricted to position the inner tubular member in turning position by a stop shoulder 96 secured to the inner tubular member and engageable with the top of the sleeve.

Mounting of the sleeve 90 on the bearings 92 to permit sliding of the inner tubular member 52 with respect thereto also permits rotation of the inner tubular member with respect thereto when the gripper elements first engage the sleeve while the inner tubular member is rotating in its raised position, and also just before the gripper elements open after the retractable support arm 62 has raised the inner tubular member to its rotating drawing position.

It should be noted that the gripper elements 78 are located below the location of a hosiery article that is positioned in the intermediate space for subsequent turning into the inner tubular member (see FIG. 1). This is to avoid gripping of the hosiery articles by the elements when they close.

To avoid pinching articles between the stop shoulder 96 and sleeve 90, an annular skirt 98 is formed over the stop shoulder and extends downwardly over the sleeve a distance sufficient to remain in covering relation over the end of the sleeve when the inner tubular member is in its raised drawing position.

Due to this downward extension of the skirt 98, the sleeve 90 is extended above the gripper elements 78 so that when the stop shoulder 96 abuts the sleeve 90 to position the inner tubular member for turning, the extent of the skirt will terminate at the tops of the gripper elements. If desired, the skirt can actually rest on the gripper elements for support of the inner tubular member thereby.

The above described gripper elements 78 of the second support means, as well as the retractable support arm 62 of the first support means, are controlled to support and shift the inner tubular member 52 in a predetermined sequence of operation by operating means in the form of common camming means having an annular cam plate 100 seated on an annular shoulder 102 of the base 30 of the outer tubular member and directly below the crank plates 81 that are attached to the gripping elements 78 through the shafts 80. This cam plate 100 has cam slots 104 disposed at the crank plate locations for receipt of cam follower pins 106 depending from the crankplates 81 in spaced relation to the shafts 80 to manipulate the gripping elements 78 by oscillation of the cam plate 100, and has a depending cam flange 108 adjacent the retractable support arm 62 and contoured to manipulate the support arm upon oscillation of the cam plate 100.

The cam slots 104 are identical and are oriented for simultaneous operation of all gripper elements.

Each cam slot 104 has a working portion 104' slanted with respect to the path of oscillation of the cam plate 100 for displacement of the follower pin 106 to oscillate its gripper element 78 as the working portion 104' moves past the follower pin 106, and has a dwell portion 104'' extending obtusely from the inner end of the slanted portion 104' along an arc concentric with the cam plate 100 to hold the follower pin 106 and gripper element 78 in closed position during travel of this dwell portion 104'' past the follower pin 106.

The depending cam flange 108 depends from a lateral extension 100' of the cam plate 100 and extends arcuately concentric with the cam plate adjacent the retractable support arm 62 for following engagement by a follower ball 110 mounted in a socket bearing 112 for free spherical movement on the support arm outwardly of the pivot 66 therefor. The cam flange has a lower flat surface 108' that positions the support arm 62 inwardly for support of the inner tubular member in its raised drawing position (FIGS. 1 and 2), an upper flat surface 108' that positions the support arm outwardly in retracted position (FIG. 4), and an inclined manipulating surface 108''' connecting the flat surfaces and functioning to cam the support arm from one position to the other. The support arm 62 remains in following contact with the cam flange 108 due to the weight of the arm and the location of the cam flange with respect to the pivot 66 from which the arm hangs.

The cam plate 100 is oscillated by an tangentially acting pneumatic piston-cylinder mechanism 114 connected to the lateral extension 100' of the cam plate by a pivoted link 116. The piston-cylinder mechanism may be mounted on a bracket 118 on the base 30 and may be actuated from the usual knitting machine controls by an electrical four-way solenoid valve or by any other suitable means. Also, other means than the piston-cylinder mechanism may be utilized to effect oscillation of the cam plate 100.

This oscillation of the cam plate 100 thus accomplishes both manipulation of the gripper elements 78 to hold the inner tubular member in turning position and manipulation of the retractable support arm 62 to shift the inner tubular member and to hold it in raised drawing position. These manipulations are phased to close the gripper elements before retracting the support arm and to open the gripper elements only after the support arm is fully inserted. This phasing is accomplished by orienting the following of the lower flat surface 108' of the cam flange 108 by the follower ball 110 with the following of the slanted portions 104' by the follower pins 106 so that the cam flange will hold the support arm 62 in raised position while the cam slot is closing the gripper elements 78, and by orienting the inclined surface 108''' and the upper surface 108'' of the cam flange with the arcuate dwell portions 104'' of the cam slots so that the gripper

fingers will be retained in closed position during retraction of the support arm, during the time the support arm remains retracted, and during subsequent insertion of the support arm as the oscillating cam plate 100 begins its return stroke.

The operation of this preferred embodiment begins preferably with the cam plate 100 in its farthest counterclockwise position as viewed in FIGS. 1, 2, 3 and 6, so that the lower surface 103' of the cam flange 103 is holding the support arm 62 in raised position to hold the inner tubular member 28 in drawing position, and the outermost ends of the slanted portions 104' of the cam slots 104 are positioning the follower pins 106 in their outermost location to position the gripper elements 78 in their open positions. In this position, the upper turning end 60 of the inner tubular member is seated in the plug portion 64 at the dial plate 26 so that the inner tubular member is positively held between the plug portion and the support arm and is drivingly connected to the dial plate 26 for rotation therewith. Further, the tip 72 of the support arm 62 closes the interior of the inner tubular member from the suction of the pneumatic means while the intermediate space 54 is open.

The elements remain in this position during a complete knitting cycle, with the hosiery article being drawn by the suction of the pneumatic means down into the intermediate space 54 and over the inner tubular member 28, which rotates with the article and thereby avoids twisting and static electricity buildup. Any partially knit articles or any other articles that drop from the knitting machine prior to and out-of-phase with the subsequent shifting of the elements for turning are drawn through the intermediate space 54 and past the open gripper elements 78, being stopped only by the support arm 62 extending across the space from the wall of the base 30 to the bottom of the inner tubular member.

When the knitting machine reaches the end of a knitting cycle, it functions in its conventional manner to press the completed article from the needles. Approximately at this same time a conventional control element on the knitting machine, such as a cam switch, actuates the cylinder-piston mechanism 114 to extend the piston and oscillate the cam plate 100 clockwise to the position of FIGS. 4, 5 and 7. During this movement, the slanted portions 104' of the cam slots 104 first cam the follower pins 106 inwardly to pivot the gripper fingers 78 into supporting engagement with the sleeve 90 for subsequent guiding and support of the inner tubular member and to close the intermediate space 54 so that articles therein are no longer pulled down by the suction of the pneumatic means, while the extent of the flat lower surface 103' of the cam flange 103 retains the support arm 62 in raised position for continued support of the inner tubular member in its raised position. As this clockwise movement continues, the arcuate dwell portions 104'' of the cam slots 104 engage the follower pins 106 to hold the gripper elements 78 in closed position, while the inclined surface 103''' of the cam flange 103 engages the ball follower 110 to cause retraction of the support arm 62, which first lowers the inner tubular member until the stop shoulder 96 abuts the sleeve 90 to support the inner tubular member in turning position with its upper end 60 dropped to the approximate level of the trailing end of an article in the intermediate space. The support arm then continues to retract away from the inner tubular member until the ball follower 110 engages the flat upper cam surface 103'', which positions the support arm at the wall of the base 30. This retraction of the support arm opens the interior of the inner tubular member 28 to the suction of the pneumatic means for drawing articles through the turning end 60 thereof from the intermediate space, trailing end first, to turn the articles and to discharge the articles through the inner tubular member into the interior 56 of the base and out the discharge end 58 thereof.

When the support arm 62 is thus retracted, any articles that may have passed through the intermediate space and were stopped by the support arm will readily be drawn off of the retracted support arm and be discharged through the end 58 of the base 30.

The cam plate 100 need remain in this clockwise turning position only long enough to assure turning and discharge of articles. The piston-cylinder mechanism 114 is then reversed to move the cam plate 100 counterclockwise to its original position. At the beginning of this counterclockwise movement the arcuate dwell portions 104'' of the cam slots 104 hold the gripper elements 78 closed while the inclined surface 103''' of the cam flange 103 causes insertion of the support arm 62 to raise the inner tubular member 52 to its raised drawing position, at which time the slanted portions 104' of the cam slots 104 cam the gripper elements to open position for drawing articles in the intermediate space as the lower flat surface 103' of the cam flange holds the support arm and inner tubular member in raised position. The components remain in this position until the cam plate 100 is reversed at the end of the next knitting cycle.

Referring now to the alternate embodiment of the present invention illustrated in FIGS. 9–14, it will be seen that this alternate stocking turner 200 resembles the previously described preferred embodiment of FIGS. 1–8 in that it also is adapted to operate with a circular knitting machine in relation to a rotating needle cylinder 202, needles 204 carried by the cylinder and a rotating dial plate 206, and it also is basically composed of a vertically disposed outer tubular member 208, an inner tubular member 210 shiftably supported in the outer tubular member and defining therewith an intermediate annular space 212, pneumatic means (not shown) for drawing articles in the tubular members, first support means 214 for supporting the inner tubular member in a raised position (FIG. 10) drivingly connected to the dial plate 206 for rotation therewith during drawing of articles into the intermediate space 212, second support means 216 for supporting the inner tubular member 210 in a lowered position (FIG. 13) during turning of articles from the intermediate space 212 into the inner tubular member, and operating means 218 for effecting shifting of the inner tubular member 210 between its raised drawing position and its lowered turning position.

As in the preferred embodiment, the first and second support means of this alternate embodiment are spaced apart vertically and are alternately disengageable so that any unturned articles may pass completely through the intermediate space 212. As a matter of fact, the first support means 214 supports the inner tubular member 210 from above in freely suspended disposition in the outer tubular member 208 so that the intermediate space may extend uninterrupted throughout the length of the inner tubular member during drawing and any articles that progress past the turning position will be drawn unobstructed completely through the intermediate space 212 (FIG. 10).

The outer tubular member 208 of this alternate embodiment has an upper section 220 extending within the needle cylinder 202 with a flared upper end near the top of the needle cylinder for receipt of articles as they are knit by the needles 204. A middle section 222 is attached endwise to the upper section 220 and to the upper extension 227 of a further enlarged housing section 226 by removable ring clamps 224 that permit separation or adjustment of the sections. This housing section 226 is attached in any suitable manner to either the knitting machine or the floor for support of the device in proper axial alignment with the needle cylinder 202. A discharge conduit 228 leads from the bottom of the housing section 226 to conventional pneumatic means (not shown) for drawing air by suction in the outer tubular member 208 to pull articles down therethrough for discharge through the conduit 228 to any suitable collection device (not shown).

The inner tubular member 210 extends continuously in axial alignment within the outer tubular member 208

from an upper turning end 230 in the vicinity of the upper end of the upper section 220 of the outer turning member to a bottom discharge end 232 within the housing section 226 of the outer tubular member. This inner tubular member 210 is of a diameter less than the diameter of the outer tubular member to define therebetween the aforementioned annular intermediate space 212.

The inner tubular member 210 is releasably held in a raised position in freely suspended disposition within the outer tubular member 208 for drawing of articles in the intermediate space 212 by the first support means 214, which in this embodment is in the form of a cylindrical plug 234 attached by a screw 236 or other means concentrically to the underside of the dial plate 206 for rotation therewith. This plug 234 has a downwardly tapering frusto-conical lower surface 238 for initially receiving and centering the upper end 230 of the inner tubular member as the member is raised and has a downwardly facing annular slot 240 surrounded by a depending annular flange 242 for seating of the inner tubular member upper end 230, which is outwardly flared to enhance wedging in the slot 240 and gripping by the flange 242. Preferably the plug 234 is formed of resilient material, such as rubber, for frictionally retaining the inner tubular member in its raised position while permitting it to be released therefrom by a downward pull. In addition, the plug 234 forms a seal to close the inner tubular member so that the suction of the pneumatic means is concentrated in the intermediate space 212 for drawing articles therein over the inner tubular member in the manner of a take-down device, with the connection of the plug 234 to the dial plate 206 causing the inner tubular member to rotate with the article as the article advances into the space, thereby avoiding twisting and static charges that could hinder subsequent turning.

The inner tubular member 210 is positioned in its lower turning position with its upper turning end 230 slightly below the top of the outer tubular member for drawing therein the trailing end of an article from the intermediate space 212 to turn the article and discharge it through the inner tubular member by he aforementioned second support means 216, which in the embodiment illustrated is a tubular sleeve 244 slidably mounted in the enlarged housing section 226 of the outer tubular member 208 and acting against annular shoulder portions 246 and 248 carried by the inner tubular member 210.

The tubular sleeve 244 seats in an annular recess 250 in the base 252 of the housing section 226 and has a lower first annular shoulder 254 extending laterally inward in overlapping relation below the lower first annular shoulder portion 246 of the inner tubular member 210, which shoulder portion 246 extends laterally outward for mating with the first shoulder 254 of the sleeve 244 for support of the inner tubular member 210 in its lowered turning position and during raising of the inner tubular member by upward shifting of the sleeve 244, as will be described below, while being spaced vertically thereabove when the inner tubular member 210 is in its raised drawing position so as not to interfere with the unobstructed extension of the intermediate space 212 therebetween.

This lower shoulder portion 246 of the inner tubular member 210 also cooperates with a second upper annular shoulder 256 of the sleeve 244 for shifting of the inner tubular member from raised to lowered position. This second upper shoulder 256 extends laterally inward in overlapping relation above the lower shoulder portion 246 of the inner tubular member 210 for mating therewith upon downward movement of the sleeve 244, which downward movement causes the inner tubular member 210 to move downwardly until its upper end 230 is pulled from the resilient plug 234 so that the inner tubular member will drop by gravity to its lower turning position, in which position its lower shoulder 246 is supportingly seated on the lower shoulder 254 of the sleeve 244.

Support of the inner tubular member 210 in its turning position and during upward shifting to its raised drawing position is obtained by the above-mentioned mating of the lower shoulder portion 246 of the inner tubular member with the lower shoulder 254 of the sleeve 244, and is further provided by mating of a second upper annular shoulder portion 248 of the inner tubular member with the upper shoulder 256 of the sleeve. This second shoulder portion 248 extends laterally outward in overlapping relation above the upper shoulder 256 of the sleeve and is spaced above the first shoulder portion 246 a distance substantially identical to the spacing of the upper and lower shoulders 254 and 256, respectively, so that mating at both locations will occur simultaneously and will cooperate to stabilize the inner tubular member in an axially aligned disposition during turning and during raising to drawing position, with this stabilization assuring proper centering of the upper end 230 of the inner tubular member for mounting on the plug 234.

The shoulders 254 and 256 of the sleeve 244 and the shoulder portions 246 and 258 of the inner tubular member 210 do not completely overlap laterally, and the free vertical space between the shoulder portions 246 and 248 is greater than the overlapped vertical thickness of the lower shoulder 254 as is the free vertical space between the shoulders 254 and 256 greater than the overlapped vertical thickness of the lower shoulder portion 246. Thus, when the inner tubular member 210 is in its raised position the sleeve may be located in a neutral position wherein there is no contact of the shoulders and shoulder portions and wherein the intermediate space 212 extends continuously therebetween (FIG. 10).

To provide as uniform suction and as smooth passage of articles through the intermediate space 212 as possible, the mating surfaces of the shoulder portions 246 and 248 and the shoulders 254 and 256 are tapered axially, preferably being formed as frusto-conical surfaces, which shape also provides for proper seating of the mating surfaces regardless of the rotational position of the inner tubular member and provides a seal for closing the intermediate space 212 from the suction so that articles will not be pulled further into the intermediate space and the suction will be concentrated in the inner tubular member 210 for turning of articles thereinto from the intermediate space. In this regard it should be noted that the sleeve 244 is located below the upper ends of the tubular members a distance greater than the extent of an article positioned in the intermediate space for turning so as to avoid catching the article between the shoulders 254 and 256 of the sleeve 244 and the shoulder portions 246 and 248 of the inner tubular member 210.

The sleeve 244 is manipulated to shift the inner tubular member 210 from one position to another by the aforementioned operating means 218, which acts on a stud 258 fixed to and extending laterally from the sleeve 244 through a vertical slot 260 in the wall of the housing section 226 of the outer tubular member 208. The stud 258 rides in a recess 262 in the end of a lever 264 that is pivoted on a pin 266 extending horizontally from a vertical mounting plate 268 secured to the housing section 226. The lever 264 is oscillated in a vertical plane to reciprocate the stud 258 and attached sleeve 244 by a pair of opposed solenoid mechanisms 270 and 272 attached to the mounting plate 268 above and below the lever 264 and operatingly connected to the lever 264 at a common connection 274 outwardly of the pivot pin 266.

Actuation of the upper solenoid 270 raises the connected end of the lever 264 and thereby lowers the end that engages the sleeve stud 258 to lower the sleeve 244 to its lower position for support of the inner tubular member 210 in its turning position. Actuation of the lower solenoid 272 has the reverse effect of raising the

sleeve 244 to shift the inner tubular member to its raised position. A pair of opposed coil springs 276 attached to the mounting plate 268 and to the lever 264 outwardly of the solenoids tends to hold the lever in a horizontal position when neither solenoid is actuated, in which horizontal position the lever holds the sleeve in a neutral intermediate position out of contact with the raised position of the inner tubular member.

The solenoids 270 and 272 may be actuated by electrical switches operated from the main control mechanism of the knitting machine in any conventional manner in proper sequence with the knitting cycle.

In operation, the inner tubular member 210 is initially positioned in its raised drawing position with its upper end 230 gripped in the resilient plug 234 and with the solenoids initially inoperative so that the springs 276 hold the sleeve 244 in its neutral position (FIG. 10). With this initial positioning of the components, the outer tubular member is freely suspended for rotation with the dial plate 206 and therefore with articles as they advance during knitting, the plug 234 seals the interior of the inner tubular member to concentrate suction in the intermediate space 212 for drawing articles thereinto, and the shoulders 254 and 256 of the sleeve 244 are spaced from the shoulder portions 246 and 248 of the inner tubular member for uninterrupted extension of the intermediate space 212 so that any articles advancing beyond a turning position will continue through the intermediate space and be discharged through the discharge conduit 228.

The components remain in this position throughout one complete knitting cycle. When the knitting is completed and just before the knitting machine presses off the completed article, a control switch actuates the upper solenoid 270, thereby pivoting the lever 264 to shift the sleeve 244 downwardly, causing the upper shoulder 256 of the sleeve to engage the lower shoulder portion 246 of the inner tubular member and force the inner tubular member downwardly (FIG. 12) until the upper end 230 is pulled from the plug 234, at which time the inner tubular member drops to its turning position (FIG. 13) wherein it is supported by seating engagement of its shoulder portions 246 and 248 against the shoulders 254 and 256 of the sleeve, which engagement closes the intermediate space 212 for concentration of suction in the now open interior of the inner tubular member so that an article in the intermediate space with its trailing end at the turning end 230 of the inner tubular member will be turned by being drawn, trailing end first, into the turning end and will be discharged through the inner tubular member and discharge conduit 228.

Upon completion of the turning operation, which requires only seconds, the lower solenoid 272 is energized to pivot the lever 264 and thereby raise the sleeve 244 and inner tubular member 210 supported thereon (FIG. 14) until the upper end 230 of the inner tubular member is supportingly seated in the plug 234, at which time the lower solenoid 272 is de-energized to permit the springs 276 to return the sleeve 244 to its neutral position (FIG. 10) for another knitting cycle.

The above described preferred and alternate embodiments of the present invention have been set out in detail for purposes of illustration only, and it should be understood that numerous variations of these and other embodiments are feasible within the scope of the present invention. For example, other means than the iris type gripper elements of the preferred embodiment or the shoulders of the alternate embodiment can be utilized to support the inner tubular member, one such other means could be radially reciprocal grippers. Similarly, a latch type support mechanism could be used to attach the inner tubular member to the dial plate instead of the plugs described above, and the attachment could shift to raise and lower the inner tubular member instead of having the sleeve or support arm perform the shifting function. As a matter of fact, the discharge of unturned articles can be accomplished without shifting of the inner tubular member. Also, various other means for actuating the components in timed relation to the knitting cycle may be used, and the invention may be adapted to other machines than circular knitting machines or may be used independently.

These examples of variations are not intended to be limiting in any way as the invention is described herein for purposes of illustration only and is not intended to be limited by this description or otherwise except as defined in the appended claims.

I claim:

1. Means for turning flexible tubular articles comprising an outer tubular member, an inner tubular member extending within said outer tubular member to define therewith an intermediate annular space, pneumatic means for drawing articles in said tubular members, first support means for supporting said inner tubular member for drawing tubular articles into said intermediate space over said inner tubular member, and second support means for supporting said inner tubular member for turning articles from said intermediate space into and through said inner tubular member, said first and second support means being alternately disengageable from said inner tubular member to provide continuous support thereof and being spaced apart longitudinally with respect to said inner tubular member to permit any unturned articles to be discharged through said intermediate space.

2. Means for turning flexible tubular articles according to claim 1 and characterized further in that said second support means is spaced from the article turning end of said inner tubular member beyond the location of an article positioned in said intermediate space for turning into said inner tubular member.

3. Means for turning flexible tubular articles according to claim 1, and characterized further in that said first support means supports said inner tubular member endwise and closes said inner tubular member to prevent air being drawn therethrough by said pneumatic means, and said second support means closes said intermediate space to prevent air being drawn therethrough.

4. Means for turning flexible tubular articles according to claim 1 and characterized further in that said first support means comprises a retractable support member movable into supporting engagement with the discharge end of said inner tubular member and retractable therefrom to permit articles to be discharged past said support member from said inner tubular member and from said intermediate space.

5. Means for turning flexible tubular articles according to claim 4 and characterized further in that said second support means is spaced from the article turning end of said inner tubular member beyond the location of an article positioned in said intermediate space for turning into said inner tubular member, and is spaced from said retractable support member behind the position of an unturned article at said retractable support member.

6. Means for turning flexible tubular articles according to claim 1 and characterized further in that said first support means comprises a support member engageable with the article turning end of said inner tubular member for support thereof in freely suspended disposition in said outer tubular member to provide continuous unobstructed extension of said intermediate annular space through said outer tubular member for discharge through said intermediate space of any unturned articles.

7. Means for turning flexible tubular articles comprising an outer tubular member, an inner tubular member extending within said outer tubular member to define therewith an intermediate annular space and being longitudinally shiftable with respect to said outer tubular member between a position for drawing tubular articles into said intermediate space over said inner tubular member for subsequent turning into said inner tubular member or for discharging articles through said intermediate space

without turning and an article turning position at which an end of said inner tubular member is positioned for turning an article from said intermediate space into said inner tubular member, pneumatic means for drawing articles in said tubular members, first support means for supporting said inner tubular member in said drawing position, and second support means for supporting said inner tubular member in said turning position, said first and second support means being alternately disengageable from said inner tubular member and being spaced apart longitudinally with respect to said inner tubular member to permit discharge of any unturned articles through said intermediate space, one of said support means being operable to shift said inner tubular member from one of said positions to the other of said positions.

8. Means for turning flexible tubular articles according to claim 7 and characterized further in that said first support means comprises a rectractable support member movable into supporting engagement with the discharge end of said inner tubular member to shift said inner tubular member between said drawing and turning positions and to support said inner tubular member in said drawing position.

9. Means for turning flexible tubular articles according to claim 8 and characterized further in that said inner tubular member has a support means seating portion for seating of said second support means in supporting position, said seating portion being slidably mounted on said inner tubular member to permit said second support means to be in supporting position during shifting of said inner tubular member by said retractable support member.

10. Means for turning flexible tubular articles according to claim 9 and characterized further in that said first and second support means are operated by common camming means phased to cam said second support means into supporting position prior to camming said retractable support member to disengage it from said inner tubular member and to cam said retractable support member to supporting position prior to camming said second support means to disengage it from said inner tubular member.

11. Means for turning flexible tubular articles according to claim 9 and characterized further in that said support means seating portion is a tubular sleeve surrounding said inner tubular member, and said second support means comprises a plurality of opposing gripper elements movable laterally into and out of supporting engagement with said sleeve and being contiguously disposed in supporting position to close said intermediate space and prevent air being drawn therethrough when said inner tubular member is in said turning position.

12. Means for turning flexible tubular articles according to claim 11 and characterized further in that said gripper elements are pivotally mounted and contiguously disposed to form an iris diaphragm for closing said intermediate space and for rigidly supporting said inner tubular member.

13. Means for turning flexible tubular articles according to claim 7 and characterized further in that said tubular members are vertically disposed for drawing articles downwardly therein, said first support means is engageable with the upper article turning end of said inner tubular member for support thereof in a raised drawing position in freely suspended disposition in said outer tubular member to provide continuous unobstructed extension of said intermediate annular space through said outer tubular member, and said second support means is longitudinally shiftable and has a laterally extending shoulder extending in overlapping relation below a mating lateral shoulder on said inner tubular member for raising said inner tubular member from a lower turning position to said raised drawing position, said shoulders being vertically spaced apart when said inner tubular member is in said drawing position to provide unobstructed extension of said intermediate space.

14. Means for turning flexible tubular articles according to claim 13 and characterized further in that one of said inner tubular member and second support means has a second shoulder overlapping the shoulder of the other in vertically spaced relation and engageable therewith upon downward shifting of said second support means to lower said inner tubular member.

15. Means for turning flexible tubular articles according to claim 13 and characterized further in that said inner tubular member is supported in said lower turning position by engagement of said shoulders.

16. Means for turning flexible tubular articles according to claim 15 and characterized further in that said second support means has a second shoulder overlapping said inner tubular member shoulder in spaced relation thereabove and engageable therewith upon downward shifting of said second support means to shift said inner tubular member from drawing position to turning position, and said inner tubular member has a second shoulder overlapping said second shoulder of said second support means in spaced relation thereabove and engageable therewith to stabilize the support of said inner tubular member in said turning position and during shifting to said drawing position.

17. Means associated with a circular knitting machine of the rotating needle cylinder type for turning tubular articles knit by said machine, said turning means comprising an outer tubular member extending within the needle cylinder and having an upper, article receiving, end adjacent the upper end of the needle cylinder, an inner tubular member extending within said outer tubular member to define therewith an intermediate annular space and having an upper, article turning, end in the vicinity of said outer tubular member upper end, pneumatic means for drawing articles downwardly in said members, first support means for supporting said inner tubular member for drawing articles into said intermediate space over said inner tubular member while closing said inner tubular member, second support means for supporting said inner tubular member for turning articles from said intermediate space into said inner tubular member while closing said intermediate space, said second support means being spaced below said upper ends beyond the location of an article positioned in said intermediate space for turning into said inner tubular member, said support means being alternately disengageable from said inner tubular member and being spaced apart vertically to permit discharge of any unturned articles through said intermediate space.

18. Means associated with a circular knitting machine of the rotating needle cylinder type having a component, such as a dial, superjacent the needle cylinder and rotatable therewith, for turning tubular articles knit by said machine, said turning means comprising an outer tubular member extending within the needle cylinder and having an upper, article receiving, end adjacent the upper end of the needle cylinder, an inner tubular member extending within said outer tubular member to define therewith an intermediate annular space and having an upper, article turning, end in the vicinity of said outer tubular member upper end, pneumatic means for drawing articles downwardly in said members, first support means for supporting said inner tubular member in a raised position in driving engagement with said component for rotation with articles as they are knit and drawn into said intermediate space over said inner tubular member, second support means for supporting said inner tubular member in a lowered position for turning articles from said intermediate space into said inner tubular member with said second support member closing said intermediate space below the location of an article positioned for turning, said support means being alternately disengageable from said inner tubular member and being spaced apart vertically to permit discharge of any unturned articles through said intermediate space.

19. Means for turning tubular knit articles according

to claim 18 and characterized further in that one of said first and second support means is operable to shift said inner tubular member from one of said positions to the other of said positions.

20. Means for turning tubular knit articles according to claim 18 and characterized further in that said first support means comprises a plug portion depending from said component and rotatable therewith, and a retractable support arm movable into engagement with the discharge end of said inner tubular member to raise said inner tubular member to said raised position with said inner tubular member upper end drivingly seated in said plug portion, to support said inner tubular member in said raised position, and to lower said inner tubular member to said lowered, turning, position.

21. Means for turning tubular knit articles according to claim 20 and characterized further in that said inner tubular member has a sleeve portion, and said second support means comprises a plurality of opposing gripper elements movable laterally into and out of supporting engagement with said sleeve portion and being contiguously disposed in supporting position to close said intermediate space, said sleeve portion being slidably mounted on said inner tubular member to permit said second support means to be in supporting position during raising and lowering of said inner tubular member by said retractable support arm.

22. Means for turning tubular articles according to claim 21 and characterized further in that said first and second support means are operated by common camming means in relation to the knitting cycle and phased to cam said gripper elements into supporting position prior to camming said retractable support arm to lower said inner tubular member and to cam said retractable support arm to raise said inner tubular member prior to camming said gripper elements from said sleeve portion.

23. Means for turning tubular knit articles according to claim 18 and characterized further in that said first support means depends from said component and is rotatable threwith and is engageable with said turning end of said inner tubular member to support said inner tubular member for rotation in said raised position and in freely suspended disposition in said outer tubular member to provide unobstructed extension of said intermediate annular space through said outer tubular member for discharge therethrough of any unturned articles, and said second support means is vertically shiftable and has a laterally extending annular shoulder extending in overlapping relation below a mating lateral annular shoulder on said inner tubular member to support said inner tubular member in said lowered turning position with said annular shoulders closing said intermediate space and to raise said inner tubular member from lowered to raised position, said annular shoulders being longitudinally spaced when said inner tubular member is supported in raised position by said first support means to provide unobstructed extension of said intermediate space.

24. Means for turning tubular knit articles according to claim 23 and characterized further in that said first support means is a yieldable plug, and said second support means has a second annular shoulder spaced above and overlapping said inner tubular member shoulder and engageable therewith upon downward shifting of said second support means to release said inner tubular member from said yieldable plug for dropping to said lowered turning position.

25. Means for turning tubular knit articles according to claim 24 and characterized further in that said inner tubular member has a second annular shoulder spaced above and overlapping said second annular shoulder of said second support means and engageable therewith when said inner tubular member is in its lowered turning position to stabilize the support of said inner tubular member in said lowered turning position and during raising to said raised position.

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