Dec. 1, 1964 G. MORETTA 3,159,015

PNEUMATIC TENSIONING DEVICE FOR CIRCULAR KNITTING MACHINES, PARTICULARLY FOR CIRCULAR MACHINES FOR MAKING STOCKINGS

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Fig.1

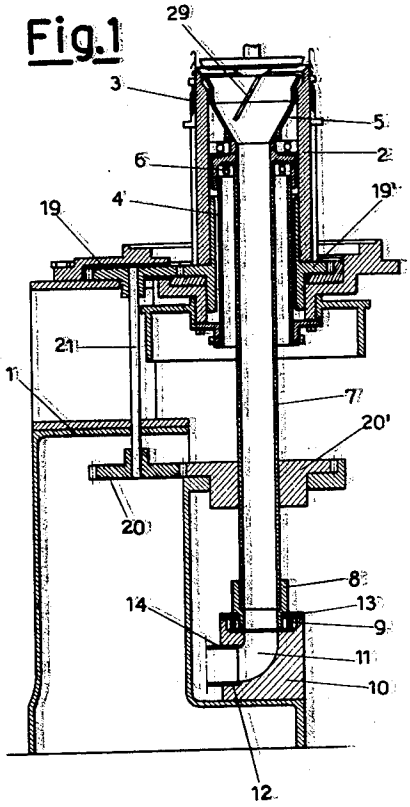


Fig.3

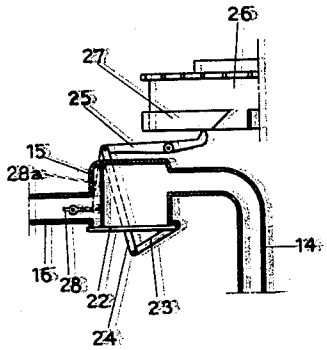


Fig.4

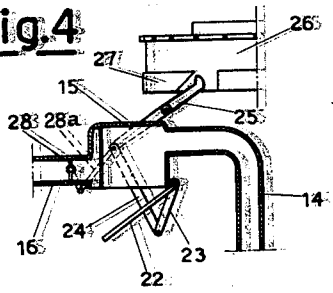
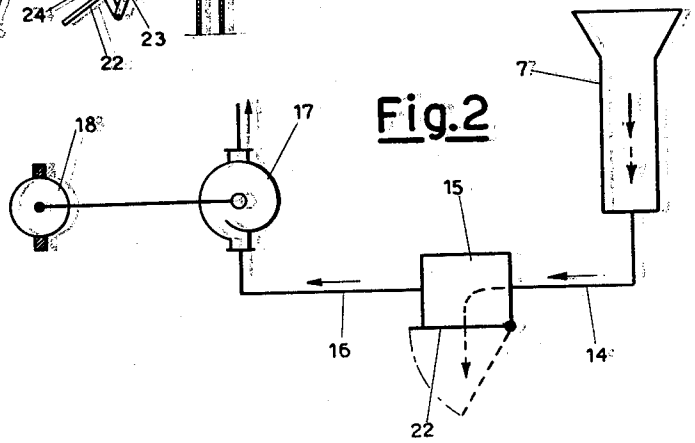


Fig.2



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PNEUMATIC TENSIONING DEVICE FOR CIRCULAR KNITTING MACHINES, PARTICULARLY FOR CIRCULAR MACHINES FOR MAKING STOCKINGS

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Fig.5

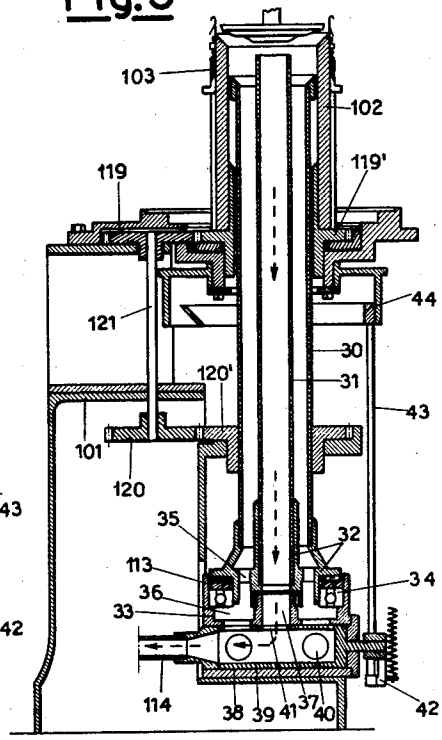


Fig.7

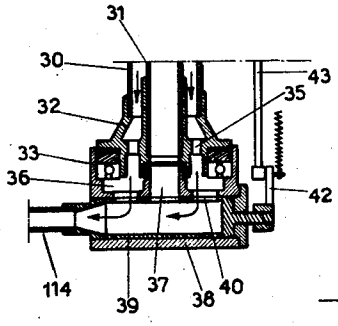
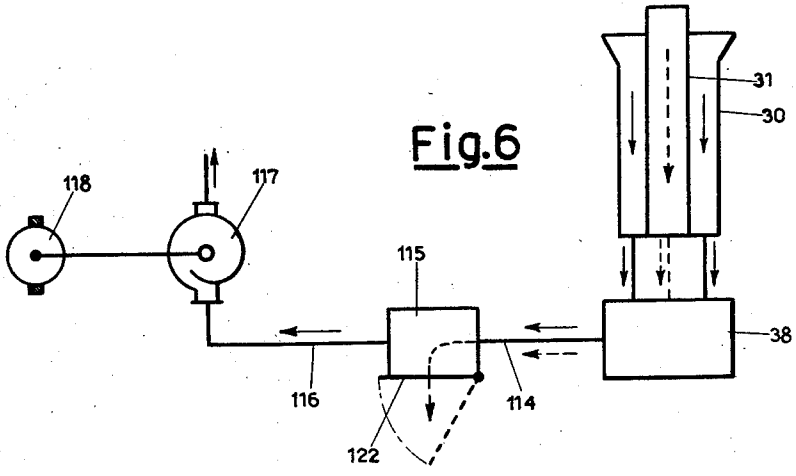


Fig.6



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PNEUMATIC TENSIONING DEVICE FOR CIRCULAR KNITTING MACHINES, PARTICULARLY FOR CIRCULAR MACHINES FOR MAKING STOCKINGS

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Fig.8

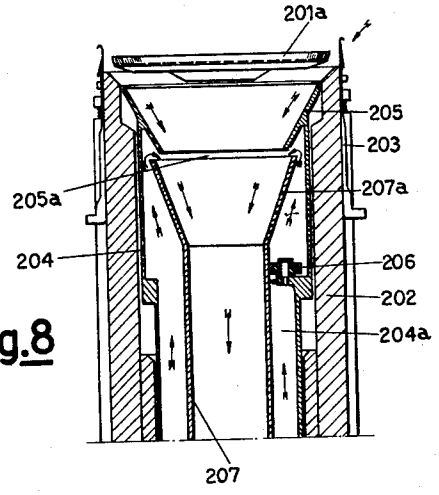
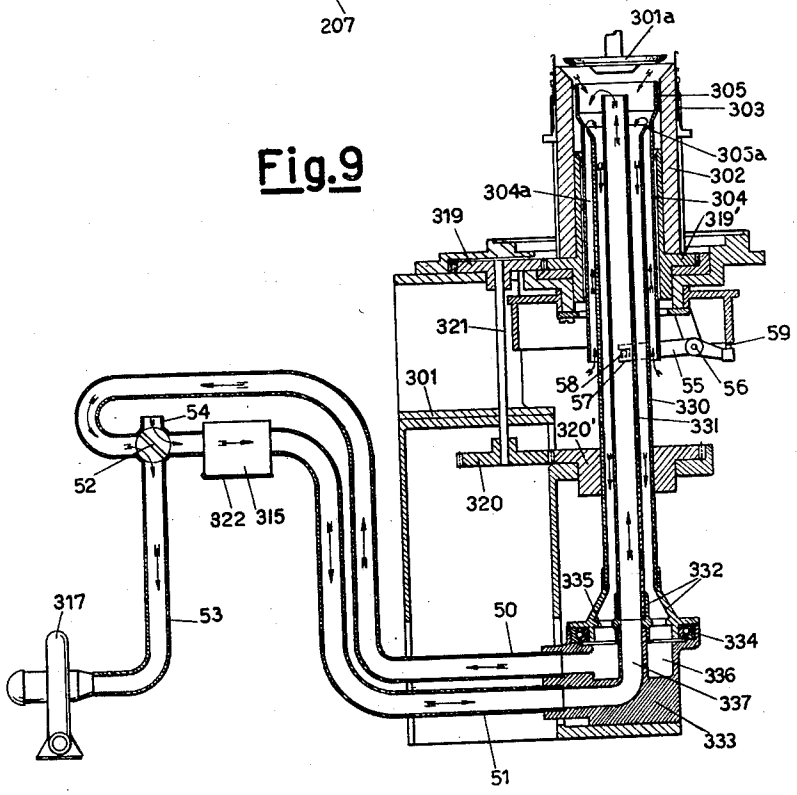


Fig.9

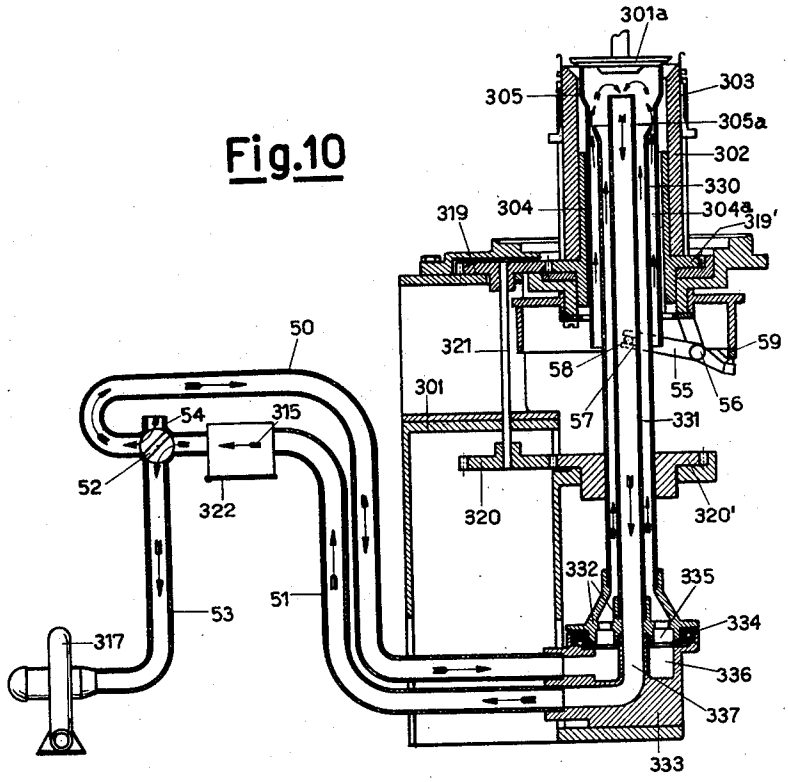


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PNEUMATIC TENSIONING DEVICE FOR CIRCULAR KNITTING MACHINES, PARTICULARLY FOR CIRCULAR MACHINES FOR MAKING STOCKINGS

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Fig.10



United States Patent Office 3,159,015 Patented Dec. 1, 1964

3,159,015

PNEUMATIC TENSIONING DEVICE FOR CIRCULAR KNITTING MACHINES, PARTICULARLY FOR CIRCULAR MACHINES FOR MAKING STOCKINGS

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Filed June 26, 1957, Ser. No. 668,187
Claims priority, application Italy, July 2, 1956, 556,014
4 Claims. (Cl. 66—149)

The present invention relates to circular knitting machines, particularly of the kind used for making stockings, and it is an object of the invention to provide a tensioning device adapted to keep the knitted fabric in tension during its formation. The kind of machine to which the tensioning device according to the invention is intended to be applied is that in which the stockings (particularly ladies' stockings) are formed individually and separately and extracted or discharged from the machine as soon as the formation of the stockings is completed.

Numerous mechanical tensioning devices are known in which a weight is applied to the stocking being formed and follows all the movements of the stocking. Those mechanical devices have various drawbacks from the point of view of construction as well as from the point of view of function.

It has already been proposed to employ a pneumatic system for tensioning the stocking formed by the circular machine. However, the known pneumatic tensioning devices have the inconvenience that the stocking, which has to descend during its formation through a tube of comparatively narrow diameter in order that it may be tensioned by the air stream flowing through such tube, cannot follow freely the rotational and oscillating movements of the needle cylinder but is impeded by the strong friction between the wall of said tube and said stocking.

Hence the tensioning action is very irregular and the stocking can easily twist so as to block the operation of the machine.

It is an object of the invention to eliminate this inconvenience and to render practical the use of a penumatic system for tensioning the stocking being formed in a circular hosiery knitting machine. The device according to the present invention substantially comprises a tube having a flaring or funnel-shaped upper end arranged coaxially in the needle cylinder and made to turn in synchronism with the rotational and oscillating movements of said cylinder, said tube being connected, at its lower portion, to a source of suction. The stocking which is descending as it is being formed in the interior of said tube is held in constant and uniform tension by the stream of air sucked downwardly through said tube and the turning of the latter with the needle cylinder prevents twisting of the stocking. To increase the tensioning effect of the air it is also possible to provide an annular gap between the upper end of the tube in which the stock descends and the flaring or funnel-shaped end portion which extends out to the needle cylinder so that additional air flow can be induced through such gap.

The stocking now can follow, together with the tube that surrounds it, all the movements of the cylinder without any relative angular movement between the stocking and the tube. This ensures the perfect descent of the stocking in the tube and that uniform tension will be applied at all times and at all point on the circumference of said stocking.

In the manufacture of ladies' stockings, particularly during the formation of the double border, it may be convenient, in order to facilitate this operation, to hold said tube still and not to make it follow the movements of the needle cylinder. It has been found however that it may be sufficient in this connection to amount the funnel-shaped upper end portion of the suction tube in a fixed position, while the tube itself, in which the stocking descends, continuously follows all the movements of the needle cylinder. The pneumatic tensioning device according to the invention may be embodied in a device for everting the stocking as soon as its formation is finished. In that case, in place of a single tube, there may be arranged, in the interior of the needle cylinder, two concentric tubes forming an annular passage therebetween, with the outer tube being closely adjacent, at the top, to the needle cylinder, and the inner tube being preferably a little longer than the outer one. Both tubes are made to turn in synchronism with the needle cylinder and the lower ends of the two tubes are connected to a distributor adapted to communicate piping extending to a source of suction alternatively with the passage between the two tubes or with the interior of the inner tube. During the knitting of the stocking, a stream of air is sucked downwardly through the passage between the two tubes which turn together with the cylinder and the stocking descends, therefore, into this passage. As soon as the formation of the stocking is completed, a downwardly air flow is produced in the interior of the inner tube, thereby to automatically evert the finished stocking and at the same time to discharge it from the machine.

The invention will be described in detail hereinafter with reference to the accompanying drawings, wherein:

FIG. 1 is a vertical section of a housing knitting machines with a tensioning device according to one embodiment of the invention;

FIG. 2 is a diagrammatic representation of the operation of the device of FIG. 1;

FIGS. 3 and 4 are detail sectional views illustrating two phases of the operation of the box in which completed stockings are collected;

FIG. 5 is a sectional view similar to that of FIG. 1, but showing a second embodiment of the tensioning device;

FIG. 6 is a diagrammatic representation of the operation of the device of FIG. 5;

FIG. 7 is a detail view of a portion of the structure of FIG. 5 but shown in a different operating position;

FIG. 8 is an enlarged sectional view similar to the upper part of FIG. 1, but showing a modification thereof; and

FIGS. 9 and 10 are axial sectional views of another embodiment of the invention for both tensioning and everting the stockings, and wherein a closed path is provided for the air flows in both operating conditions.

In the drawings there are illustrated diagrammatically only those parts of a circular hosiery knitting machine, of a kind known per se in the art, which are necessary for full understanding of the subject matter of the present invention. It is obvious that all the other parts of the knitting machine may be constructed according to any of the various known embodiments thereof. The following description, therefore, is limited to a detailed explanation of the tensioning device according to the invention, and only superficially mentions those members of the circular hosiery knitted machine to which said device is applied.

It will be seen that the knitting machine of FIG. 1 has a frame 1 in which the cylinder 2 carrying the needles 3 is supported rotatably.

In the interior of the cylinder 2 there is arranged a supporting structure 4 rotatably carrying at its top, a funnel-shaped or flaring member 5 which extends, at its upper border, closely adjacent to the upper end of the cylinder 2. In the structure 4 there is supported rotatably, by means of a bearing 6, a tube 7 which is joined to the member 5 and projects downwardly from the cylinder 2. This tube 7 is arranged coaxially with the

cylinder 2 and its lower end is fitted into a cylindrical collar 8 rotatably mounted by means of a bearing 9 in a fixed block 10 provided with a cavity 11 and with a joint 12. A gasket 13 provides a seal between the rotatable collar 8 and the fixed block 10. To the joint 12 there is connected a pipe 14 which, through a box 15 and a pipe or conduit 16 (see FIGURES 2–4), is in communication with the inlet of an air pump or blower 17 driven by a motor 18 (FIG. 2).

The tube 7 is rotatably driven from the cylinder 2 through gears 19 and 20 fixed on a shaft 21. The gear 19 is in engagement with a toothed rim 19′ secured to the cylinder 2 and the gear 20 meshes with a gear 20′ secured on the tube 7. Therefore, the tube 7 turns in perfect synchronism with, and at the same speed as the cylinder 2. The ratio of transmission of the rotary movement between the cylinder 2 and the tube 7 is 1:1. The box 15 through which the finished stockings can be ejected, is provided for that purpose with a door or port 22 controlled through a system of levers 23, 24, 25 by the control drum 26 of the machine which is provided for that purpose with a special cam ring 27 (FIGS. 3 and 4). A throttle valve 28 is pivoted in the conduit 16 and also actuated through the lever 25 by way of a link 28*a* so that valve 28 is open when door 22 is closed (FIG. 3) and valve 28 is closed when door 22 is open (FIG. 4).

Operation of the device is as follows. The pipe or tube 7 turns in synchronism with the cylinder 2 and, during knitting of the stocking, valve 28 is open and door 22 is closed so that an air flow, as indicated by the arrows in full lines on FIG. 2, occurs through tube 7, pipe 14, conduit 16 and blower 17.

The stocking being formed is therefore subjected to a downward force sufficient to keep it under tension. During the first stage of the formation of the double border of ladies' stockings, said border is sucked into the funnel shaped member 5, and such entry is facilitated by special fins 29 (FIG. 1) provided in the interior of that member. Then the stocking descends in the tube 7 and follows, with the latter, all the turning movements of the cylinder 2. Hence the tensioning can be effected with greatest regularity and there is no relative angular movement at all between the stocking and the tube 7. Hence friction is minimized.

When the formation of the stocking is completed and the finished stocking is detached or pressed-off in known manner from the needles of the cylinder 2, it is sucked by the air flow through the tube 14 into box 15 and, at that time, the door 22 is opened to let the stocking come out and fall into an underlying collecting vessel. The door 22 is controlled by the drum 26 which, at the desired time, as shown on FIG. 4, presents before the lever 25 a cavity of the cam ring 27 in such a way that this lever 25 is made to turn by a spring (not represented) in the direction causing one end to enter into said cavity while its opposite end causes, through the levers 24 and 23, the opening of the door 22 and, at the same time, the closing of the throttle valve 28. The ejection of the stocking, therefore, is effected as indicated by the arrows in dotted lines on FIG. 2.

The modification of the device according to the invention as illustrated in FIGS. 5 to 7 operates substantially according to the same principles as described above, and parts of such modification which are similar to corresponding parts of the device of FIGS. 1–4 are identified by the same reference numerals, but in the 100 series. However, in place of the single tube 7, there are provided two concentric tubes 30 and 31 both arranged within and coaxially with respect to its cylinder, at its upper end, 102. The tube 30 extends closely adjacent to the cylinder 102 while the internal tube 31 has its upper end projecting beyond the tube 30. Both tubes 30 and 31 are supported, at their bottom ends, in a rotatable piece 32 mounted on a fixed piece 33 by means of bearings 34. A gasket 113 provides a seal between the two pieces 32 and 33. The piece 32 presents an inner seat for the tube 31 and an outer seat for the tube 30 and between the two seats there are provided passageways 35 establishing communication between an annular chamber 36 in the fixed piece 33 and the annular passage between the two tubes 30 and 31. In the fixed piece 33 there is further provided a central chamber 37 which is in communication with the interior of tube 31.

Below the fixed piece 33 and fixedly connected therewith there is provided a cylindrical distributor 38 containing a turnable sleeve 39 provided with apertures 40 and 41 which are adapted to establish communication of the interior of the sleeve 39 with the annular chamber 36 and with the central chamber 37, respectively. The interior of the sleeve 39 is in permanent communication, at one end, with the tube 114 and, as in the case of the preceding embodiment, through the box 115 and the tube 116, with the inlet of pump or blower 117.

The sleeve 39 can be turned to connect the inlet of pump 117 with the passage between tubes 30 and 31 (FIG. 7) or with the interior of the tube 31 (FIG. 5). This rotation of sleeve 39 can be controlled simply by means of a crank 42 extending from sleeve 39 and connected to a rod 43 actuated, at the desired time, by a cam on any suitable member of the knitting machine.

During the formation of the stocking, the distributor is in the position indicated on FIG. 7 and the downward air flow (indicated by the arrows in full lines on FIGS. 6 and 7) occurs in the annular space or passage between the two tubes 30 and 31 which are turned in synchronism with the cylinder 102 by means of the pairs of gears 119, 119′ and 120, 120′. As soon as the stocking is completed, and during the press-off cycle, the distributor is turned to the position shown on FIG. 5, and the downward air flow occurs in the interior of the tube 31 (as indicated by the arrows in broken lines on FIGS. 5 and 6). The finished stocking is thus automatically everted and ejected through the inner tube 31, the distributor, the tube 114 and the box 115 which has its door 122 in the open position thereof. The control of the door 122 is effected in the manner previously described with reference to FIGS. 3 and 4.

As shown on FIG. 8, in which the several parts are identified by the same reference numerals as the corresponding parts in FIG. 1, but in the 200 series, it is possible to increase the effectiveness of the air flow by slightly spacing the upper end of the tube 207 from the funnel-shaped member 205.

Inside the cylinder 202 there is supporting structure 204 which, at its upper end, carries the funnel-shaped member 205 extending close to the upper end of cylinder 202. The tube 207 is arranged coaxially, and in a freely rotatable manner, inside the cylinder 202. Bearings 206, of which only one is visible in the drawing, are carried by the structure 204 and serve to center the tube 207. The tube 207 terminates, at its upper end, in a funnel-shaped part 207*a* which, however, is not joined to the funnel-shaped member 205 of the fixed structure but rather is spaced therefrom to define a circular passageway or gap 205*a* through which the interior of the tube 207 is in communication with an annular space 204*a* between the structure 204 and the tube 207.

As indicated by the arrows on FIG. 8, the air drawn downwardly through the interior of the tube 207 is not only taken through the passageway between the upper end of cylinder 202 and the usual dial 201*a*, but is also drawn from the annular space 204*a* and through the gap 205*a*. The annular space 204*a* freely communicates with the atmosphere at its lower end. By reason of this arrangement, it is possible to suck a greater volume of air through tube 207 and the tensioning effect on the stocking is correspondingly increased.

As shown on FIGS. 9 and 10, wherein the several parts are identified by the same reference numerals as the cor-

responding parts of FIGS. 5, 6 and 7, but in the **300** series, it is also possible to provide a machine having a combined tensioning and everting device with a free passageway or gap **305***a* between the upper end of the outer tube **330** and the funnel-shaped member **305** extending close to the cylinder **302**. As in the embodiment of FIGS. 5–7, the two tubes **330** and **331** are supported, at the bottom, in a rotatable piece **332** supported by bearings **334** in a fixed member **333**. The piece **332** presents an inner seat for the tube **331** and an outer seat for the tube **330** and, between the two seats, there are provided passageways **335** establishing communication between an annular chamber **336** formed in the fixed piece **333** and the annular space between the two tubes **330** and **331**.

In the fixed piece **333** there is also provided a central chamber **337** which, through the seat of the inner tube **331**, is in communication with the interior of the latter tube. In the embodiment of FIGS. 9 and 10, the annular chamber **336** is in communication with a conduit **50** and the central chamber **337** is in communication with a conduit **51**. The conduits **50** and **51** lead to a two-way valve **52** which is connected, by means of a conduit **53**, to the inlet of an air pump or blower **317** and, by means of a conduit **54**, to the atmosphere. In the conduit **51**, there is inserted or interposed the box **315** provided with the door **322** for the ejection or removal of the successively knitted stockings.

The supporting structure **304** in the interior of the needle cylinder **302** is displaceable axially by means of a two-armed lever **55** pivoted at **56** and having a fork **57** at one end which is engaged with a pin **58** fixed on the structure **304**. The other end of the lever **55** is engageable, from above, by a cam member **59** adapted to rock the lever **55** in the direction for raising its forked end **57** and thereby lift the entire tubular structure **304** sufficiently so that the upper edge of funnel-shaped part **305** comes to rest against the dial **301***a*, as on FIG. 10. The tubes **330** and **331** are made to rotate in synchronism with the cylinder **302** by means of the gears **319**, **320** fixed to the shaft **321** and respectively meshing with the toothed rim **319'** on the cylinder **302** and the gear **320'** fixed to the tube **330**.

Operation of the device of FIGS. 9 and 10 is as follows:

During normal operation of the circular hosiery knitting machine, the device maintains the necessary tension on the stocking being formed. In this stage of operation, the device is in the condition illustrated on FIG. 9, that is, with the two-way valve **52** positioned so that the suction conduit **53** communicates with the conduit **50**, and with the structure **304** in its lowered position. The stocking being formed descends in the annular space between the rotating tubes **330** and **331**, and the air is sucked downwardly through such annular space. The flow of air into the space between tubes **330** and **331** occurs through the gap between the cylinder **302** and the dial **301***a*, through the annular space **304***a* between the structure **304** and the tube **330** and the gap **305***a* between the funnel-shaped member **305** and the upper end of the tube **330**, and finally from the outside through the conduit **54**, the two-way valve **52** (in the position of FIG. 9), the box **315** with its door **322** closed, the conduit **51**, the central chamber **337** of the piece **333** and the interior of the tube **331** into the space between the two tubes **330** and **331**.

The above described flow of air from conduit **54** is completely free and, therefore, can be made up of a great volume of air so that the resulting tensioning of the stocking is very effective.

Upon the completion of a stocking, the device is changed over to the condition illustrated on FIG. 10 for the purpose of everting and ejecting the finished stocking. In such condition, the valve **52** places the suction conduit **53** in communication with the conduit **51**, and the fixed structure **304** inside the cylinder is lifted by means of the cam **59** and lever **55**. During everting and ejecting of a finished stocking, normal operation of the knitting machine is halted, that is, the cylinder **302** and the dial **301***a* do not turn and the tubes **330** and **331** are also at rest. The funnel-shaped member **305** bears, at its upper edge, against the dial **301***a*. The flow of air now occurs downwardly in the interior of the tube **331**. The air for such flow may be sucked through the gap **305***a* and through the annular space between the tubes **330** and **331**, which annular space is in free communication with the atmosphere or outside through the apertures **335**, the annular chamber **336**, the conduit **50**, the valve **52** (in the position of FIG. 10) and the conduit **54**. In this case, it will be seen that a very substantial rate of flow of air can be achieved so that the everting and ejecting effect is instantaneous and reliable. It will be understood that the operation and control of the door **322** of the ejecting box **315**, illustrated only diagrammatically on FIGS. 9 and 10, are similar to the operation and control of the door **22** of box **15**, as previously described with reference to FIGS. 3 and 4.

Although the control means for the two-way valve **52** have not been illustrated or described, such control means may be of any convenient conventional form and be actuated by an existing member of the knitting machine (for instance, the main drum thereof) so as to cause the actuation of the valve at the desired time.

Although illustrative embodiments of this invention have been described in detail herein with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the invention, except as defined in the appended claims.

I claim:

1. In a knitting machine having a needle cylinder; a pneumatic device for applying tension to each article as the latter is formed and for everting each article pressed off the needle cylinder, said device comprising a first tube coaxial with said needle cylinder and having an open end adjacent the latter; a second tube extending coaxially within said first tube and space radially inward from the latter to define an annular space therebetween, said second tube having an open end adjacent said open end of the first tube; means interconnecting said first and second tubes with the needle cylinder to rotate and oscillate with the latter; and means selectively operative, during the forming of each article, to cause air to flow in said annular space in a direction away from said needle cylinder and said open end of the first tube so that the article is formed over said second tube and has tension applied to it in said annular space, and, during the press-off cycle of the machine, to cause air to flow in said second tube in the direction away from said needle cylinder and said one end of the second tube so that the finished article is everted and ejected through said second tube.

2. In a knitting machine, a pneumatic device as in claim 1; wherein said means operative to cause air to flow alternatively in said annular space between the tubes and in said second tube includes means defining a source of vacuum, and distributor valve means connected between the other ends of said first and second tubes and said source of vacuum, said distributor valve means being selectively movable to a first position, in which said annular space between the tubes is communicated with said source of suction, and a second position, in which the interior of said second tube is communicated with said source of suction.

3. In a knitting machine, a pneumatic device as in claim 1; further comprising a funnel-shaped member supported non-rotatably within said needle cylinder and spaced a small distance from said one end of the first tube to define an annular gap therebetween, said first tube being spaced radially inward from said needle cylinder to define an annular passage therebetween so that air can

flow through said passage and gap into said space between the tubes and into the interior of said second tube.

4. In a knitting machine, a pneumatic device as in claim 1; wherein said means operative to cause air to flow alternatively in said annular space between the tubes and in said second tube includes means defining a source of vacuum, a first conduit communicating with said annular space and a second conduit communicating with the interior of said second tube at the other ends of said tubes, and a two-way valve connected with said source of vacuum and said first and second conduits and having an opening to the atmosphere, said valve being movable between one position, where said first and second conduits are connected to said source of vacuum and said opening to the atmosphere, respectively, and another position, where said first and second conduits are connected to said

opening to the atmosphere and said source of vacuum, respectively.

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