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(54) Sock turning device

(57) An article-turning device for turning a generally tubular fabric article inside out receives the article from an article-supplying device axially about a rod (2) of the article-turning device. One end of the rod is telescopically connected to the article-supplying device. A first article-urging device (10) radially enlarges in a direction along the axis of the rod away from the one end of the rod, from a first diameter to a second diameter that is larger than the first diameter for urging the article away from the axis of the rod and a second article-urging device (3) radially enlarges in the direction from a third diameter that is substantially the same as a diameter of the rod (2) proximate the one end of the rod and smaller than the first diameter to a fourth diameter that is larger than the third diameter for initially urging the article away from the axis of the rod, the second expansion device being between the one end of the rod and the first expansion device. The first article-urging device is generally cone shaped, but has three surface planes (10a) that are parallel to the axis of the rod and equally spaced discontinuously about a circumference of the first article-urging device at the second diameter of the first article-urging device to truncate the cone shape.

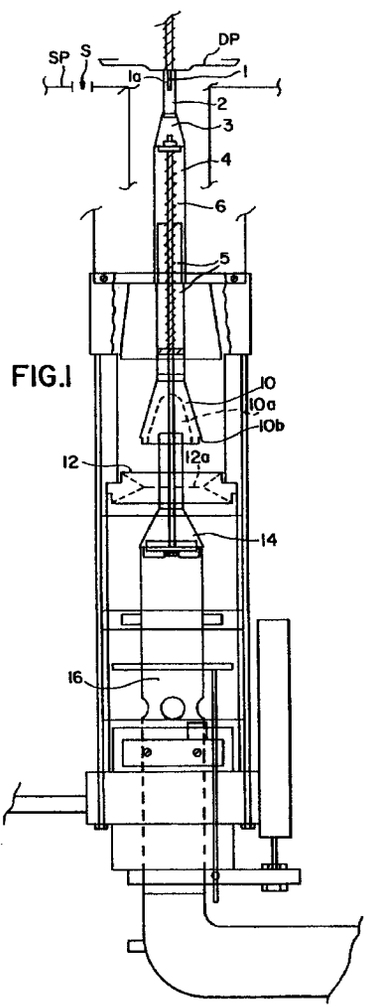

FIG.1

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Description

Background of the Invention

The invention relates to a device for turning a generally tubular fabric article inside out. In particular, the device turns inside out a tubular fabric article for making a sock during the manufacture of the finished sock product after a tubular article for the sock has been made, but before the toe part of the sock is closed.

Tubular fabric articles for a variety of finished products including, but not limited to, socks, are lengths of tubular fabric from an article-supplying device, for example, a circular knitting machine. The tubular article is then inserted axially into a device that turns the article inside out for a specific purpose such as the sewing of the toe from the inside of the sock.

One device for turning a tubular fabric article inside out is disclosed in Turini's U.S. Patent 5,235,825 issued August 17, 1993, for example. This device has an outer tubular casing with a coaxial tube inside it. An end of the coaxial tube inside the casing tube is closed by a conical expansion piece that narrows into an axial rod that extends away from the coaxial tube toward an end of the casing tube. The coaxial tube provides a first suction into the space between the casing tube and the coaxial tube and expansion piece while the expansion piece closes the end of the coaxial tube. The first suction draws the tubular article into the casing tube coaxially about and along the rod, expansion piece and a portion of the coaxial tube proximate its end that is closed by the expansion piece. The first, then-leading end of the tubular article in this movement coaxially passes over the expansion piece and the end of the coaxial tube and the tubular article continues to be sucked into the device in this way until the opposite end of the tubular article is proximate the end of the coaxial tube that is closed by the expansion piece. The coaxial tube then moves axially away from the rod and expansion piece and transfers its suction to the inside of the coaxial tube. The opposite end of the tubular article that is then proximate the end of the coaxial tube that is then separated from the expansion piece is thus sucked into the coaxial tube and the rest of the tubular article reverses its direction of suction movement back up to the end of the coaxial tube and over it to follow the opposite, now-leading end of the tubular article, whereby the tubular article is turned inside out. Thereafter, the tubular article continues to be sucked through the coaxial tube to a location for further processing, such as closing the toe of a sock, for example.

The suction-operating article-turning device of the Turini '825 patent is intended to be used at the circular hook or dial plate of a circular knitting machine that supplies the tubular fabric article to the turning device. In one embodiment, the end of the rod opposite the expansion piece is hinged to the center of the dial plate. This has an advantage in assuring axial alignment of the dial plate and, thus, the tubular article with the rod, expansion piece and coaxial tube of the article-turning device. It also has two disadvantages, however, because in many devices for supplying tubular fabric articles, the dial plates or the like rotate about their axes and move longitudinally of their axes and, thus, about and along the aligned axes of the rods, expansion pieces and coaxial tubes of associated article-turning devices during use.

When a dial plate of an article-supplying device that is hinged to a rod of a turning device moves axially during use, the axial movement will also move the rod, expansion piece and, thus, the coaxial tube of the article-turning device. It is the axial movement of the coaxial tube of the article-turning device relative to its casing tube and expansion piece that controls the necessary change in the suction of the coaxial tube of the article-turning device operation, however, so that such axial movement from the dial plate is undesirable.

One solution to some of the suction difficulty from axial movement of a dial plate may be suggested by Figure 4 of the Turini '825 patent, although in this Figure, the rod is not connected to the dial plate that is not shown in the Figure. This solution is the provision of a sleeve of the article-supplying circular knitting machine about the casing tube of the suction-operating article-turning device where an axial end of the rod could be connected to the dial plate. Telescopic movement of the casing tube of the article-turning device in the sleeve of the article-supplying would then control suction flow and reduce suction changes as compared to the flow change from a change in a mere spacing of the article-supplying and article-turning devices, but this would require the movement of the whole article-turning device. Such movement would add difficulties to its mounting and may not be desirable in relation to later product-finishing devices that receive the turned article from the article-turning device.

Further, use of the article-supplying and article-turning devices necessarily includes their maintenance and repair, for which it can be necessary or desirable to separate them. If the rod is hinged to the dial plate, this requires removing the rod and expansion piece from the article-turning device with separation of the dial plate. This would be difficult or impossible with the embodiment of Figure 4 of the Turini '825 patent, because of a collar in the resulting upward path of the expansion piece. Avoiding this difficulty would require the further guillotine device shown in Figure 3 of the Turini '825 patent, which is, however, another complication.

In some knitting machines, furthermore, the dial plate is hinged to the knitting machine, as shown in Turini's U.S. Patent 5,052,196, for example. This would then require the rod and expansion piece to tilt, as shown in Figure 11 of the Turini '196 patent or other linkages for the dial plate and/or rod that are more complicated than the hinges shown in the Turini '825 and '196 patents. The hinges, moreover, do not easily accommodate dial plates that rotate as described above.

When the dial plate of an article-supplying device rotates, the tubular article it supplies rotates with it. If the rod and expansion piece are hinged to the dial plate, they must rotate with it, too. There is then no rotation of the

article relative to the rod and expansion piece, but the expansion piece must provide a rotatable suction seal to the end of the coaxial tube that it closes, which is difficult to achieve and maintain over time in use. If the rod and expansion piece are not hinged to the dial plate, the rotational suction-seal difficulty is solved, but the tubular fabric article then rotates relative to the rod and expansion piece. Because the fabric is not rigid, it can also move radially of the rod and, from the relative rotation, wind about the rod at least sufficiently to prevent the suction movements of the article necessary to turn it inside out. Imperfect alignment between the dial plate and rod or lateral oscillations of the rod when it is not connected to the dial plate can aggravate the winding problem.

Summary of the Invention

It is an object of the invention to alleviate these and other difficulties in a suction-operating article-turning device having a rod connected to a portion, such as a dial plate, of an article-supplying device, such as a circular knitting machine, in which the dial plate moves axially and/or rotates in use.

To these and other ends, the rod may be telescopically movable to accommodate axial movement of the dial plate in use. The rod and dial plate also may be relatively rotatably connected, for example by an axial pin and socket, to accommodate rotation of the dial plate in use and axial separation. The article-turning device may also be provided with more than one article-urging devices to hold the article away from the rod and keep it from winding thereabout. An article-urging device may also have a truncated conical shape to facilitate axial movement of the article axially therealong.

More particularly, in an article-turning device for receiving a generally tubular fabric article from a article-supplying device about and axially along a rod of the article-turning device and for turning the article inside out by suction operation, the rod extending along an axis of the rod from one axial end of the rod at a first portion of the article-supplying device that is movable axially of the rod, and for turning the article inside out, the article-turning device having a suction flow-providing spacing from a second portion of article-supplying device proximate the first portion of the article-supplying device, the invention provides:

connection means for connecting the one end of the rod to the first portion of the article-supplying device for axially moving the rod with the first portion of the article-supplying device; and

telescopic means at an opposite axial end of the rod for relative movement axially of the rod,

whereby the relative movement of the telescopic means makes the suction flow-providing space independent of the axial movement of the first portion of the article-supplying device and the rod.

In an article-turning device for receiving a generally tubular fabric article from an article-supplying device about and axially along a rod of the article-turning device, the rod extending along an axis of the rod from one axial end of the rod at a first portion of the article-supplying device that rotates about the axis of the rod, and for turning the article inside out, the invention provides:

first article-urging means axial of the rod and radially enlarging in a direction along the axis of the rod away from the one end of the rod from a first diameter to a second diameter that is larger than the first diameter for urging the article away from the axis of the rod; and

second article-urging means axial of the rod and radially enlarging in the direction from a third diameter that is substantially the same as a diameter of the rod proximate the one end of the rod and smaller than the first diameter to a fourth diameter that is larger than the third diameter for urging the article away from the axis of the rod, the second expansion means being between the one end of the rod and the first expansion means.

In an article-turning device for receiving from an article-supplying device a generally tubular fabric article about and axially along a rod of the article-turning device, the rod extending along an axis of the rod from one axial end at a first portion of the article-supplying device that rotates about the axis of the rod, and for turning the article inside out, the invention provides:

first article-urging moans axial of the rod and radially enlarging in a direction along the axis of the rod away from the one end of the rod from a first diameter to a second diameter that is larger than the first diameter for urging the article away from the axis of the rod;

wherein the first article-urging means is generally cone shaped; and

wherein three planes that are parallel to the axis of the rod and equally spaced discontinuously about a circumference of the first article-urging means at the second diameter of the first article-urging means truncate the cone shape of the first article-urging means.

The invention also provides combinations of the features described above with or without other features described hereafter.

Brief Description of the Drawing

A preferred embodiment that illustrates but does not limit the invention will now be described with reference to the drawing, wherein:

Figure 1 is a schematic elevation, partly in cross section, of the preferred embodiment of a portion of an article-turning device with a first, dial-plate portion of a circular knitting device with which the article-turning device is used for supplying a generally tubular fabric article to the article-turning device;

Figure 2 is a top view of a first article-urging portion of the portion of the article-turning device shown in Figure 1; and

Figure 3 is a top view of a collar portion of the portion of the article-turning device shown in Figure 1.

Description of the Preferred Embodiment

Figure 1 shows a portion of an article-turning device at a first, dial-plate portion DP of a circular knitting device that supplies a generally tubular fabric article (not shown) to the article-turning device from the periphery of the dial plate. Further descriptions of such devices are found in the Torini '825 and '196 patents identified above and U.S. patents 3,063,275, 3,108,462, 3,267,698, 3,296,838, 3,473,350, 4,665,720 and 5,284,033, the disclosures of which are incorporated herein by reference to complete the description of any portion of the devices that is not fully described herein.

The dial plate of the circular knitting device shown in Figure 1 has an axial, downwardly projecting pin 1 that rotates about its axis and moves axially with the dial plate in use. The pin 1 is relatively rotatably and axially movably received in a socket 1a in one axial end of an axial rod 2 of the article-turning device. As a result, the rod is axially aligned with the dial plate but does not have to rotate with the dial plate, although some non-synchronous rotation generally occurs. The rotation of the dial plate also rotates the tubular fabric article it supplies along the rod about the axis of the rod, and, because this rotation is synchronous, there can be relative rotation between the rod and the article that could twist the article about the rod unless prevented by article-urging devices, as described later.

A pair of telescopically arranged tubes 5 axially space an axially opposite end of the rod from a first article-urging device 10 that has first and second diameters as will be described in further detail later. At the opposite end of the tubes is a second article-urging device 3 that connects the rod to the tubes. The second article-urging device is axially closer to the end of the rod at the dial plate than to the first article-urging means.

The second article-urging device 3 has a third diameter at the opposite end of the rod that is substantially the same as the diameter of the rod proximate the end of the rod that is connected to the dial plate, the rod in this embodiment being cylindrical so that the rod progresses smoothly into the third diameter of the second article-urging device. The second article-urging device conically enlarges to a larger fourth diameter axially away from the rod.

The tubes 5 are cylindrical and have substantially the same diameter as the fourth diameter of the second article-urging device so as to maintain this larger diameter all the way to the first article-urging device. The telescopic arrangement of the tubes permits their relative telescopic movement axially of the rod. An expansion spring structure 6 inside the tubes urges telescopic expansion up to the limits of the spring and, of course, accommodates telescopic compression of the tubes. In this embodiment, the telescopic expansion of the tubes that is urged by the spring is less than required to keep the first article-urging device pressed onto a collar 12, but sufficient to keep the socket 1a on the pin 1, and when the first article-urging device is pressed onto the collar as later described, its compression is sufficient to accommodate the axial movement of the dial plate DP. The telescopic arrangement of the tubes, therefore, maintains the pin and socket connection of the rod and dial plate.

The first article-urging device 10 has a first diameter at the telescopic tubes that is substantially the same as that maintained by the telescopic tubes from the fourth diameter of the second article-urging device. It conically enlarges axially away from the rod from the first diameter to a second diameter and then steps down to a smaller diameter base that fits into a central opening 12a in the collar 12 as later described and provides lips 10b that seat on the collar. Three planes 10a that are parallel to the axis of the rod and first article-urging device are equally spaced about the first article-urging device and truncate its conical shape discontinuously about the circumference of the second diameter as shown in Figure 2. Only three conical segments extend, therefore, from the first to the second diameter of the first article-urging device so as not to impede the axial and/or rotational movement of the article. This also permits the opening 12 in the collar 12 to be round as shown in Figure 3 so as not to impart radial excursions to the article, which could promote such twisting of the article as would impede its movements.

The base of the first article-urging device 10 is connected to a neck of an expansion piece 14 in a manner similar to that shown in Figure 4 of the Torini '825 patent, for example. The expansion piece closes an end of a coaxial tube 16 that moves axially away from the rod to change suction flow from outside the coaxial tube to inside it to turn a tubular article inside out as previously described.

Operation

When the coaxial tube 16 is in the position shown in Figure 1 with its end closed by the expansion piece 14 seated therein, the expansion piece pushes the first article-urging device 10 up from the collar 12 to the position shown in Figure 1. The spring and telescopic arrangements of the tubes 5 accommodate this and any concurrent axial movement of the dial plate DP of the article-supplying device, whereby a suction flow-providing space S between the article-turning device and a second portion SP of the article-supplying device is independent of the axial movement of the dial plate.

As is known, this position of the coaxial tube also causes the suction to be applied to the space about the coaxial tube that draws a tubular article (not shown) from the dial plate. The tubular article rotates with the dial plate as it is sucked axially along and about the rod, tubes, and article-urging devices and past the expansion device.

The seating of the expansion piece in the coaxial tube also keeps the expansion piece, article-urging devices, tubes and rod from rotating with the dial plate, the rotation of the dial plate being accommodated by the

relative rotatability of the pin 1 and socket 1a. Even though the rod, dial plate and, thus, the tubular article are axially aligned by the pin and socket, however, the suction and rotating movements of the tubular article can still cause the article to wind about the rod or tubes. The second article-urging means urges the article away from the axis, therefore, and the diameter of the tubes maintains this, to reduce the risk of such winding as prevents the necessary axial movement of the article.

When the article has moved axially enough that its opposite end is at the end of the coaxial tube, the coaxial tube moves away from the rod. The spring and telescopic arrangements of the tubes 5 keep the expansion piece seated in the end of the coaxial tube, however, until the lips 10b of the first article-urging device 10 seat in the collar 12. Farther movement of the coaxial tube then unseats the expansion piece to open the end of the coaxial tube and change the suction to its inside, whereby the opposite end of the article is sucked into the coaxial tube and the article turned inside out as the rest of the article follows.

The collar 12 is necessary to the article-turning process, therefore, and it is necessary to axially progress the rotating article through opening 12a in the collar to accomplish the turning. The opening in the collar is necessarily smaller in diameter than the first article-urging device, however, in order to support the article urging device. The axial and rotational movement of the article past the first article-urging device and collar is, therefore, particularly difficult. This is the reason for the planar truncation of the first article-urging device, whereby only its conical segments actually have to engage the article in order to urge its anti-twisting expanded progress toward the expansion piece and the opening in the collar is round to avoid causing twist-provoking radial excursions of the rotating article progressing thereby.

Still other combinations, permutations and variations of the invention as will occur to those in the art are contemplated as part of the invention defined by the following claims. In particular, it should be understood specifically that, although a fabric article and dial plate have been described, these terms are intended to include other equivalent generally tubular materials of paper or plastic that may be considered only fabric-like, for example, and equivalent devices appropriate to such other materials. It should also be understood specifically that, as used herein, turning inside out moans to turn the physical outside of the article into the inside without regard to what may be considered the inside or outside of the fabric or the finished product made from the tubular fabric article.

Claims

1. In an article-turning device for receiving a generally tubular fabric article from an article-supplying device about and axially along a rod of the article-turning device and for turning the article inside out by suction operation, the rod extending along an axis of the rod from one axial end of the rod at a first portion of the article-supplying device that is movable axially of the rod, and for turning the article inside out, the article-turning device having a suction flow-providing spacing from a second portion of article-supplying device proximate the first portion of the article-supplying device, the improvement comprising:

   connection means for connecting the one end of the rod to the first portion of the article-supplying device for axially moving the rod with the first portion of the article-supplying device; and

   telescopic means at an opposite axial end of the rod for relative movement axially of the rod,

   whereby the relative movement of the telescopic means makes the suction flow-providing space independent of the axial movement of the first portion of the article-supplying device and the rod.

2. The article-turning device according to claim 1, wherein at least one of the rod and telescopic means comprises a tube.

3. The article-turning device according to claim 1, wherein the connection means comprises one of a pin and axially separable socket therefor on the one end of the rod and the other of the pin and socket for provision on the first portion of article-supplying device and expansion means in the telescopic means for urging the pin and socket together.

4. The article-turning device according to claim 2, wherein the connection means comprises one of a pin and axially separable socket therefor on the one end of the rod and the other of the pin and socket for provision on the first portion of article-supplying device and expansion means in the telescopic means for urging the pin and socket together.

5. In an article-turning device for receiving a generally tubular fabric article from an article-supplying device about and axially along a rod of the article-turning device, the rod extending along an axis of the rod from one axial end of the rod at a first portion of the article-supplying device that rotates about the axis of the rod, and for turning the article inside out, the improvement comprising:

   first article-urging means axial of the rod and radially enlarging in a direction along the axis of the rod away from the one end of the rod from a first diameter to a second diameter that is larger than the first diameter for urging the article away from the axis of the rod; and

   second article-urging means axial of the rod and radially enlarging in the direction from a third diameter that is substantially the same as a diameter of the rod proximate the one end of the rod and smaller than the first diameter to a fourth diameter that is larger than the third diameter for urging the article away from the axis of the rod, the second

expansion means being between the one end of the rod and the first expansion means.

6. The article-turning device according to claim 5, wherein the first portion of the article-supplying device is movable axially of the rod and the article-turning device has a suction flow-providing spacing from a second portion of the article-supplying device proximate the first portion of the article-supplying device, the improvement further comprising:

connection means for connecting the one end of the rod to the first portion of the article-supplying device for axially moving the rod with the first portion of the article-supplying device; and

telescopic means at an opposite axial end of the rod for relative movement axially of the rod,

whereby the relative movement of the telescopic means makes the suction flow-providing space independent of the axial movement of the first portion of the article-supplying device and the rod.

7. The article-turning device according to claim 6, wherein the connection means comprises one of a pin and axially separable socket therefor on the one end of the rod and the other of the pin and socket for provision on the first portion of article-supplying device and expansion means in the telescopic means for urging the pin and socket together.

8. The article-turning device according to claim 5, wherein the second article-urging means is closer to the one end of the rod than to the first article-urging means.

9. The article-turning device according to claim 6, wherein the second article-urging means is closer to the one end of the rod than to the first article-urging means.

10. The article-turning device according to claim 7, wherein the second article-urging means is closer to the one end of the rod than to the first article-urging means.

11. The article-turning device according to claim 5, wherein the fourth diameter is substantially the same size as the first diameter and maintained therebetween.

12. The article-turning device according to claim 6, wherein the fourth diameter is substantially the same size as the first diameter and maintained therebetween.

13. The article-turning device according to claim 8, wherein the fourth diameter is substantially the same size as the first diameter and maintained therebetween.

14. The article-turning device according to claim 10, wherein the fourth diameter is substantially the same size as the first diameter and maintained therebetween.

15. In an article-turning device for receiving from an article-supplying device a generally tubular fabric article about and axially along a rod of the article-turning device, the rod extending along an axis of the rod from one axial end at a first portion of the article-supplying device that rotates about the axis of the rod, and for turning the article inside out, the improvement comprising:

first article-urging means axial of the rod and radially enlarging in a direction along the axis of the rod away from the one end of the rod from a first diameter to a second diameter that is larger than the first diameter for urging the article away from the axis of the rod;

wherein the first article-urging means is generally cone shaped; and

wherein three planes that are parallel to the axis of the rod and equally spaced discontinuously about a circumference of the first article-urging means at the second diameter of the first article-urging means truncate the cone shape of the first article-urging means.

16. The article-turning device according to claim 15, wherein the first portion of the article-supplying device is movable axially of the rod and the article-turning device has a suction flow-providing spacing from a second portion of the article-supplying device proximate the first portion of the article-supplying device, the improvement further comprising:

connection means for connecting the one end of the rod to the first portion of the article-supplying device for axially moving the rod with the first portion of the second device; and

telescopic means at an opposite axial end of the rod for relative movement axially of the rod,

whereby the relative movement of the telescopic means makes the suction flow-providing space independent of the axial movement of the first portion of the article-supplying device and the rod.

17. The article-turning device according to claim 15, the improvement further comprising:

first article-urging means axial of the rod and radially enlarging in a direction along the axis of the rod away from the one end of the rod from a first diameter to a second diameter that is larger than the first diameter for urging the article away from the axis of the rod; and

second article-urging means axial of the rod and radially enlarging in the direction from a third diameter that is substantially the same as a diameter of the rod proximate the one end of the rod and smaller than the first diameter to a fourth diameter

that is larger than the third diameter for urging the article away from the axis of the rod, the second expansion means being between the one end of the rod and the first expansion means.

18. The article-turning device according to claim 17, wherein the first portion of the article-supplying device is movable axially of the rod and the article-turning device has a suction flow-providing spacing from a second portion of the article-supplying device proximate the first portion of the article-supplying device, the improvement further comprising:

connection means for connecting the one end of the rod to the first portion of the article-supplying device for axially moving the rod with the first portion of the article-supplying device; and

telescopic means at an opposite axial end of the rod for relative movement axially of the rod,

whereby the relative movement of the telescopic means makes the suction flow-providing space independent of the axial movement of the first portion of the article-supplying device and the rod.

19. The article-turning device according to claim 17, wherein the second article-urging means is closer to the one end of the rod than to the first article-urging means.

20. The article-turning device according to claim 18, wherein the fourth diameter is substantially the same size as the first diameter and maintained therebetween.

FIG.1

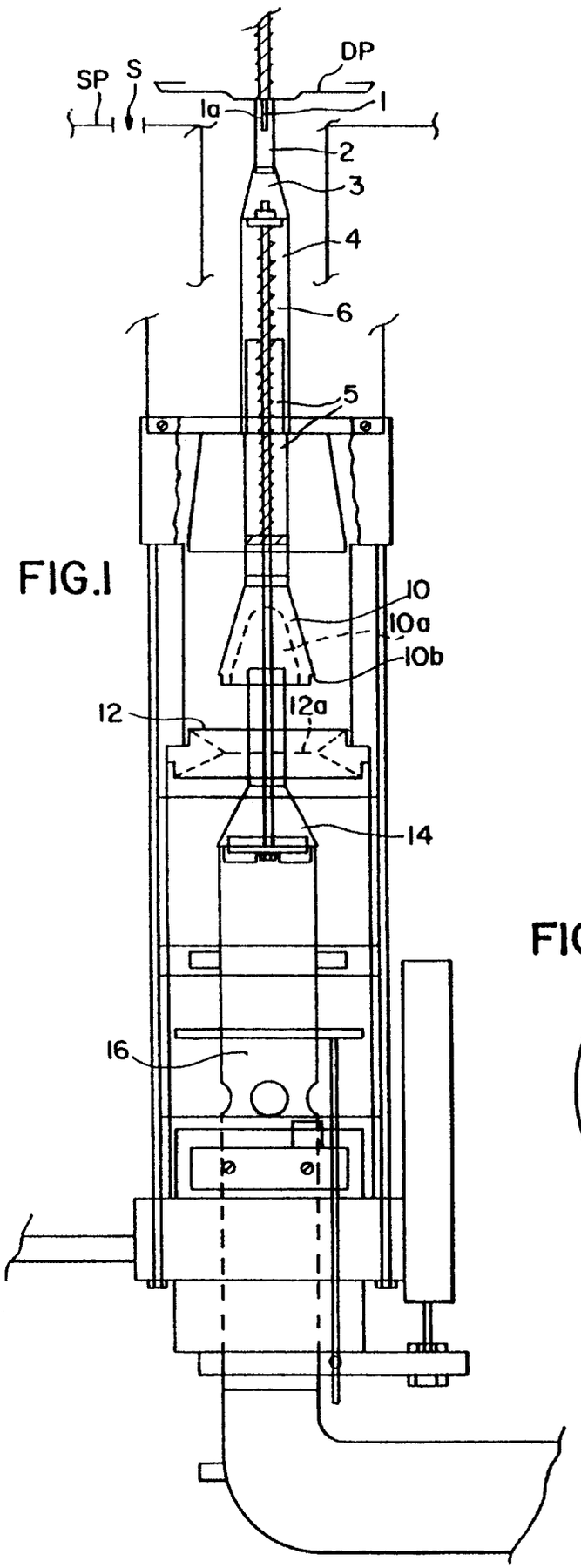


FIG.2

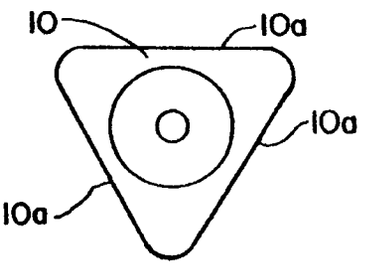
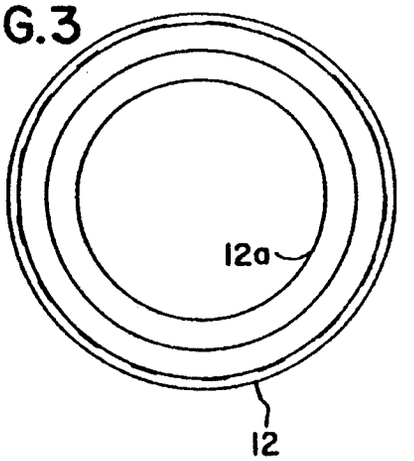


FIG.3



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 11 2889

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
D,A	US-A-5 235 825 (TURINI)		D04B15/92
D,A	EP-A-0 329 625 (TURINI)		
A	GB-A-2 124 260 (SOLIS S.R.L.)		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

D04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 December 1995	Van Gelder, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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