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(54) **Component elements of tights**

(57) A tubular textile 20 produced by the needle-cylinder (or cylinders) is discharged through a tube 12 (the so-called duct) towards the calender 14 which acts to maintain the knitted textile under tension and to insert it into the hose-collecting reservoir 16 beneath it, all of which rotate in synchronism with the needle-cylinder or cylinders.

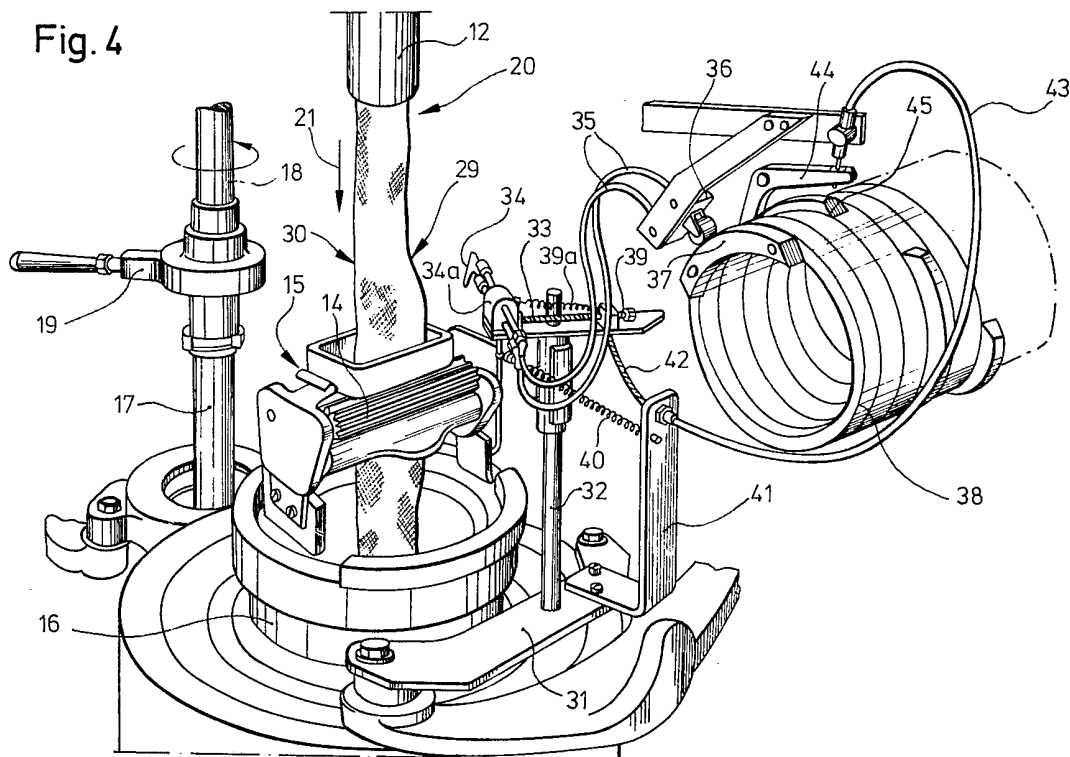
A flattened shaping element is inserted into the textile above the calender, the upper part of the shaping element being inserted in the duct and being centered therein. The lower part bears, with the interposition of the

flattened tubular textile on the hose-drawing rollers of the calender.

The lower part of one of the longitudinal edges of the shaping element has a vertical section which lies further from the axis of rotation than the other points on the shaping element. Consequently, during operation of the machine, the said vertical section and the knitted textile which covers it move along a cylindrical surface.

This creates the possibility of cutting the textile with the aid of an incandescent electrical resistance 34. This takes place at each revolution of the shaping element when the resistance is held in a position in which it is touching the said cylindrical surface. The cutting is stopped on movement of the resistance away from the cylindrical surface. The variation of the position of the resistance and its heating are controlled by cams 37,45 carried by the main drum of the machine, in its turn driven by the chain which establishes the duration of the cycle.

Fig. 4



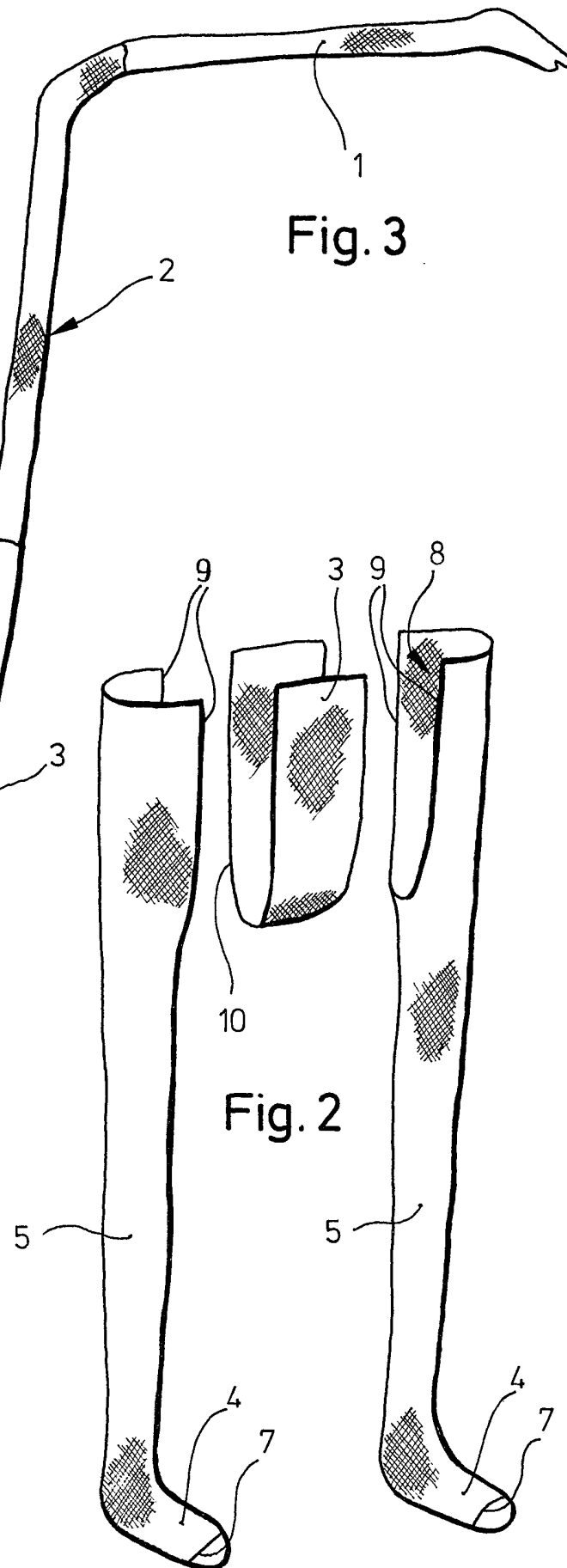
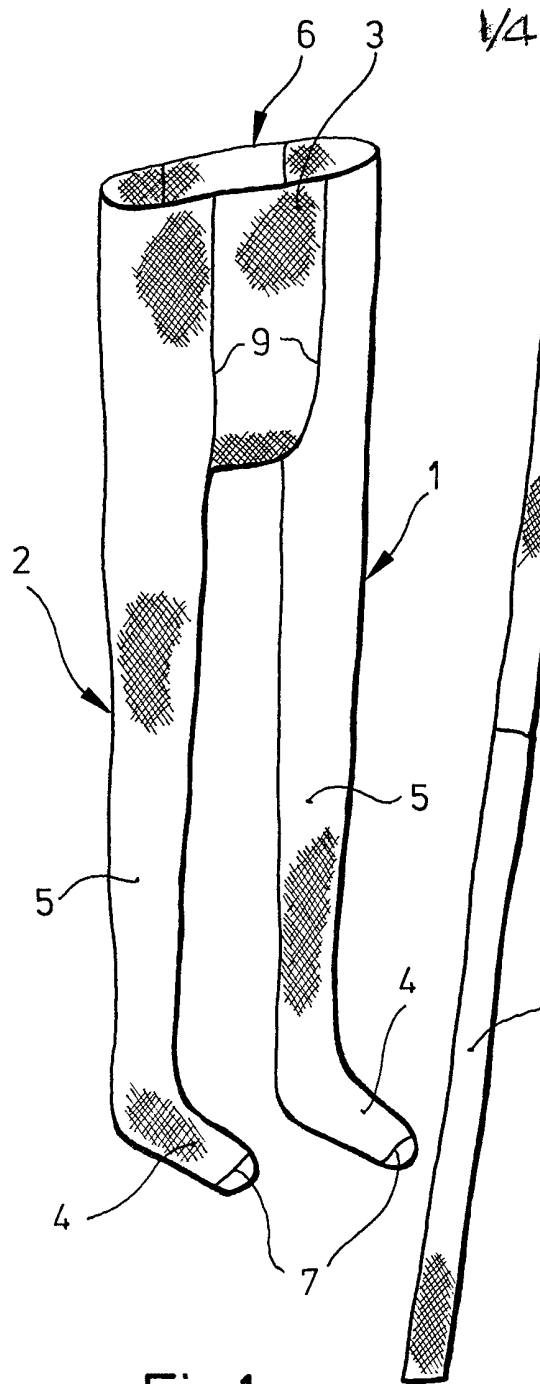


Fig. 3

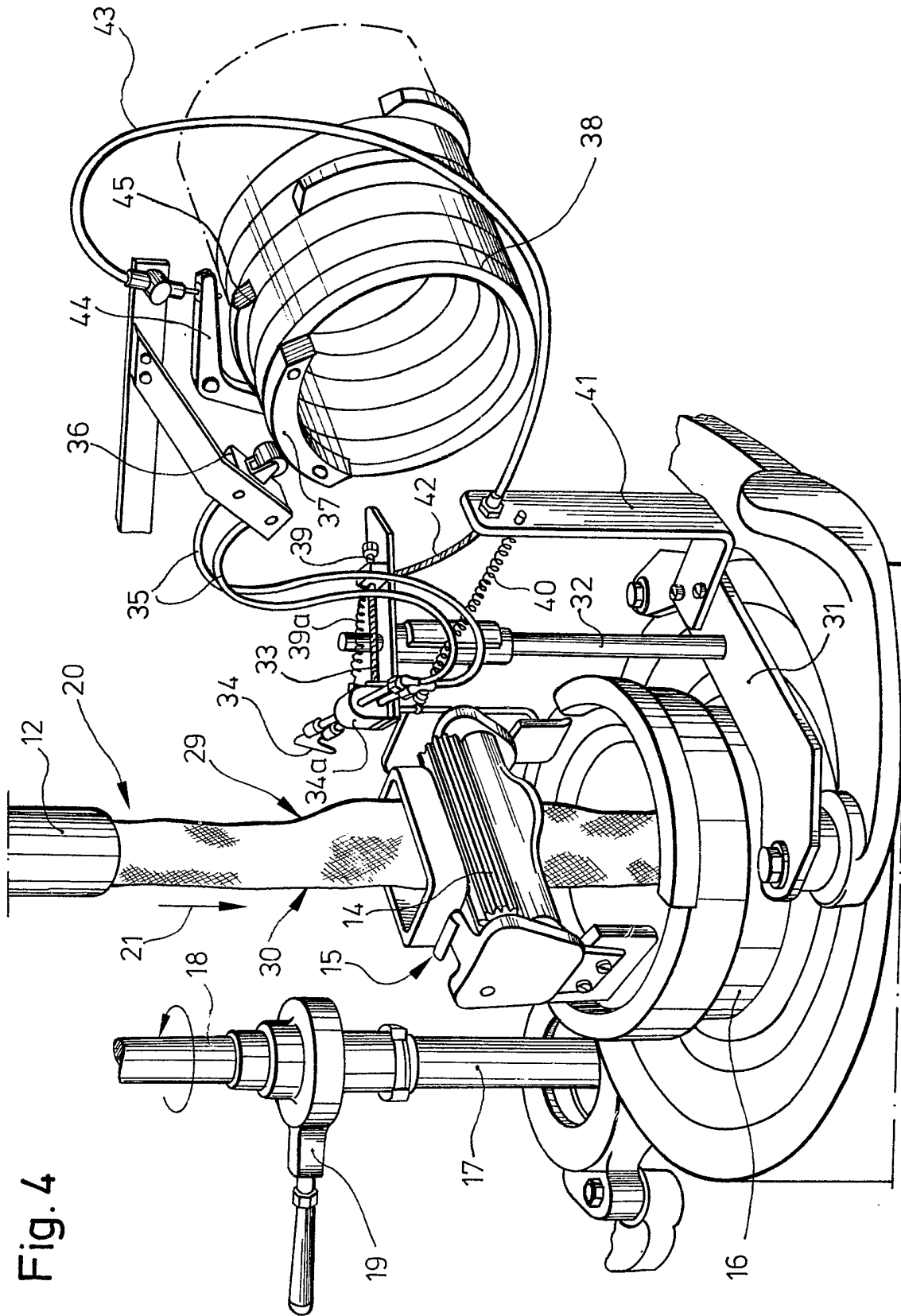


Fig.5

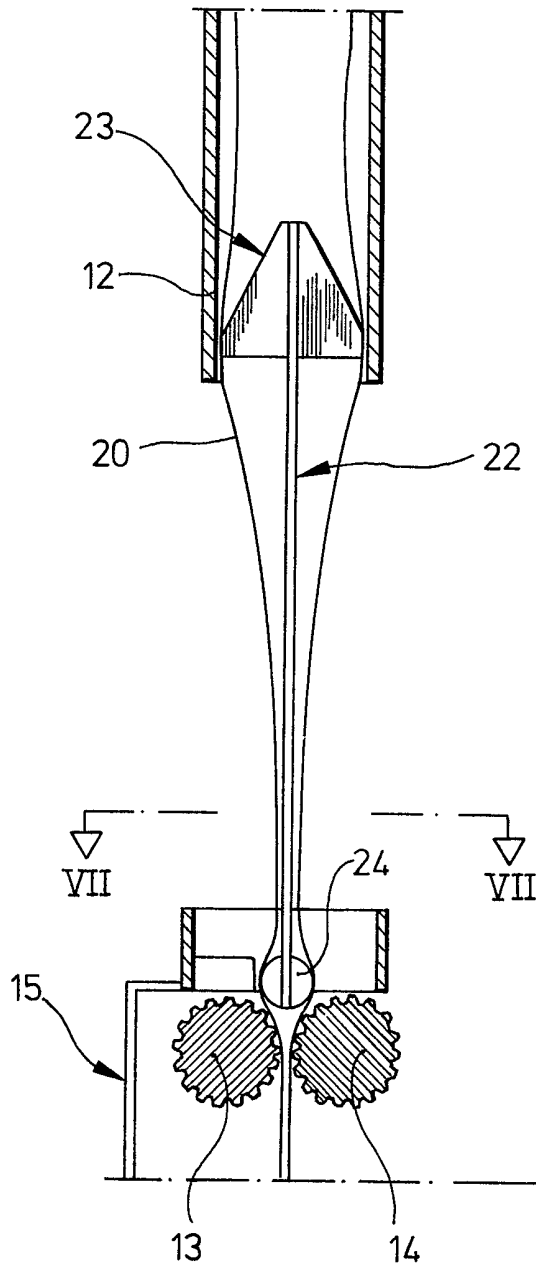
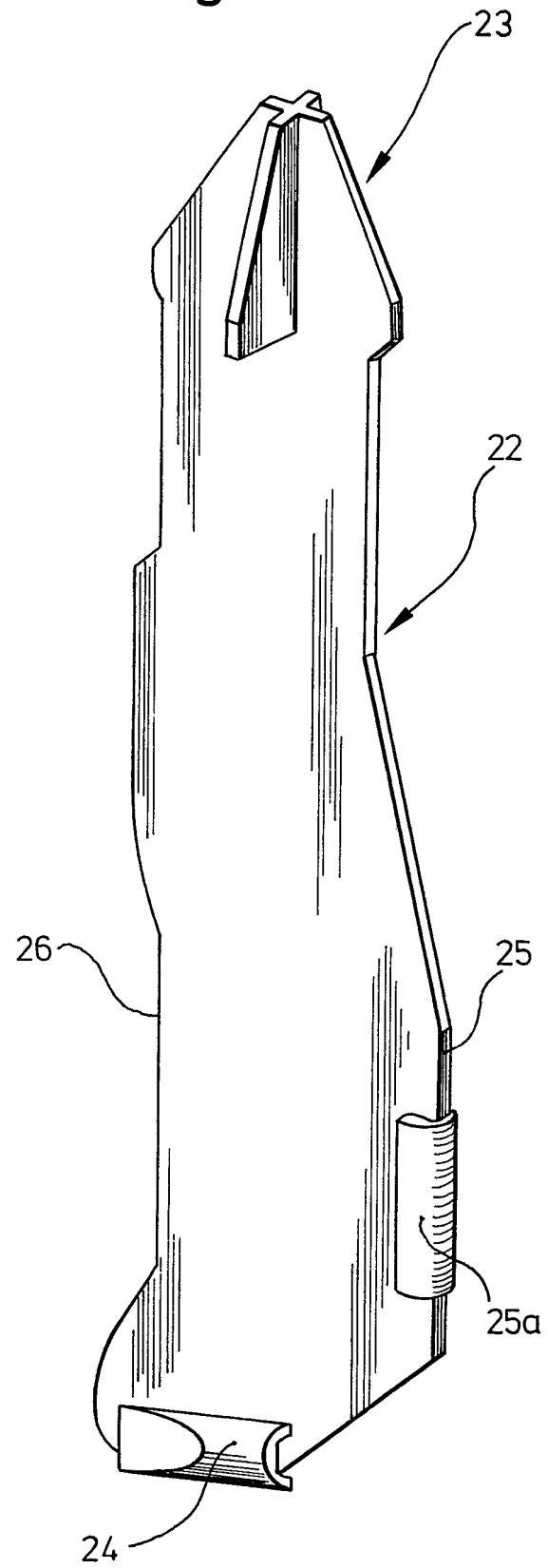


Fig.6



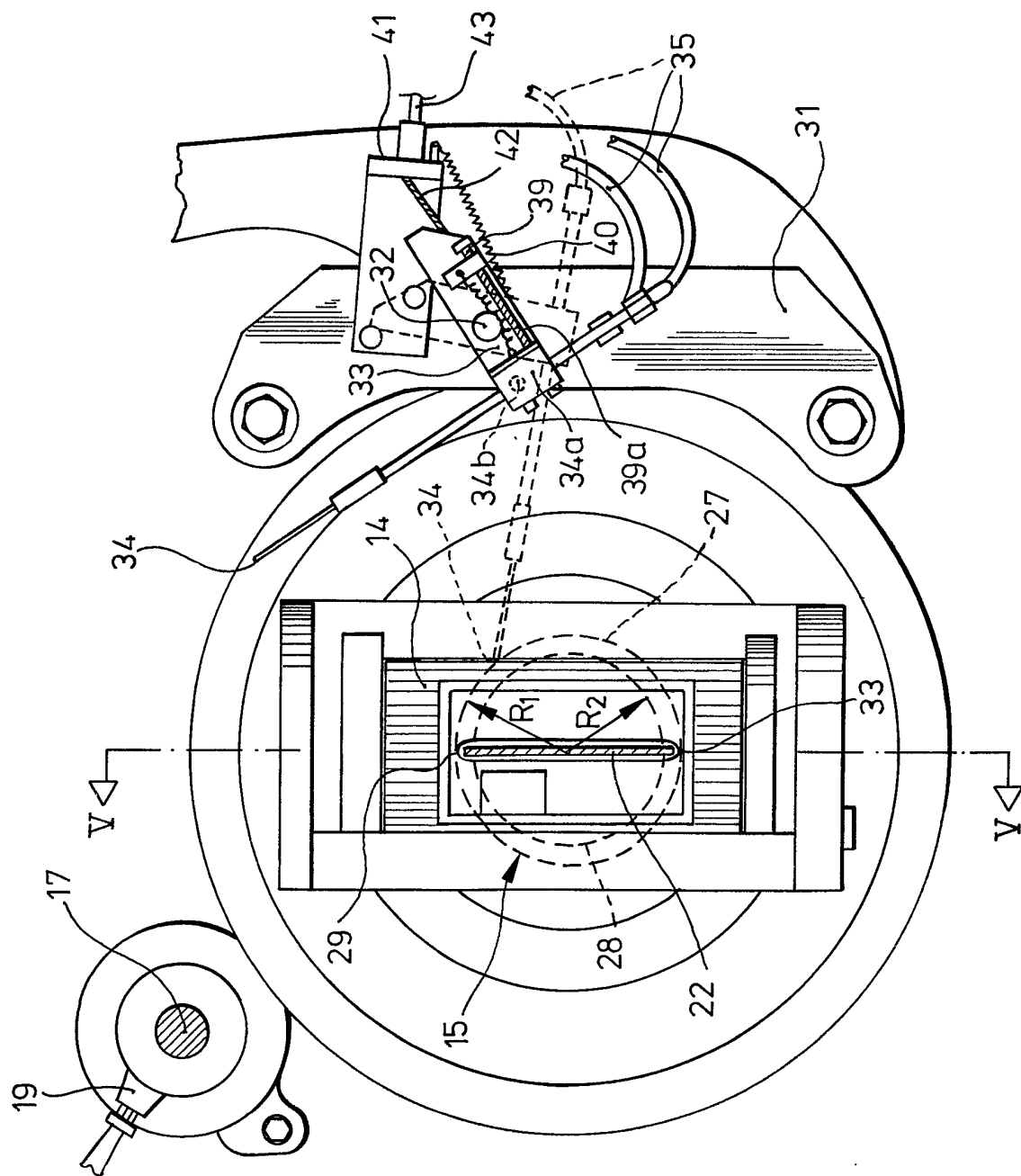


Fig. 7

SPECIFICATION

Fabrication and preparation for assembly of the component elements of so-called tights

- 5 The present invention relates to a process and apparatus for the fabrication and preparation for assembly of the component elements of so-called tights.
- 10 It is known that tights, that is the type of pantyhose having a length which is such that, during use, they come almost up to the user's waist, are composed of two side elements shaped in the form of stockings and an intermediate element, or so-called gusset.
- 15 The leg of each of the said side elements, which is longer than in conventional stockings, has an end portion which is opened longitudinally by means of a cut, and the edges of which are joined each to one of the edges of the gusset.
- 20 All these components of tights are fabricated on a circular knitting machine, generally of the double-cylinder type, in the form of tubular pieces, and are then prepared for assembly by being separated and cut longitudinally, this being carried out by hand.
- 25 The manual, preparatory operation of cutting the parts of the tights results in the production of about forty dozen pairs of tights for women and fortyeight/fifty dozen assorted types of tights for boys, in eight hours. The average cost per dozen, taking account of
- 30 the current industrial cost of manual labour, is about 1,300 lire per dozen.
- To this cost are added the inevitable disadvantages associated with the use of manual operations, that is inaccurate cutting and resulting wastage due
- 35 to lack of attention, fatigue and other factors.
- The object of the present invention is to avoid the disadvantages mentioned above and to lower the manufacturing costs for tights considerably, while simultaneously ensuring a qualitative improvement;
- 40 the whole without modifying the basic structure of the existing machinery, but limiting changes to simple adaptations which are easy to carry out on circular machines of known type.
- According to the present invention this object is
- 45 achieved by a process for the fabrication and preparation for assembly of the component elements of so-called "tights", characterised in that it consists of:
- a) the fabrication of these elements in the form
- 50 of tubular knitted-textile parts on a circular knitting machine with at least one cylinder, of the type having a rotatable hose-collecting reservoir provided with an inlet calender, situated below the duct through which the tubular textile produced by the
- 55 needle-cylinder is discharged, and
- b) cutting the tubular textile along a generatrix while the textile is passing through the space separating the lower end of the duct from the calender;
- 60 c) the said cutting being controlled by cams carried by the main drum of the machine, which in turn is driven by its respective chain.
- According to a preferred embodiment of the invention, a section of one of the edges or longitu-
- 65 dinal folds of the flattened, tubular textile located

upstream of the inlet to the calender, is maintained in a position radially further away from the common axis of rotation of the needle-cylinder, the duct and the hose-collecting reservoir than the other parts of

70 the textile passing through the zone between the outlet from the duct and the inlet to the calender, and in that, in order to cut the textile at the cylindrical surface through which the said section passes an incandescent electrical resistance is brought close to

75 the textile.

Other characteristics and advantages of the invention will become clearer from the description which follows with reference, by way of non-limiting example, to one embodiment illustrated in the

80 appended drawings, in which:

Figure 1 is a perspective view of a pair of tights to the manufacture whereof the present invention relates,

Figure 2 shows the same pair of tights in exploded, perspective view,

Figure 3 is a plan view of the semi-fabricated product including the parts which will be transformed into the component elements of the tights illustrated in *Figures 2* and *3*,

90 *Figure 4* is a partial perspective view of a circular stocking machine, modified to make it suitable for carrying out the process according to the invention,

Figure 5 is a vertical section taken on line V-V of *Figure 7*,

95 *Figure 6* is a perspective view of one of the elements shown in *Figure 5*,

Figure 7 is a section taken on line VII-VII of *Figure 5*.

The tights illustrated in *Figure 1* are composed of

100 two side elements 1 and 2 respectively and a central, intermediate element or so-called gusset 3. The elements 1 and 2 are both made in the form of stockings, each comprising a foot 4 and a leg part 5. This latter is longer than usual for stockings, so that

105 the upper edge 6 of the tights can come up substantially to the user's waist.

The end portion of each part 5, opposite the foot end 4 which is finished by a closing seam 7, has a longitudinal cut 8. The edges 9 of this cut are each

110 joined to one of the longitudinal edges 10 of the gusset 3, which is formed from a tubular textile piece cut along a generatrix.

According to the present invention, the elements 1, 2 and 3 from which the tights are assembled, are

115 fabricated on a single- or double-cylinder circular knitting machine. To this end, the circular knitting machine is programmed to produce identical groups of the three elements continuously. Each of these groups includes (see *Figure 3*): a tubular textile

120 portion 11 comprising a gusset part which will constitute the so-called gusset 3 followed by the leg part of a stocking which will constitute one of the side elements 1, 2 of the tights, and the associated foot 4, followed by the leg part 5 of the stocking

125 which will constitute the other side element of the tights and finally its associated foot. Several supplementary rows of knitting usable for the closing operations, are constructed, in a manner known *per se*, in continuance of the last row of each foot 4.

130 The ends of the various component elements of

each group, and those of the various groups, are connected together by means of separation threads which, in order easily to be identified, have a colour which contrasts with that of the yarn from which the elements of the tights themselves are made.

The tubular knitted textile fabricated, in a manner known *per se*, by the needle-cylinder or cylinders of the circular knitting machine progresses downwardly and leaves through the lower end of a duct 12 (Figures 4 and 5). After it has passed downwardly through a space 25 to 30 cm in length, this textile is grasped by the hose-drawing rollers 13 and 14 respectively of a calender generally indicated by the reference numeral 15.

The structure and operation of this calender, which is placed at the top of a hose-collecting reservoir 16, are well known and will not, therefore, be described in detail. It suffices to emphasise the fact that the reservoir 16 and the calender 15 overlying it are coaxial with the needle-cylinder and with the duct 12 of the machine and rotate in perfect synchronism therewith. The drive for the group comprising the calender 15 and the reservoir 16 is taken from the drive for the needle-cylinder through a transmission which includes aligned drive shafts 17 and 18 which are interconnected by means of a clutch 19. This latter can be opened to allow the relative phasing of the needle-cylinder and the calender-reservoir group to be adjusted as desired.

The tubular textile 20 (see Figure 4), which moves downwardly in the direction of the arrow 21, is flattened by the rollers 13, 14 of the calender 15 so that it takes on the form of a double-layered strip of knitted textile.

Into this double layered strip, or flattened tube, is introduced a shaping element best seen in Figure 6. This has the form of an elongate plate 22, preferably of metal, which is thin but sufficiently rigid to give it stability of form under the working conditions of the machine. Its upper part 23, which is inserted in the lower end portion of the duct 12, has a transverse section in the form of an equilateral cross and a tapered end portion in order to facilitate its introduction into the duct. The lower edge of the plate 22, on the other hand, has a thickened part 24, essentially of circular cross-section, which bears, with the interposition of the tubular textile 20, against the upper, facing portions of the rollers 13 and 14. Since the upper portions of the cross-shaped transverse-section, which precede the tapered portion of this part, centre the shaping element 22 relative to the duct 12, even with the interposition of the textile 20, the common axis of rotation of the needle-cylinder, the duct 20 and the calender 15 lies in the plane of the shaping element constituted by the plate 22.

One of the longitudinal edges of the shaping element 22 has a radially outer section 25, a small distance from the calender 15, which, when the shaping element is mounted in its operative position described above, is parallel to the said common axis of rotation and spaced therefrom further than any point on the opposite longitudinal edge of the shaping element. In particular, the other edge of the shaping element, at the same height, has a cut-away portion defined by a radially-inner, vertical section

26 closer to the said axis of rotation than the said section 25. Consequently, during the simultaneous rotation of the cylinder, the duct 12 and the calender 15 with the hose-collecting reservoir, the radially-outer section 25 describes a cylindrical surface 27 (Figure 7) and the radially-inner section 26 of the shaping element a cylindrical surface 28 of radius R_2 less than the radius R_1 of the cylindrical surface 27. Hence the edge 29 of the flattened portion of the tubular textile 20 which flows downwardly along the section 25 of the shaping element moves along the said cylindrical surface 27 having the diameter R_1 . The diametrically opposite edge 30 of the said flattened portion of the tubular textile moves simultaneously along a cylindrical surface the radius of which is considerably less than the radius R_1 .

Consequently, during the rotation of the needle-cylinder and of the calender-reservoir group, the aforesaid edge 29 will constantly be at a distance from the axis of rotation of the said elements which is greater than that of all other points on the textile, which descends towards the calender 15, from the said axis. This effect is used to achieve, in a simple manner, the required cutting of the tubular textile which leaves the duct 12 and which descends through the calender 15 into the hose-collecting reservoir 16.

To this end, an arm 33 is mounted on a fixed support plate 31 (see Figure 4) for rotation about a pivot 32 projecting upwardly from the said plate. On one end of the arm is an electrical resistance 34 supplied by means of conductors 35 connectable to an electrical power supply (not illustrated) through the switch 36 which is normally open. Closure of this switch is controlled by the action of cams 37 (only one of which is indicated in Figure 4) mounted on the periphery of the main drum 38 of the machine.

The angular position of the resistance 34 relative to the arm 33 may be adjusted by means of the screw 39 which acts as an adjustable stop against which the spring 39a pulls the support 34a, which is rotatable about the pivot 34b carrying the resistance 34. A spring 40, connected between the arm 33 and a right-angled bracket 41 fixed to the support 31, biases the arm 33 to rotate in a anti-clockwise sense (viewed from above), to bring the resistance 34 close to the surface traversed by the said section 25 of one of the longitudinal edges of the shaping element covered by the fold 29 (see Figure 4) of the flattened tubular textile. To the other end of the arm 33 is fixed the core 42 of a Bowden cable having a sheath 43. The other end of this core 42 is fixed to the bellcrank lever 44 controlled by the cams 45 carried by the main drum 38. The arrangement is such that, when one of the cams 45 acts on the bellcrank lever 44, the lever 33 is rotated, against the action of the spring 40, from the position illustrated in broken outline in Figure 7 to the position shown by a continuous line in the same Figure.

At the same time as the resistance 34 approaches the surface over which the fold 29 of the textile passes, the cam 37 releases the microswitch 36 and the resistance 4 is supplied with current, causing instantaneous incandescence.

Consequently, while the resistance is in the posi-

tion illustrated in broken outline in Figure 7, at each revolution of the needle-cylinder and calender, the fold 29 of the flattened tubular textile 20 which covers the section 25 of the shaping element comes into contact with the incandescent resistance which thus cuts the knitted textile along the said textile part.

The section 25 of the edge 29 of the shaping element is conveniently covered with a small plate 25a of refractory material in order to prevent short-circuiting and premature destruction of the shaping element due to repeated contact with the incandescent resistance.

Since, as is known, the rollers 13 and 14 of the calender advance the tubular textile formed by the machine by a small distance at each revolution of the needle-cylinder, as long as the resistance is in the position illustrated in broken outline in Figure 7, this tubular textile, as it advances, is cut along the generatrix which coincides with the section 25 of the shaping element.

Thus, by arranging the cams 45 appropriately on the main drum 38, one can effect the cutting of the tube 11, intended to constitute the gusset, and subsequently the cuts 8 in the tubular side elements 1 and 2 (see Figures 1 to 3) following that which will be used as the gusset.

The fabrication of an entire group constituted by the tubular textile portion which will become the gusset and those which will become the side elements of the tights coincides with a complete revolution of the drive chain of the machine. At each successive revolution a further group is constructed and so on.

On leaving the circular knitting machine, these groups may be separated from each other and, similarly, the component elements of the various groups may also be separated from each other. This is facilitated by the fact that these groups and the various elements of the individual groups are connected together by separation threads of a colour which contrasts with the colour of the base yarn from which the tubular textile is constructed continuously.

If it is desired to move the position of the generatrix along which the cutting is effected, it suffices to open the clutch 19 and to rotate the calender, the needle cylinder being stopped, or *vice versa*.

Naturally, the principle of the invention remaining the same, its details may be varied widely with respect to that described above and illustrated in the enclosed drawings, without thereby departing from the scope of the present invention.

Thus, for example the cutting of the textile could be effected with means other than a resistance. Indeed, an abrasive wheel could be used and could be controlled and carried, like the resistance 34, by the arm 33, the position of which is variable with respect to the shaping element, or by a support arranged to follow the rotation of the tubular textile which flows downwardly guided and modelled by the common action of the shaping element 22 and the calender 15.

CLAIMS

1. A process, for the fabrication and preparation for assembly of the component elements of so-called "tights", characterised in that it consists of:
 - a) the fabrication of these elements in the form of tubular knitted-textile parts on a circular knitting machine with at least one cylinder, of the type having a rotatable hose-collecting reservoir (16) provided with an inlet calender (15), situated below a duct (12) through which the tubular textile (20) produced by the needle-cylinder is discharged,
 - b) cutting the tubular textile along a generatrix while the textile is passing through the space separating the lower end of the duct (12) from the calender (15);
 - c) controlling said cutting by cams (37, 45) carried by a main drum (38) of the machine, which in turn is synchronously driven by its associated drive chain.

2. A process, as claimed in Claim 1, characterised in that a section of one of the edges, or longitudinal folds, (29, 30) of the flattened, tubular textile 20 located upstream of the inlet to the calender (15) is maintained in a position radially further away from the common axis of rotation of the needle-cylinder, the duct (12) and the hose-collecting reservoir (16) than the other parts of the textile passing through the zone between the outlet from the duct and the inlet to the calender, and in that, in order to cut the textile at the cylindrical surface through which the said section passes an incandescent electrical resistance (34) is brought close to the textile.

3. A process, as claimed in Claim 2, characterised in that the said resistance (34) is carried by a support fixed to an arm (33) which is rotatable about an axis (32) parallel to the common axis of rotation of the needle-cylinder, its duct (12) and the hose-collecting reservoir (16), and in that this arm (33) is constantly acted upon by a spring (40) which biases the resistance (34) towards the said cylindrical surface; the said arm (33) on which the support for the resistance (34) is mounted being acted upon by a Bowden cable (42, 43) controlled, through a lever (44), by the cams (45) situated on the main drum (38) of the machine.

4. A process, as claimed in Claim 3, characterised in that a microswitch (36) is connected in the circuit for the resistance (34), the closure of the switch being controlled by the cams (37) carried by the main.

5. A process, as claimed in any one of Claims 1 to 4, characterised in that the rotation of the main cylinder of the machine and of its duct (12) is controlled by the drive chain which is arranged to make the circular knitting machine fabricate, at each complete revolution of the said chain, a group, or complex, constituted by a length of tubular textile (11), intended to be made into a gusset, connected at its free end to the leg part (5) of one of the side elements (1, 2) of the tights, the foot part (4) of which is connected to the free end of the leg part (5) of the other side element of the tights, followed by the respective foot part (4).

6. A process, as claimed in Claim 5, characterised

in that the said groups, or complexes, of the three elements specified above and the elements themselves of the various groups are connected together by means of separation threads.

7. A process, as claimed in Claim 6, characterised in that the said separation threads are of a colour which contrasts with the colour of the base yarn used for the construction of the tubular textile (20) which is to be made into tights.

8. A process, as claimed in Claim 2, characterised in that, in order to maintain the position of one of the edges (29, 30) of the flattened textile in that part of its path in which the tubular textile passes between the lower outlet from the duct (12) and the inlet to the

calender (15) - at a greater distance from the common axis of rotation of the needle-cylinder, the duct (12) and the hose-collecting reservoir (16), than the other parts of the textile passing through the said part of the path, a shaping element is inserted in the said tubular textile, the shaping element having an enlarged part (24) on its lower edge, which is of substantially circular transverse section and which bears, with the interposition of the tubular textile (20) against the upper, mutually-converging parts of rollers (13, 14) of the calender (15) and which is provided, at its other end, with means (23) for centering it with respect to the duct (12).

9. A process, as claimed in Claim 8, characterised in that the said centering means (23) comprise ribs arranged perpendicular to the plane of the plate (22) constituting the shaping element, so as to form an equilateral cross in transverse section.

10. A process, as claimed in Claim 9, characterised in that the said equilateral-cross section has a tapered end part in order to facilitate the introduction of the shaping element into the lower part of the duct (12).

11. A process as claimed in any one of Claims 8 to 10, characterised in that a section (25) of one of the longitudinal edges of the shaping element is covered with a refractory material.

12. A process, as claimed in any one of Claims 8 to 11, characterised in that the said shaping element is made from metal.

13. A single-cylinder or double-cylinder circular stocking machine of the type having a hose-collecting reservoir (16) provided with an inlet calender (15) situated below the duct (12) through which the tubular textile (20) produced by the needle-cylinder passes, characterised in that it is provided with means (22) for maintaining one part of the tubular textile, during its movement from the duct to the calender, protruding further from the common axis of rotation of the cylinder and the reservoir than the other parts of the said textile, and in that it includes cutting members (34) arranged to act on the said protruding part of the textile at each revolution of the cylinder.

14. A machine, as claimed in Claim 13, characterised in that the said means are constituted by a shaping element in the form of an elongate plate (22) the upper part of which can be inserted into the end part of the duct (12) or of the cylinder, the shaping element having centering elements (23) and the lower edge thereof having an enlarged part (24) of

essentially circular transverse section intended to bear on the rollers (13, 14) of the calender (15), the said plate (22) being shaped such that one of its opposite longitudinal edges, a small distance from its lower edge, has a section (25) parallel to the axis of rotation of the shaping element and spaced further from this axis than any part of the opposite longitudinal edge of the shaping element itself.

15. A machine as claimed in Claim 13 or 14, characterised in that the said cutting members are constituted by an electrical resistance (24) touching the circular path (27) of the part of the tubular textile (20) which flows along the said means adapted to maintain it protruding further from the axis of the cylinder.

16. A machine, as claimed in Claim 15, characterised in that the said resistance (24) is carried by an arm (33) rotatable about a pivot (32) parallel to the axis of the cylinder, and is supplied through a switch (36), the closure of which is controlled by at least one cam (37) carried by the main drum (38) of the machine.

17. A machine, as claimed in Claim 16, characterised in that the said main drum (38) also carries at least one cam (45) arranged to displace, by means of a Bowden transmission (42, 43), the said arm (33) between a position in which the resistance (34) lies in the path (27) of the most protruding part of the textile (20) and a position in which the said resistance (24) is displaced radially away from this path.

18. A machine, as claimed in one of Claims 14 to 17, characterised in that the section (25), furthest from the axis of rotation, of one of the longitudinal edges of the plate (22) constituting the shaping element is covered with a refractory material (25a).

19. An industrial product manufactured by carrying out the process according to any one of Claims 1 to 12, characterised in that it comprises a group, or complex, constituted by a portion of tubular textile having a length corresponding to that of the gusset of a pair of tights, joined by means of a separation thread to the free end of the leg part (5) of one of the side elements (1, 2) including the stocking part of the tights, the foot part (4) of which is joined, by means of a separation thread, to the free end of the leg part (5) of the other stocking side element (1, 2), followed by the associated foot (5).