

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
7 March 2002 (07.03.2002)

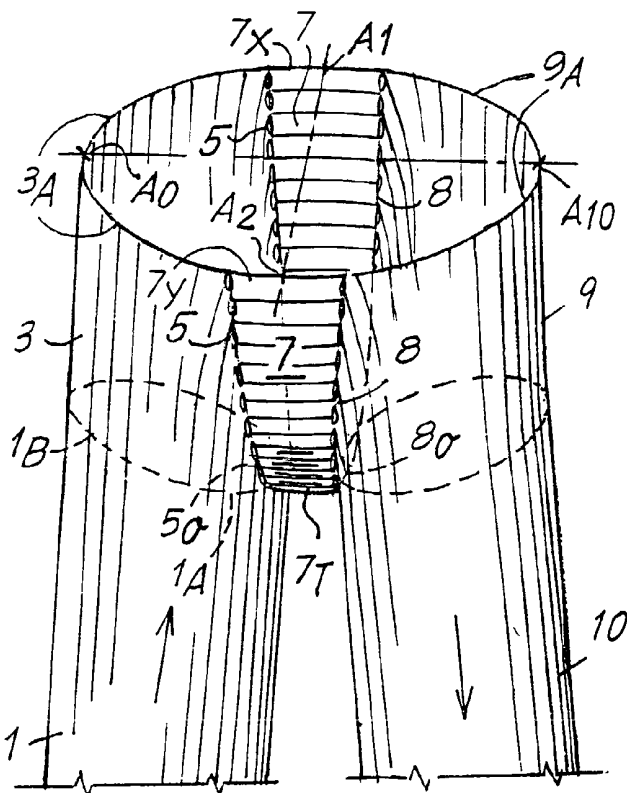
PCT

(10) International Publication Number
WO 02/18689 A2

- (51) International Patent Classification⁷: **D04B** (74) Agents: **MANNUCCI, Michele** et al.; Via della Scala, 4, I-50123 Firenze (IT).
- (21) International Application Number: PCT/IT01/00440
- (22) International Filing Date: 7 August 2001 (07.08.2001) (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: FI2000A000184 28 August 2000 (28.08.2000) IT
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- (72) Inventor; and (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
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(54) Title: METHOD FOR FORMING, IN A SINGLE UNINTERRUPTED OPERATION, A KNITTED GARMENT, SUCH AS A PANTY HOSE, BRIEFS OR SHORTS, WITHOUT ASSEMBLING SEAMS, ON A SINGLE-CYLINDER CIRCULAR MACHINE; GARMENT THUS OBTAINED AND DEVICES FOR IMPLEMENTING SAID METHOD



(57) Abstract: In sequence the following steps are performed: formation of a first leg piece (1); formation of a first side portion (3) of the body piece, with gradual reduction (decrements) in the rows of stitches until processing with the needles of a partial arc is terminated, with reduction of one needle at each end every four rows; finishing and movement away of the end (3A); formation of a central band (7) of fabric along the "crutch" with the needles of the residual arc, with a desired plurality of rows which extend along the line of the crutch, and with loose stitches, the stitches (5) of a row being fastened to each of the stitches of the first row of said central band (7) every four rows of the side portion (3); formation of a second side portion (9) of the body piece, with increments (8) by means of renewed operation of a needle every four rows; formation of the second leg piece (10) with all the needles.



Published:

— without international search report and to be republished
upon receipt of that report

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"METHOD FOR FORMING, IN A SINGLE UNINTERRUPTED OPERATION,
A KNITTED GARMENT, SUCH AS A PANTY HOSE, BRIEFS OR SHORTS,
WITHOUT ASSEMBLING SEAMS, ON A SINGLE-CYLINDER CIRCULAR
MACHINE; GARMENT THUS OBTAINED AND DEVICES FOR
5 IMPLEMENTING SAID METHOD"

DESCRIPTION

According to the technique currently applicable, panty hose are made
by assembling by sewing the individual parts which form them (leg pieces,
10 body piece, and optionally - but very frequently - a so-called gusset in the
region of the crutch) and which are knitted beforehand separately from each
other. This involves two drawbacks, both of which are fairly major: the
separate use of several machines and devices, which negatively affects the
time required for manufacture of the article; the presence of the assembling
15 seams in the finished garment.

Various attempts have therefore been made to obtain the manufacture
of a panty hose using a single machine, in a single uninterrupted operation
and without assembling seams.

This aim appears to have been satisfactorily achieved with the
20 invention described in the GOLDEN LADY Italian patents (inventor Paolo
Conti) No. 1,286,874 filed on 6 November 1996 and No. 1,294,827 filed on 24
July 1997.

Said patents, however, relate to a machine consisting of an assembly
of two single-cylinder circular machines and a "frontal" type straight textile
25 machine; a combination of machines, therefore, which is fairly complex and
costly.

However, hitherto, it has not been possible to attain a more ambitious
goal: that of manufacturing a panty hose in a single uninterrupted operation
and without assembling seams using a normal single-cylinder knitting
30 machine.

In the past, and also in a fairly recent past, various attempts have been
made in this connection. The following patents may be mentioned: Italy No.

982,087 BILLI S.p.A.; Germany No. 818,542 LACKS; USA No. 3,075,375 GARROU et al; Italy No. 1,058,099 MATEC; USA No. 3,292,392 LUCHI; Italy No. 841,975 LUCHI; UK No. 1,460,670 BILLI.

However, all the aforementioned inventions have been unable to
5 achieve the predefined goal of their inventors - and, therefore, have not found
a practical application in industry - because their use produced and would
produce a panty hose having a "body piece" with extremely small dimensions,
such as to make the garment thus manufactured even unwearable, and
therefore entirely unsuitable for its function. It may also be pointed out,
10 moreover, that these inventions have given rise to another drawback, even
though "secondary" and of lesser importance; namely that, during formation of
the first part of the "body piece" of the panty hose, immediately following the
formation of the first leg piece, and during the step immediately preceding the
formation of the second leg piece, the cylinder of the machine must operate
15 only with an alternating rotational movement, at a speed less than that which
can be obtained if it is made to operate with a continuous movement.

A first object of the invention concerns a method for the formation of a
garment of the panty hose type, with two leg pieces and a body piece, directly
by means of a circular machine for knitwear and in particular stockings with a
20 needle cylinder performing a continuous and/or alternating rotational
movement.

A second object of the invention concerns a garment obtained with the
above method.

A third object of the invention includes a circular machine for stockings
25 and the like for implementing the above method, as well as devices to be
combined with said machine.

Substantially the method in question comprises in combination and in
sequence the steps of:

- A) - formation of a first leg piece with all the needles;
- 30 B) - formation of a first side portion of the body piece, with a gradual
reduction (decrements) in the rows of stitches and needles operating along a
partial arc, until processing with the needles of the arc complementary to the

preceding arc is terminated, each individual reduction being performed approximately every n rows (where n is preferably between three and five);

C) - finishing and interruption of operation of the needles of said
5 explementary arc and movement away of the end of the first side portion of
the fabric from said arc;

D) - formation of a central band of fabric along the "crutch" with the
needles of the said partial arc with a desired plurality of rows which extend
along the line of the crutch, and with loose stitches, the stitches of a row being
fastened to each of the stitches of the first row of said central band every n
10 rows of said first side portion;

E) - renewed operation of the needles of the explementary arc and
initial formation of a second side portion of the body piece, with increments
obtained by means of renewed operation of a needle every n rows along the
abovementioned partial arc, and with joining of the last row of said central
15 band along the increments of said second side portion;

F) - formation of the second leg piece with all the needles.

A particular development of the invention consists in a new processing
method - applicable to a single-cylinder circular knitting machine - which
allows the production in a single uninterrupted operation on a machine of this
20 type, by means of minor modifications, of an article such as panty hose or
briefs or shorts or the like, without assembling seams, the body piece having
a suitable height and any desired width considered necessary.

With reference to the proposed manufacture of panty hose or shorts,
this method consists of six steps:

25 - First step: formation, according to the system ordinarily used, of one
of the two leg pieces of the garment;

 - Second step: formation of a first side portion of the body piece located
above said first leg piece already formed, by means of the gradual reduction
in the number of working needles, with exclusion from operation of a needle
30 after a certain number of rows of stitches, depending on the dimensions which
are to be given to the body piece and the quality of the yarn, with the
formation, along the upper part of this portion of the body piece, of a double

fabric edge, also obtained by the needles of the cylinder of the machine with the aid of sinkers. Since, for these purposes, the rows of stitches of the fabric are unable to form the entire circumference of a circle, but only an arc of a circle, in order to allow the cylinder of the machine to achieve formation thereof operating with a continuous rotating - and not alternating - movement, the action of an additional yarn guide - of the ordinary type, but use of which is not envisaged in normal knitting machines - is introduced, which yarn guide, in order to prevent the row of stitches already formed from coming loose, fastens the end portion thereof;

10 - Third step: once formation of said first side portion of the body piece located above the first leg piece of the pant hose has been completed, the cylinder of the machine then forms the central part of the body piece itself with rows of stitches parallel to the "crutch". According to the method described here, the body piece is provided with the heightwise and widthwise
15 dimensions, which are considered necessary and desirable, by means of the formation of said central part with stitches which are looser, i.e. untensioned and "slackened", and therefore wider, obtained with a greater length of the stroke of the needles. During this step a double fabric edge, also obtained by the needles of the machine cylinder with the aid of sinkers, is simultaneously
20 formed along the upper circumference or waistline of said part of the garment;

 - Fourth step: subsequent renewed increase in the number of working needles, until they have all been reintroduced into the working process, in order to join said central part of the body piece to that of the additional side portion thereof, underneath which the second leg-piece of the garment must
25 be situated;

 - Fifth step: completion of the body piece with the formation of the second side portion thereof, underneath which the second leg piece of the garment must be situated - and which is therefore symmetrical with that described in the explanation of the second step of the working process - by
30 means of the gradual increase in the number of working needles, in order to join the shape of this second side portion of the body piece to that of the central part thereof;

- Sixth step: formation of the second leg piece of the garment.

All of the above will emerge more clearly from the description which follows.

Obviously, in the case of production of ordinary briefs without leg
5 pieces, the operations described in steps 1 to 6 will be limited to the sole formation of the side portions of the body piece.

Other characteristic features of the method, the garment manufactured with said method, the machine and the devices combined therewith are defined by the further claims at the end of this description.

10 The invention will be better understood with reference to the description and the attached drawing which shows a practical non-limiting example of the invention itself. In the drawing:

Figs. 1 to 12 show, in perspective and summary form, various steps of the method, Fig. 5 showing the garment being formed in the step of Fig. 4, but
15 in the condition assumed when the garment is worn, and Fig. 11 being a view along the line XI-XI of Fig. 10 and Fig. 12 showing the garment when worn;

Figs. 13, 13A, 13B and 13C show a detail and enlarged features of the knitted fabrics in the zone of the body piece;

Fig. 14 shows a variant of Fig. 13C;

20 Figs. 15 to 21 show, similar to Figs. 3,4,6,7,8,9 and 10, the steps of the method in which the garment is also provided with a tubular double-edge finish along the waistline;

Figs. 22 to 26 show various - plan and perspective - views of a device for forming a reinforcement during continuous rotational operation for the
25 formation of side portions of the body piece;

Figs. 27 to 31 show a cross-sectional view and various perspective views of a device for the formation of a finish at the ends of the central band of the body piece, in alignment with the tubular double-edge finishes of Figs.
15 to 21;

30 Figs. 32 to 36 show the steps for formation of the finish according to Figs. 27 to 31.

Figs. 1 to 12 illustrate the steps of the method for forming leg pieces

and body piece of the garment of the panty hose type, independently of the finishes along the edge which correspond to the waistline.

Fig. 1 shows the formation of a first leg piece 1 with all the needles 2 of the needle cylinder of a circular knitting machine, of which A1, A2, A0 and A10 indicate some of the characteristic points on the needle circumference. For the formation of the leg piece all the needles of the needle circumference are used; similarly for the formation of the second leg piece 10 (see in particular also Figs. 10 to 12) again all the needles of the needle circumference are used. The body piece comprises a first side portion 3 (formed with a main yarn 30), an intermediate band 7 (formed with a main yarn 70) which extends along the so-called crutch line, and a second side portion 9 symmetrical with the portion 3; the second leg piece 10 is then formed. In order to form the first side portion 3 with the main yarn 30, initially all the needles of the needle cylinder of the machine are used with gradual reductions until only the needles of the arc A1, A0, A2 are used to form the end edge 3A along a portion of the waistline. In order to form the band 7, the needles of the arc A1, A10, A2 are used in the manner described below. In order to form the second side portion 9, symmetrical with the portion 3, initially the needles of the arc A1, A0, A2 (freed from the fabric of the first side portion 3) are used and the operation continues with increments until all the needles on the needle circumference of the machine are used, and the formation of the second leg piece 10 is then performed, with formation of the fabric in the opposite direction to that in which the first leg piece 1 is formed, namely from the body piece towards the end of the leg piece 10, while the first leg piece 1 is made starting from the tip, i.e. from the foot towards the body piece.

More particularly, when during formation of the leg piece 1 the line which is indicated by 1A, 1B in the drawing is reached, formation of the first side portion 3 of the body piece commences, initiating a gradual reduction in the working needles, from the point A10 of the needle circumference, gradually reducing the working needles for formation of said portion 3 with the exclusion of a needle after every n rows of stitches, for example after every four rows of stitches. A reduced profile 5 of the fabric of the first side portion 3

is thus obtained; the profile 5 extends, at the end of processing of the portion 3, as can be seen from the sequence of Figs. 1, 2 and 3, as far as the minimum arc A1, A0, A2 of working needles for the formation of said first side portion 3, i.e. as far as the end 3A of the waistline. At this point a suitable finish is advantageously provided on the final edge 3A of the portion 3, which edge 3A extends along the needle arc A1, A0, A2; a suitable finish will be indicated by way of example and preference below. The fabric of the first side portion 3A is then abandoned, so that the edge 3A and any suitable finish associated therewith is in the condition shown by way of example in Fig. 4, while along the profile 5 the fabric of the garment being formed is kept engaged with the arc of needles A1, A10, A2, each of the needles of this arc engaging with a row every n - and in particular for example every four - rows which have formed the first side portion 3.

The situation indicated in Fig. 4 is thus achieved, with the arc of needles A1, A0, A2 free and non-operative and with the arc of needles A1, A10, A2 which engage with the profile 5 delimiting the first side portion 3 with a number of rows of stitches of this portion 3 which is four times the number of needles of the arc A1, A10, A2. Fig. 13 clearly shows the rows of end stitches along the profile 5 where it is possible to note - viewing the right-hand side - the presence of stitch loops B1, B2, B3, etc., which are engaged by the successive needles forming part of the arc A1, A10, A2, while the stitch loops B11, B12, B13 of the rows forming the side portion 3, included between the rows to which the loops B1 and B2 belong, are not engaged by the needles, as are not the end stitch loops B21, B22, B23 of the rows included between the row to which the loop B2 belongs and the row to which the loop B3 belongs, and so on for the rows included between the end loops B3 and B4 and so on. Fig. 5 shows the article being formed, as in the portion obtained during the step in Fig. 4, but shown in the condition in which this portion takes in the worn article.

At this point formation - with a main yarn 70 - of the central band of fabric 7 commences, which band once the article is finished and worn, extends along the crutch line of the finished garment; this central band is

formed with the needles of the arc A1, A10, A2 performing a continuous (or optionally alternating) movement. It may be noted in particular from Figs. 13 that the band 7 is formed with relatively very wide stitches, starting with a row of stitches 7A which engages with the stitch loops B1, B2, B3, B4, etc. and continuing with a number of rows of stitches which may be any desired number so as to obtain any width of the central band 7 and thus the desired dimensions of the body piece widthwise, while the loose stitches of the central band 7 ensure a sufficient extension of the lengthwise dimensions of the crutch. The stitches of the band 7 will each have a width corresponding to that of the stitches of four adjacent partial rows of the portions 3 and 9. It may be noted in particular from Fig. 6 that, during formation of the band 7, the rows of stitches which form it extend perpendicularly to the rows of stitches which formed the leg piece 1 and the first side portion 3. The number of rows of stitches which form the band 7 is undefined in the sense that rows of stitches may be formed in any desired number in order to obtain formation of the body piece in combination with the two side portions 3 and 9. The sole constraint to which the formation of the band 7 of fabric is subject is the number of needles of the arc A1, A10, A2, the needles of which are intended for the formation of said band 7; this is equivalent - by way of difference - to a corresponding number of needles which are assigned for formation of the end edge 3A and the corresponding leading edge 9A of the two side portions 3 and 9, respectively, which together with the widthwise extension of the central band 7 and in particular the end edges 7X, 7Y of the rows of stitches of the central band 7 must form the waistline.

Clearly, the smaller the number of needles of the arc A1, A10, A2, the smaller the number of stitches of the rows which are formed with the needles of this arc to form the central band 7, but the rows which form the central band 7 may also be very numerous, without particularly influencing the structure of the article; the wide - i.e. loose - stitches of the central band 7 allow an extension of the band 7 itself sufficient to form a crutch line deep enough for proper fitting of the garment on the body of the person wearing the garment.

The band 7 may be made with a yarn 70 different from that with which

the side portions 3 and 9 are formed, this yarn being able to possess a greater coarseness and/or suitable elasticity, so as to obtain the desired result for the purposes of wearability of the finished garment. The band 7 may be finished along the terminal lines 7X and 7Y in any suitable manner as better explained in an example described below, and the end zones of the band 7, adjacent to the end lines 7X may be formed with an additional yarn or with a yarn having different characteristics, in particular, as regards coarseness and elasticity, compared to the rest of the band 7. The band 7 may also be formed with a suitable gusset such as that indicated by 7T, in an intermediate position along the overall extension of said band 7, in order to reinforce - as frequently required for garments of the kind in question - the bottom zone of said band 7 which extends along the crutch line.

At the end of formation of the band 7, the needles of the arc A1, A10, A2 form the row of end stitches 7B of said band 7, which is symmetrical with respect to the first row of stitches 7A of the band 7 which have engaged with the loops B1, B2, B3, B4, etc.

In these conditions, shown in Fig. 6, the formation of the second side portion 9 of the body piece is commenced, initially - by means of the needles of the arc A1, A0, A2 - with the edge 9A, which may be equipped with a suitable finish similar to that which may be envisaged along the edge 3A of the first side portion 3, this finish being performed first in order to start off the formation of said second side portion 9. Fig. 7 shows the formation of the leading end 9A (which may be equipped with a preliminary finish) and the start of formation of the fabric of said second side portion 9 with increments of the rows of stitches of the fabric 9 along the line 8, i.e. with the insertion of additional needles at the two ends of the arc A1, A0, A2, i.e. initially inserting gradually the needles adjacent to the arc A1, A0, A2 and forming part of the arcs A1, A10 and A2, A10; the formation of said second portion is performed by increasing gradually the needles from the point A1 to the point A10 and from the point A2 to the point A10 and introducing operation of a needle of these arcs after the formation of n rows of fabric of the second end portion 9, in practice for example introducing a needle at each end of the arc of needles

instantaneously in operation, every four rows of stitches formed with the needles already in operation. A profile 8 joining together the fabric of the band 7 (along the row of stitches 7B) and the fabric of the second side portion 9 is thus formed; this profile 8 corresponds to and is symmetrical with the profile 5 already formed. Given the procedure for insertion of the needles in order to form the increments of the second portion 9 - which is equivalent to, but the reverse of procedure for reduction of the working needles during the formation of the first side portion 3 of the body piece - the two profiles 5 and 8 which flank the central band 7 are identical and in particular both these two profiles are defined by eyelets, i.e. small holes, which are due to the presence of the first row 7A and end row 7B of the central band 7, which rows 7A and 7B engage with a stitch loop every four (or n) end stitch loops of the adjacent fabric of the side portions 3 and 9. At the end of formation of the second side portion 9, all the needles of the arc A1, A10, A2 will have started working in order to complete the profile 8 symmetrical with the profile 7. The article is then terminated with all the working needles of the needle cylinder, in order to form the second tubular leg piece 10.

It is worth drawing attention to the fact that the two profiles 5 and 8, bordering between each of the two side portions 3 and 9 and the central band 7, are extended with the needles of the arc A1, A10, A2; 5o and 8o indicate in the drawing the two intermediate points of said profiles 5 and 8 from where (at 5o) the decrements, i.e. the reductions in the working arc of the leg piece 1, commence for formation of the profile 5 of the first side portion 3 and where (at 8o) the increments of the profile 8 at the end of formation of the second side portion 9 terminate. It is also worth commenting that, in order to increase the extension of the side portions 3 and 9, the arc of needles A1, A0, A2 should be increased to the detriment of the number of needles of the arc A1, A10, A2 with which the rows of stitches of the band 7 are formed; however, the overall extension along the crutch line of the band 7 may be corrected - if the number of needles which form the rows of said band 7 must be reduced - by increasing the dimension of the stitches of the rows forming the band 7 itself and modifying the elasticity characteristics of the yarn or yarns with

which said band 7 is made. It should also be taken into account that the number of rows with which the band 7 is formed, i.e. basically the width which may be imparted to the band 7 (with a suitable number of rows for formation thereof), is not dependent upon any circumstance which may be negative with regard to the form of the two side portions 3 and 9. It is also worth considering that, during formation of the band 7, the size of the stitches of the rows of stitches which form said band 7 may be modified along the extension of the band itself; it is possible to envisage, for example - as required - an increase in the size of the stitches of the band 7 towards the ends 7X,7Y thereof and a reduction in the central zone between the points 5o and 8o of said band 7; this reduction in width may also be obtained using a working process of the "retained stitch" type.

The terminal end 3A of the first side portion 3 of the body piece and the leading end 9A of the second side portion 9 of the body piece form part of the waistline of the knitted garment or panty hose formed in the manner described and a finish for these ends 3A and 9A is appropriate. This may be obtained with the formation of a suitable edge which may be elasticized with a varied configuration of the end rows along the end 3A of the portion 3 and the first rows along the end 9A of the portion 9 and/or with the presence of additional yarns which are for example elasticized along said end edges 3A and 9A. Also and advantageously it is possible to form a so-called double edge or tubular edge with techniques which are known in the field and which may be implemented both at the end and the start of formation of a fabric. Figs. 15 to 21 are similar to Figs. 3, 4, 6, 7, 8, 9, 10, but differ from them because these Figs. 15 to 21 show in a particularly clear manner the presence of a tubular finishing edge 3X along the final edge 3A of the first side portion 3 and an initial double edge 9X along the initial line 9a of the side portion 9 of the garment body piece.

The formation of finishes such as 3X and 9X or other equivalents is obtainable whatever the manner in which the two side portions 3 and 9 of the body piece are formed, which side pieces 3 and 9 may be formed with a continuous rotational movement of the needle cylinder or with an alternating

movement of the needle cylinder. A similar finish may also be formed along the end edges 7X and 7Y of the central band 7, extending along the crutch of the garment, which may also be performed with a continuous rotational or alternating movement of the needle cylinder.

- 5 The side portions 3 and 9 of the body piece may be formed with a continuous movement of the needle cylinder or with an alternating movement of the needle cylinder.

 In order to form these portions with a continuous movement of the needle cylinder - which is advantageous owing to the greater rapidity with which this processing operation may be performed - it is possible to envisage a fastened arrangement of the end stitches of each partial row of the portions 3 and 9, respectively, as shown in Figs. 13 and as may be performed with a device which is illustrated schematically in Figs. 22 to 26, in order to create a reinforcement able to prevent undoing of the partial rows of the side portion 3 (and the side portion 9) of the body piece, formed by the main yarn 30. Starting from the final annular row indicated by 1A, 1B of the leg piece 1 and during the whole formation of the fabric of the first side portion 3 as far as the end 3A, along the profiles 5 of the needle reductions, i.e. the decrements, it is envisaged inserting, for the formation of the last stitches of each of the gradually reduced partial rows of the side portion 3, in addition to the main yarn 30, an additional yarn 31 which is arranged alongside the main yarn so as to form the fabric of the portion 3 for, for example, the four end stitches of the gradually reduced rows of this fabric; the additional yarn 31 is supplied with a yarn guide which is made to move rapidly forwards and backwards on the front of the needles in the region, for example, of the four final needles assigned at a particular instant for the formation of a partial row in which the reinforcement must be performed; in this way the additional yarn 31 engages with the four end loops together with the main yarn, is then rapidly transferred with a section 31A onto the front of said four needles which are engaged with it and is then engaged a second time by the same four needles and is finally cut together with the main yarn when the needle cylinder terminates processing of the row of stitches in question of the portion 3A; this is repeated

at the start of formation of each successive row. Finally, these reinforcements obtained with the additional yarn 31, which is positioned so as to be combined with the main yarn along the - for example - four end stitches of each partial row prevent the stitches of the partial rows of the portion 3 from otherwise becoming unraveled since the main yarn is gradually cut along the profiles 5. The four stitches reinforced with the additional yarn 31 commence at the point 5o, i.e. at the point A0 of the needle circumference when the decrements start, i.e. the reduction in the working needles for the formation of the first portion 3 and along the whole profile 5 as far as the point where the reduction in the needles terminates and therefore the formation of the fabric of the portion 3 terminates, adjacent to the points A1 and A2 of the needle circumference, if necessary continuing also on the fabric which forms the tubular reinforcing edges 3X of the portion 3. In an entirely similar manner, starting from the points A1 and A2, there takes place the formation of the reinforcements for fastening the partial rows of the second side portion 9 starting from the leading edge 9A (or also from the tubular edge or double edge 9X if present) along the whole profile 8 as far as the point 8o which constitutes the end of the formation of the increments for creation of the side portion 9 and therefore when the circular knitting must be resumed for formation of the leg piece 12.

In order to perform insertion of the additional yarn 31 for formation of the reinforcements both along the profile 5 and along the profile 8, a device such as that shown in Figs. 22 to 26 may be envisaged. These show a device which is combined with the needle cylinder of the knitting machine which rotates with a continuous movement and in which the main yarn is cut at the ends of the partial rows. With the yarn 31 in addition to the main yarn, the formation of the end stitches of the partial rows is performed, in order to ensure fastening of the stitches to the ends of the partial rows which are gradually reduced along the profiles 5 and 8 which flank the central band 7 extending along the crutch line. The device is designed to perform the stitches with the additional yarn 31 in the region of the four end stitches of the rows extending in the zones adjacent to the said profiles 5 and 8.

201 indicates the so-called sinker disk or plate, underneath which the needle cylinder is located. 103 indicates the needles of a group of four needles which are assigned at a particular instant for performing the four last end stitches of a partial row of stitches of the side portion 3 of the body piece, where the decrements are performed and where the yarns which form said partial rows are cut; the rotation of the needle cylinder is indicated by the arrow f101. Alongside the needle cylinder there is a vertically extending support structure 105 with a lower fixed base 105A arranged underneath an upper arm 105B. At the end of this arm 105B there is provided a pivot pin 107 about which the lever 109A of a pivoting yarn guide 109 is able to pivot, said yarn guide being able to perform deviating movements as can be seen from a comparison of Figs. 22, 23, 24. The arm 109A is actuated via an end member 109B by a connecting rod 110 which is in turn operated by a crank 112 integral with a vertical shaft 114 extending in the structure 105. The shaft 114 has, underneath and integral with it (Figs. 24, 26), a sprocket wheel 116 capable of meshing with an internally toothed segment 118 which is mounted on a feeler 120 which pivots about a pivot pin 122 mounted on the base 105A. The feeler 120, with its end member 120A having a lateral extension, is able to be acted on by the four butts 103A of the four needles 103 which at a particular instant - by means of electronic sensors which are known per se - are displaced to a level such as to interfere with said end member 120A and engage with the yarn 31 supplied by the yarn guide 109, when these needles 103 must form the four reinforced end stitches of the individual partial rows which form the side portion 3 of the body piece. In the conditions immediately prior to those in which the needles 103 shown in Figs. 22 to 26 must intervene - for formation of the partial rows of the portion 3 -, the yarn guide 109 is located in the position shown in Fig. 22, where the end member 120A of the feeler 120 is located opposite the butt 103A of the first of the needles 103 which may strike this end member 120A. In the initial conditions shown in Fig. 22, the yarn 31 supplied by the yarn guide 109 is located in the position shown in Fig. 22 itself, i.e. the yarn 31 is retained by a conventional pneumatic suction nozzle 123; the yarn 31 is engaged and worked by the

three needles 103 which engaged with it in the position where the yarn is supplied by the yarn guide 109 located in the position shown in Fig. 22. Immediately after reaching the position shown in Fig. 22, the feeler 120A, 120 is displaced suddenly by the first of the butts 103A of the needles 103 which have just finished operating; in this way this butt 103A and the other successive butts displace the feeler 120A, 120 through a limited angle about the shaft 122 as far as the position shown in Fig. 23; the displacement of the feeler 120, 120A about the shaft 22 causes the corresponding angular displacement of the toothed segment 118 and therefore a reverse and greater angular rotation of the sprocket wheel 116 which meshes with this toothed segment; the rotation of the sprocket wheel 116 causes the corresponding rotation of the shaft 114 with which said sprocket wheel is integral; the shaft 114 in turn causes, by means of the hinged joint 112, 110, 109B, the sudden rotation of the arm 109A and therefore the yarn guide 109 from the position shown in Fig. 22 into the position shown in Fig. 24; this results in a rapid positioning of the yarn 31 again in front of the four needles 103 in question with a section 31A of the yarn 31 as also shown in Figs. 13 and 14; the yarn guide 109 is thus located in a position again ahead of the needles 103, so that the further advancing movement of the needles 103 from the position in Fig. 23 into the position in Fig. 24 causes the formation of stitches by the needles 103 with the main yarn with which the partial rows of the portion 3 were formed and with the double addition of the additional yarn 31 onto the four needles 103. The yarn guide 109 together with all the devices which control it, is then brought back into the initial position shown in Fig. 22 by a special actuator or by opposition means which are for example elastic, the feeler 120, 120A having lost contact with the butts 103A of the four needles which were inserted at the level of the feeler itself in order to perform reinforcement with the yarn 131. Basically the yarn 131 was able to form, together with the main yarn 30 for formation of the side portion 3, the four end stitches of each final row, until it is cut together with the main yarn 30 after formation of said reinforcement 31, 31A in the four end stitches. The group of four needles 103 which performed, for four rows, the formation of the reinforcement preventing

unraveling of the rows of the main yarn is replaced, eliminating the last of the four needles which worked previously and after inserting ahead of them a further needle for forming the new group of four needles displaced by one position, so as to allow the yarn 31, 31A to be able to create the four end
5 stitches at the ends of the successive four rows which are formed after reduction by one needle along the profile 5 for formation of the side portion 3. Formation continues along the whole of the profile 5 from the start of the reductions in the stitches of the partial rows to the end of formation of the side portion 3, i.e. along the whole arc from A0 to A2 and from A0 to A1. The
10 operation described is performed at the two ends of each partial row of the portion 3.

An operation which is the reverse of that just described is performed during processing of the article for formation of the second side portion 9 with increments along the profile 8 (instead of decrements along the profile 5), said
15 increments starting from the points A1 and A2 of the needle circumference as far as the point A0, when the portion 9 is completed so as to involve all the needles, then resulting in the formation of the second leg piece 10.

The formation of a reinforcement such as that 307 (Fig. 21) along the ends 7X, 7Y of the band 7, in combination with the double-edge
20 reinforcements 303 and 309 extending along the end edges 3A and 9A of the side portions 3 and 9 of the body piece, is now described in greater detail.

With reference to Figs. 27 to 36, these show the formation of a finish along the two ends 7X, 7Y of the band 7, adjacent to the finishes (such as those of the tubular double edges 303 and 309) formed at the ends 3A and
25 9A of the side portions 3 and 9 of the body piece, with an auxiliary device as illustrated in Figs. 27 to 31.

Figs. 27 to 31 show in schematic form the disk or plate 201 of the sinkers 203, which is positioned in a conventional manner coaxially and immediately above the end of the needle cylinder, so as to co-operate with the
30 needles themselves. Said disk or plate 201 is made to rotate - normally in the same direction as the needle cylinder - for the conventional operations. In order to form the double-edge finish and the reinforcement described above,

the movement imparted to the shaft 205 of the disk or plate 201 of the sinkers 203 is supplied from the machine to a toothed pulley 207 (or other equivalent member) and transmitted to a sleeve 209 which surrounds the upper part of the shaft 205. The shaft 205 has a longitudinal slit 205A and the sleeve 209

5 has two opposite Z-shaped slits 210A, 210B, 210C, with the longitudinal central section 210A and two opposite inclined sections 210B and 210C; the two slits 205A and 210 (A,B,C) are crossed by a pin 212 which engages at its ends, in a diametral position, with a ring 214 surrounding the sleeve 209 and sliding along it; the ring 214 has an external groove 214A inside which the

10 rollers 216A of a fork member 216 slide; said fork member 216 has an arm 216B which is hinged at 218 with a support 220 and is operated at the ends 218C by an actuator (not shown) which causes pivoting of the fork 216 and therefore sliding of the ring 214 and the pin 216 between an intermediate position and two opposite end positions. The rotation of the toothed pulley

15 207 is transmitted by the sleeve 209 and by the pin 212 to the shaft 205. By axially displacing the ring 214 (with the fork member 216) from an intermediate position where the pin 212 is located in the central section 210A of the Z-shaped slit of the sleeve 209, upwards into the zone 210B, in addition to the continuous rotation derived from the pulley 207, a limited, temporary,

20 angular displacement in one direction is imparted to the shaft 205 and to the disk or plate 201 of the sinkers 203; by displacing instead axially the ring 214 downwards, the pin 212 is brought back into the central section 210A and the disk or plate 201 is moved backwards again. When the pin 212 is displaced from the zone 210A into the bottom inclined zone 210C, a limited, temporary,

25 angular displacement is imparted to the disk or plate 201 in the opposite direction to the preceding direction. These temporary displacements in either direction, imparted to the disk or plate 201 of the sinkers 203, have the function of producing operation of a pair of sinkers 203 which are made to project at the appropriate time and temporarily from the perimeter of said disk

30 or plate 201 and then retract. The operation of said specific sinker(s) 203, causing projection or retraction, is obtained with conventional systems, by providing above the disk or plate 201 cams such as that 230 and 232

operated by electronic systems able to operate at the appropriate time and temporarily the butt of the specific sinker(s) which must be made to project temporarily for the function which is described hereinbelow (in order to form the finish with reinforcement at the ends 7X and 7Y of the central band 7).

- 5 Said or each of said specific sinkers may thus project, be displaced angularly (due to the angulation imparted by the Z-shaped slit 10A,B,C), be retracted and return angularly into the original angular position, one or more times and at the appropriate time according to the program.

Let us consider further Figs. 15 to 21, which show, with the same sequences as in Figs. 3, 4, 6, 7, 8, 9 and 10, an article provided with finishes on the ends 3A and 9A of the side portions 3 and 9, each of these finishes is formed as a conventional tubular double edge 303 and 309, at the end of formation of the side portion 3 and at the start of formation of the side portion 9.

- 15 The device described with reference to Figs. 27 to 31 allows formation of a finish on the ends 7X and 7Y of the central band 7, as a substantial continuation of the double-edge finish 303 of the side portion 3 of the body piece 3, until the initial double edge 309 commences.

In order to achieve this, during formation of the central band 7 and in particular the ends 7X, 7Y thereof, the intervention of a pair of sinkers 203S (operated by the device described with reference to Figs. 27 to 31) is envisaged, as schematically illustrated in Figs. 32 to 36.

At the end of formation of the double edge 303, the formation of the central band 7 commences (using the main yarn 70), with the stitches of the first row 7A which engage with the stitches 5 spaced by groups of $\underline{n}$ rows (four in this case) forming the side portion 3 of the body piece. With the cams 230, 232, a pair of sinkers 203S is made to project from the disk or plate 201, said sinkers engaging with a stitch at MA (Fig. 32) and being then retracted; after a few rows of the band 7, the disk or plate 203 is displaced by the pin 212 which enters into the inclined section 210B of the Z-shaped slit of the sleeve 209, so that the sinkers 203S are displaced angularly in the direction of the arrow fS (Fig. 33); then the sinkers 203S are again made to project and thus transfer

the stitch MA, depositing it at the point PA (Figs. 34 to 38); immediately afterwards the sinkers 203S are repositioned backwards and retracted; at this point the pin 212 is displaced into the section 210C of the Z-shaped slot and the disk 201 is angularly displaced in the opposite direction to that which occurred previously, and the sinkers 203S perform the function similar to that described above, but at the opposite end of the working front of the central band 7; finally, the pin 212 returns into the central section 210A of the Z-shaped slit. After a few further rows of the band 7 have been knitted, a further similar function is performed with a stitch MB in a successive row - formed for construction of the band 7 - which is also translated in the direction fS and then deposited at a point PB which is spaced from the point PA. These operations continue in succession along the two ends 7X, 7Y during formation of the band 7, thus creating a fold in the ends 7X, 7Y of the band 7, which are retained along the engaging points PA, PB and successive points, at both the ends of the band 7 being formed. This creates a finish 307 which extends - in the finished garment - between the two double-edge finishes 303, 309 in a comfortable and aesthetic manner.

According to two possible alternatives, the structure of the central band (corresponding to that already indicated by 7 previously) may be formed with the alternating movement of the needle cylinder or with the continuous rotation of the needle cylinder. At least in this second case, along the ends 7X and 7Y there may be formed (see Fig. 14) with an additional yarn 71, 71A a reinforcement which is similar to that which was indicated by 31 and 31A in Figs. 13 and which can be obtained with continuous-movement operation of the needle cylinder and with a device of the type such as that already described with reference to Figs. 22 to 26. Both with alternating-movement processing and with continuous-movement processing of the band 7, when the arrangement described with reference to Figs. 32 et seq. is not used, the ends 7X and 7Y of the central band 7 may be folded and kept against said band, to which they may be suitably fastened, with the adoption of special measures, such as the addition of additional yarns with special elasticity and/or coarseness characteristics, or the like.

Fig. 14 shows the formation of the central band 7 with the continuous movement of the needle cylinder, with cutting of the main yarn 70 at the ends 7X, 7Y and with the presence of reinforcements formed with an additional yarn 71 which is supplied by a pivoting yarn guide of a device such as that
5 shown in Figs. 22 to 26, so as to form structures such as those formed by the additional yarn 31, 31A, illustrated in Fig. 13.

It is understood that the drawing shows only an example provided by way of a practical demonstration of the invention, said invention being able to vary with regard to its forms and arrangements, without thereby departing
10 from the scope of the idea underlying the invention itself. The presence of any reference numbers in the accompanying claims has the purpose of facilitating reading of the claims with reference to the description and the drawings and does not limit the scope of protection represented by the claims.

CLAIMS

1) Method for forming a knitwear garment, such as a panty hose, briefs or shorts in a single operation and without assembling seams, on a single-cylinder circular knitting machine, with a needle cylinder performing
5 both a continuous and alternating rotational movement, characterized in that it comprises in combination and in sequence the following steps:

A) - formation of a first leg piece (1) with all the needles;

B) - formation of a first side portion (3) of the body piece, with a gradual reduction (decrements) in the rows of stitches (5) and needles operating along
10 arcs A10-A1 and A10-A2, until processing with the needles of an arc A1-A0-A2 of the cylinder needles is terminated, each individual reduction being performed approximately every $\underline{n}$ rows (where $\underline{n}$ is preferably between three and five);

C) - finishing and interruption in operation of the needles of the arc A2-A0-A1 and movement away of the end (3A) of the first side portion (3) of the fabric from the arc of the needles A1-A0-A2;
15

D) - formation of a central band (7) of fabric along the "crutch" with the needles of the arc A2-A10-A1 with a desired plurality of rows which extend along the line of the crutch, and with loose stitches, the stitches (5) of a row
20 being fastened to each of the stitches of the first row (7A) of said central band (7) every $\underline{n}$ rows of said first side portion (3);

E) - renewed operation of the needles of the semi-arc A1-A0-A2 and start of formation of an initial finish along one end (9A) and formation of a second side portion (9) of the body piece, with increments (8) obtained by
25 means of renewed operation of a needle every $\underline{n}$ rows along the arcs A2-A10 and A1-A10, and with joining of the end row (7B) of said central band (7) along the increments (8) of said second side portion (9);

F) - formation of the second leg piece (10) with all the needles.

2) Method as in claim 1, characterized in that, during formation of
30 said central band (7A, 7, 7B), a reinforcing gusset (7T) is formed in an intermediate zone of the band (7).

3) Method as in claim 1 or 2, characterized in that a respective

reinforcing and elastic finish, of the tubular double-edge type (303; 309) or the like, is formed at the end (3A) of the formation of the said first side zone (3) and at the start (9A) of the formation of the second side portion (9) of the body piece.

5 4) Method as in claim 3, characterized in that a finish (307) combined with the reinforcing finish, such as the tubular double edges (303; 309) at the ends (3X; 9X) of the side portions (3; 9) of the body piece, is formed at the ends (7X; 7Y) of the central band (7).

 5) Method as in claims 3 and 4, characterized in that, at the ends
10 of the tubular double edge (303; 309) of said two side portions (3; 9), by means of sinkers (203S) of the disk or plate, end stitches (MA; MB; etc.) spaced from the end (7X and/or 7Y) of said central band (7) are transferred and engaged at points (PA; PB; etc.) of the fabric of said central band (7) in order to create a finish at the ends (7X and/or 7Y) of said band (7), combined
15 with the finishes (303; 309) of the ends (3A; 9A) of said two side portions (3; 9).

 6) Method as in at least one of claims 1 to 5, characterized in that the two side portions (3; 9) of the body piece, with associated reductions (5) and associated increments (8), are formed with an alternating movement of
20 the needle cylinder.

 7) Method as in at least one of claims 1 to 5, characterized in that said two side portions (3,9) of the body piece are formed with a continuous movement, and in the region of the gradual reductions (5) and the gradual increments (8) the main yarn is cut and reinforcements are created for
25 preventing unraveling of the stitches, with insertion of additional yarns (31) in at least two and especially at least three stitches adjacent to the ends (5; 8) of the partial rows of said side portions (3, 9).

 8) Method as in claim 7, characterized in that said reinforcements are created with reinforcing yarns (31) supplied by additional yarn guides
30 actuated so as to distribute additional yarn repeatedly to the end stitches of said portions.

 9) Method as in at least one of claims 1 to 8, characterized in that

said central band (7) is formed with an alternating movement of the needle cylinder.

10) Method as in at least one of claims 1 to 8, characterized in that said central band (7) is formed with a continuous movement of the needle cylinder and with cutting of the yarn at the ends (7X; 7Y) of the rows of fabric of said central band (7).

11) Method as in claim 9 or 10, characterized in that a finish is formed at the ends of said central band (7) using additional yarn (431).

12) A garment of the panty hose type, comprising two leg pieces and a body piece, characterized in that the body piece is formed by two side portions (3; 9) as a continuation of the respective leg pieces (1; 10) with partial rows of stitches decreasing from the respective leg piece, with a reduction of an end stitch every $\underline{n}$ rows, and by a central band (7) formed by partial rows of stitches extending along the crutch line, each stitch of the first and last rows (7A; 7B) of said central band (7) being engaged with the end stitches (B1; B2; B3; B4; etc.) of one every $\underline{n}$ rows of said side portions (3; 9) themselves, along joining lines (5; 8) of the reductions (decrements) and increments of the partial rows of said side portions (3; 9).

13) Garment as in claim 12, characterized in that said central band (7) is formed with stitches which are extremely slack, i.e. wide, each stitch of said band (7) extending approximately by the same amount as the stitches of four (or $\underline{n}$) partial rows of the side portions (3, 9).

14) Garment as in claim 12 or 13, characterized in that the end stitches of the partial rows of said side portions (3; 9) along the joining lines (5; 8) are reinforced with additional yarn (31) which is repeatedly engaged with said end stitches, said partial rows being formed with yarn cut at the ends of the rows themselves.

15) Garment as in at least claim 12, characterized in that the stitches adjacent to the ends (7X; 7Y) of the partial rows of stitches of said central band (7) are reinforced with additional yarn (431) which is repeatedly engaged with said end stitches, the main yarn forming said rows of stitches of the central band and the additional yarn (431) being cut at the ends of said

partial rows.

16) Garment as in at least claim 12, characterized in that said side portions (3, 9) have along the waistline (3A; 9A) a finish formed by a tubular double edge (303; 309).

5 17) Garment as in at least claim 12 or 16, characterized in that the ends (7X; 7Y) of the central band (7) are finished with a lip (307) which is folded and preferably engaged with the fabric itself of said band (7).

18) Garment as in at least claim 12, characterized in that said side portions (3, 9) are formed by rows knitted with an alternating movement.

10 19) Garment as in at least claim 12 or 18, characterized in that said central band (7) is formed by rows knitted with an alternating movement.

20) Method as described and illustrated.

21) Garment as described and illustrated and formed with the method described and illustrated.

15 22) A circular machine for stockings or the like, comprising a needle cylinder (2), a disk or plate (201) for the sinkers (203), selection and operating means for activation of the needles and the sinkers, characterized in that it is equipped and programmed to perform - with a continuous and/or alternating rotational movement - in combination and in sequence the steps of:

20 A) - formation of a first leg piece (1) with all the needles;

B) - formation of a first side portion (3) of the body piece, with gradual reduction (decrements) in the rows of stitches (5) and needles operating along arcs A10-A1 and A10-A2, until processing with the needles of an arc A1-A0-A2 of the cylinder needles is terminated, each individual reduction being
25 performed approximately every $\underline{n}$ rows (where $\underline{n}$ is preferably between three and five);

C) - finishing and interruption in operation of the needles of the arc A2-A0-A1 and movement away of the end (3A) of the first side portion (3) of the fabric from the arc of the needles A1-A0-A2;

30 D) - formation of a central band (7) of fabric along the "crutch" with the needles of the arc A2,A10,A1 with a desired plurality of rows which extend along the line of the crutch, and with loose stitches, the stitches (5) of a row

being fastened to each of the stitches of the first row (7A) of said central band (7) every $\underline{n}$ rows of the said first side portion (3);

E) - renewed operation of the needles of semi-arc A1-A0-A2 and start of formation of an initial finish along one end (9A) and formation of a second side portion (9) of the body piece, with increments (8) obtained by means of renewed operation of a needle every $\underline{n}$ rows along the arcs A2-A10 and A1-A10, and with joining of the end row (7B) of said central band (7) along the increments (8) of said second side portion (9);

F) - formation of the second leg piece (10) with all the needles.

10 23) A device (Figs. 22 to 26) to be combined with a circular machine for stockings or the like according to claim 22, with a needle cylinder rotating with a continuous movement, for the formation of a garment using the method according to at least one of claims 1 to 11, characterized in that it comprises: a yarn guide (109) able to perform rapid alternating movements in front of a limited number of adjacent needles (103) which can be selected and can also be switched continuously; a pivoting member (120, 122) with feeler (120A) able to be struck by the butts (103A) of the needles (103) selected for a variation in level of the butts themselves; a transmission (118; 116; 114; 112; 110; 109B) - which may be mechanical or equivalent - for performing said alternating movements of the side yarn guide (109) in co-operation with opposing return means.

25 24) A circular machine (Figs. 27 to 31) for stockings or the like as in claim 22, with a needle cylinder and disk or plate (201) for the sinkers (203) and with cams (230, 232) for selectively causing the projection from and retraction into said disk or plate (201) of selected sinkers (203), and with a transmission (207; 205) for the synchronous movement from the needle cylinder to the disk or plate (201), characterized in that it comprises in said transmission a device able to produce suitably timed and temporary, forward and backward, angular movements of the disk or plate (201) and, in synchronism, projection and retraction of a pair of sinkers (203S), so as to transfer a stitch (MA) of the ends of a central band (7) into an internal offset position, for the formation of an end finish of said central band.

25) Machine as in claim 24, characterized in that it comprises, among the transmission members (207, 205) for the disk or plate (201), a sleeve (209) sliding upon operation of a fork member (216) and provided with a Z-shaped slit (210A, 210B, 210C), a longitudinal slit (205A) being provided
5 in the shaft (205) of the disk or plate (201), and a pin (212) being engaged with a sliding ring (214) and passing through said two slits (210A, 210B, 210C; 205A) so as to transmit the rotation between sleeve (209) and shaft (205) and impart a temporary angulation in either one of the two directions with the axial displacement of said ring (214) along the sleeve (209).

10 26) Circular machine for stockings, for implementing the method according to one of claims 1 to 11, as described and illustrated.

Fig. 1

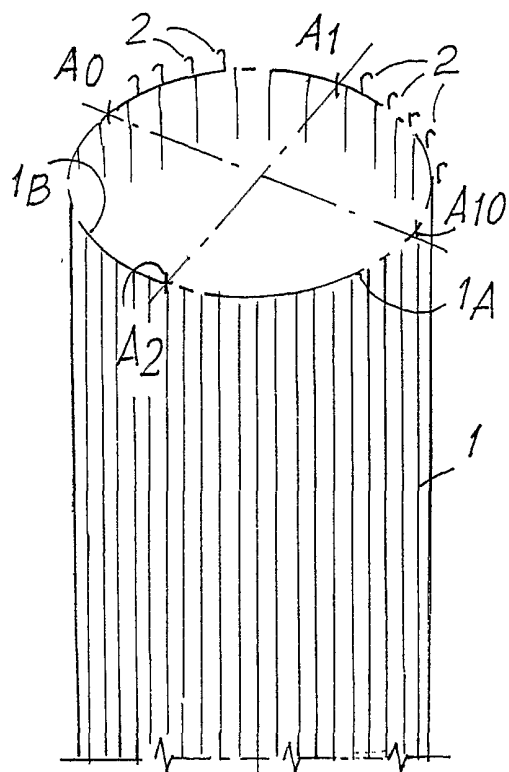


Fig. 3

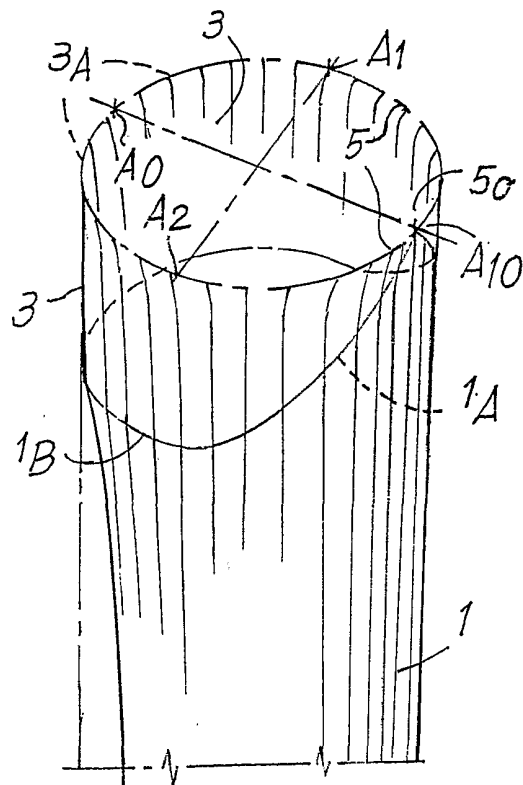


Fig. 2

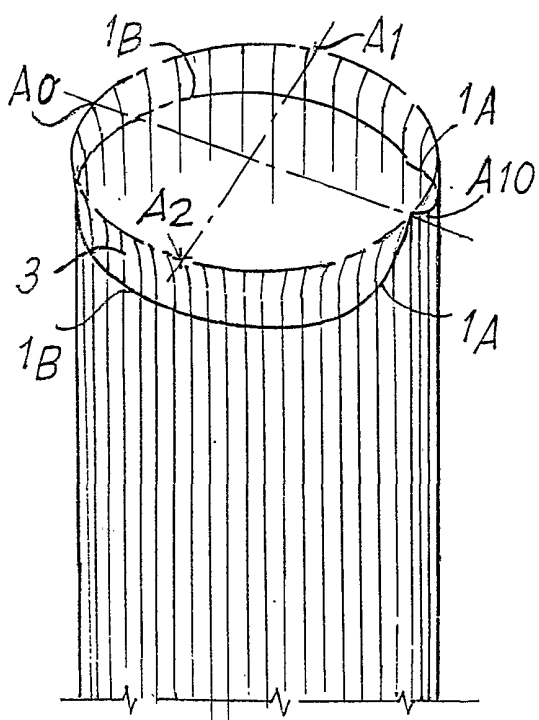


Fig. 4

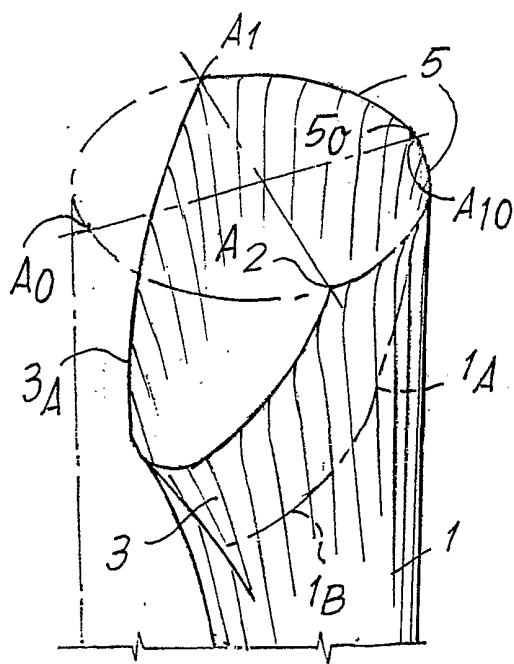


Fig.5

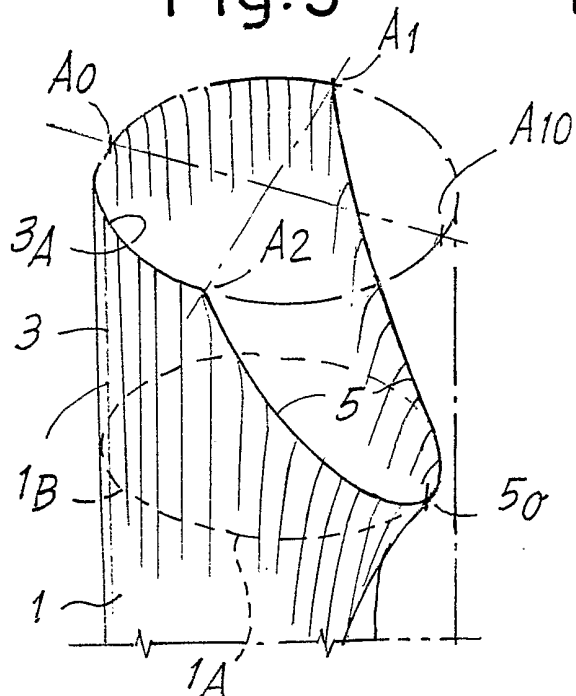


Fig.7

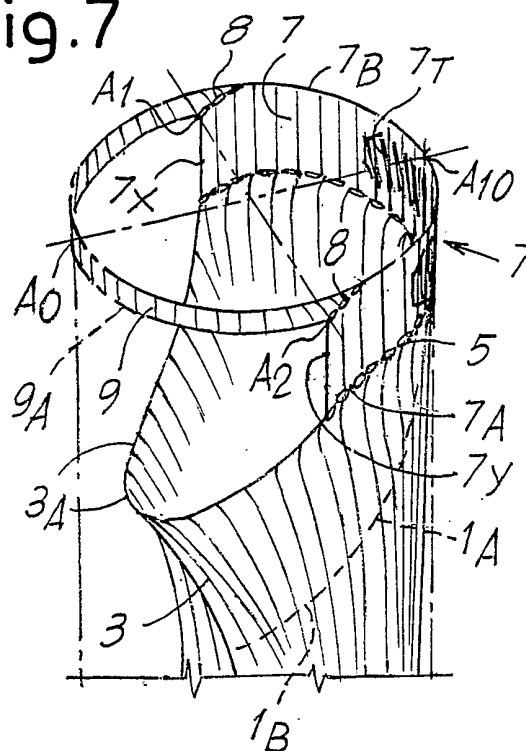


Fig.6

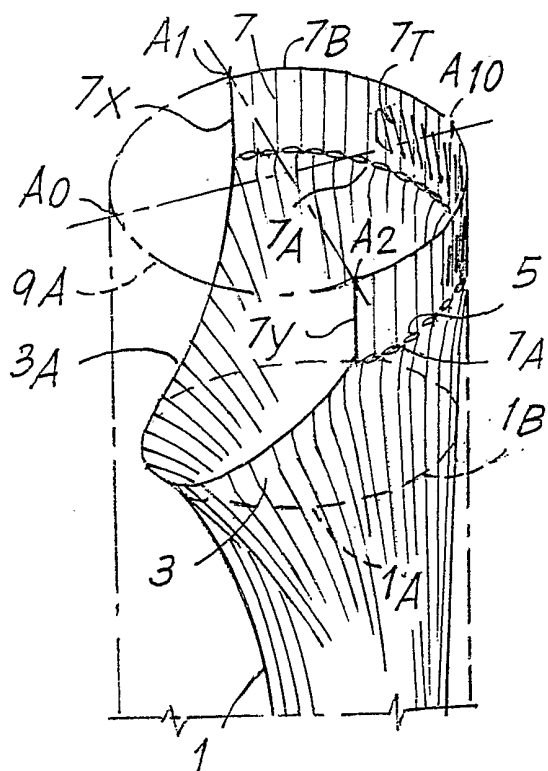


Fig.8

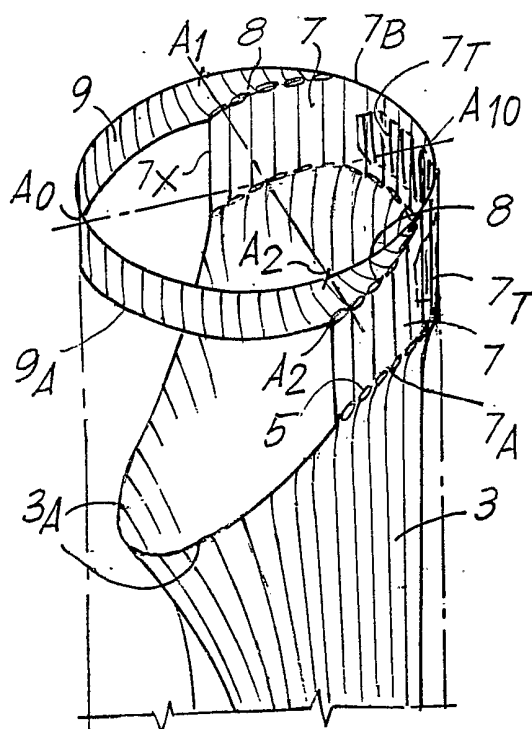


Fig. 9

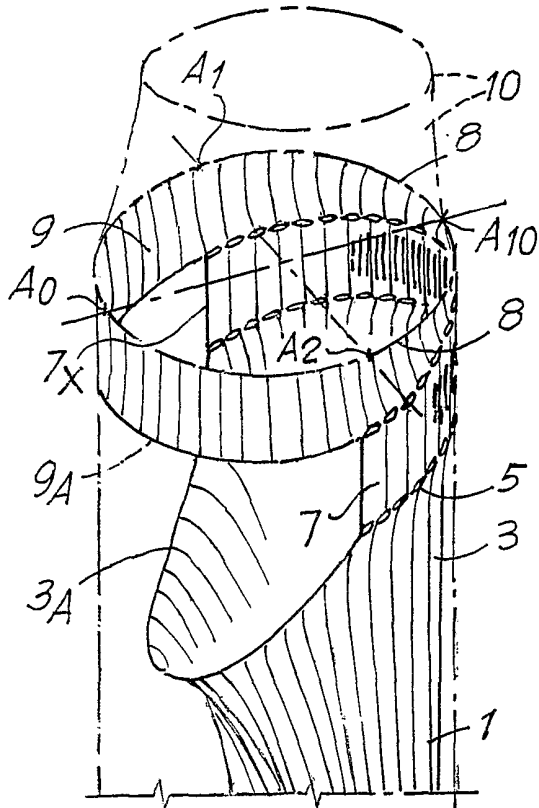


Fig.10

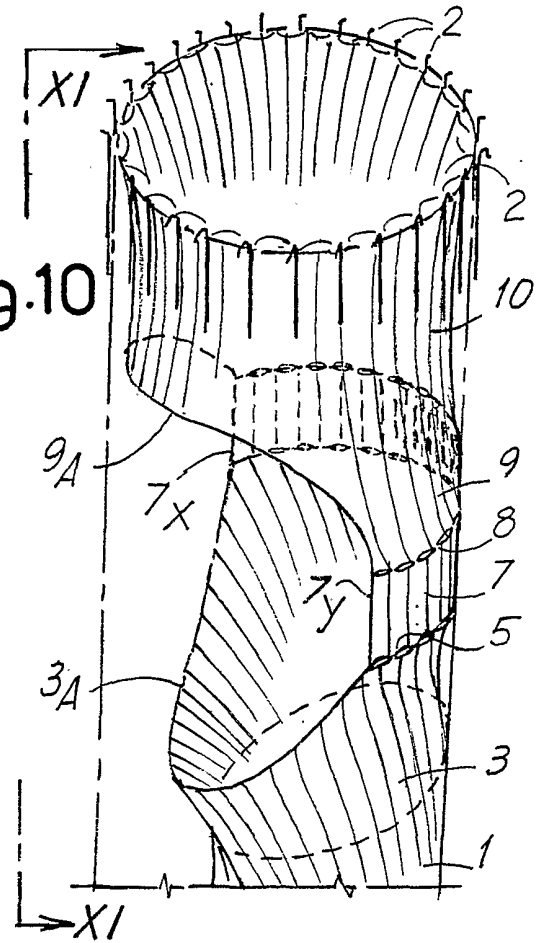


Fig. 11

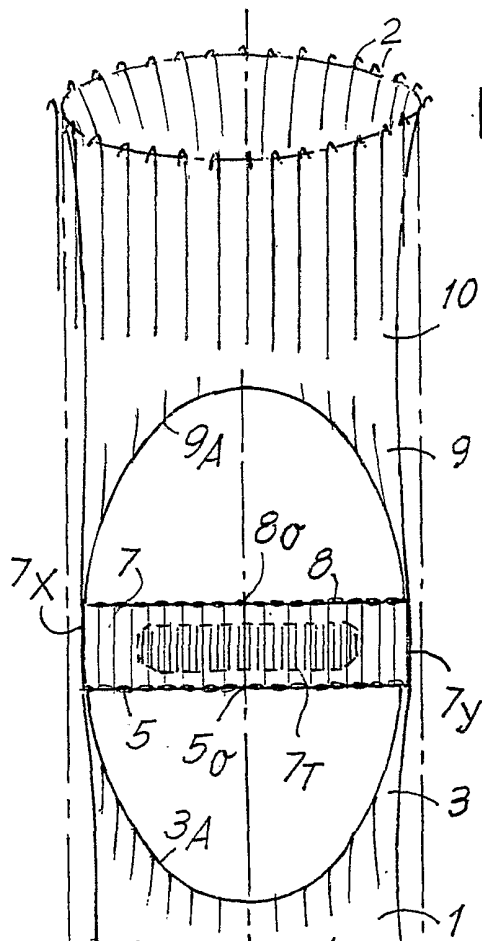


Fig.12

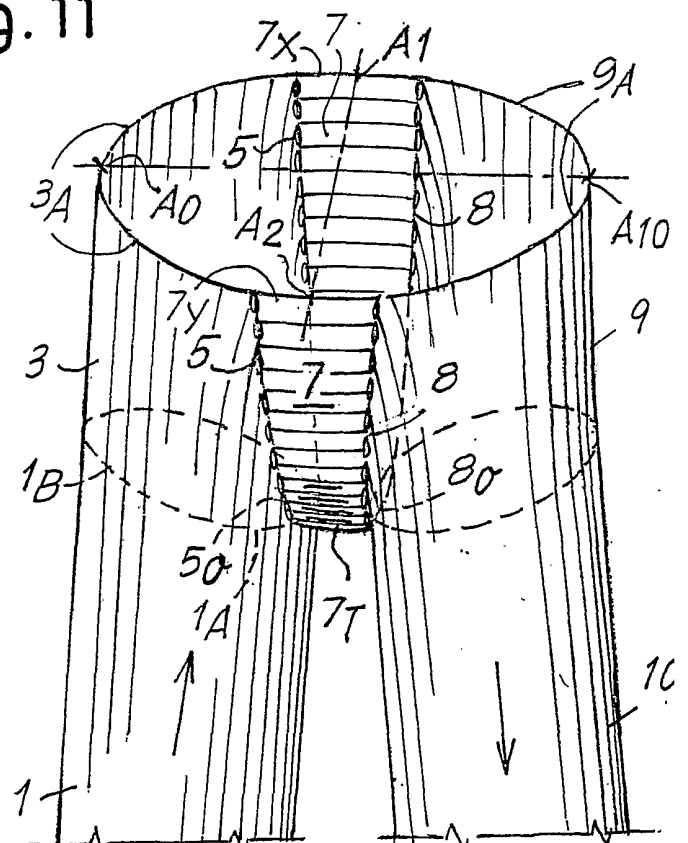
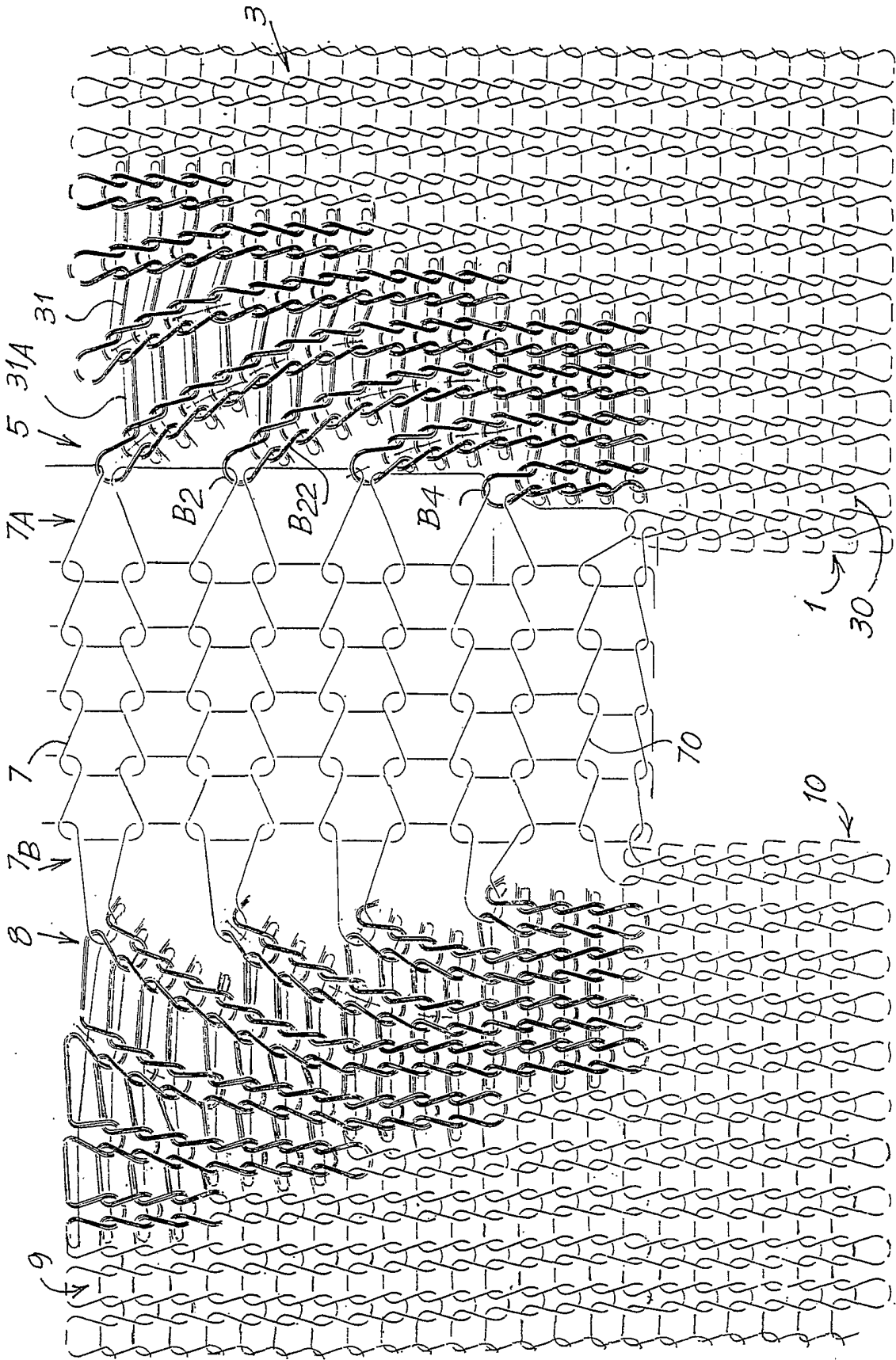


Fig.13



5/20

Fig.13A

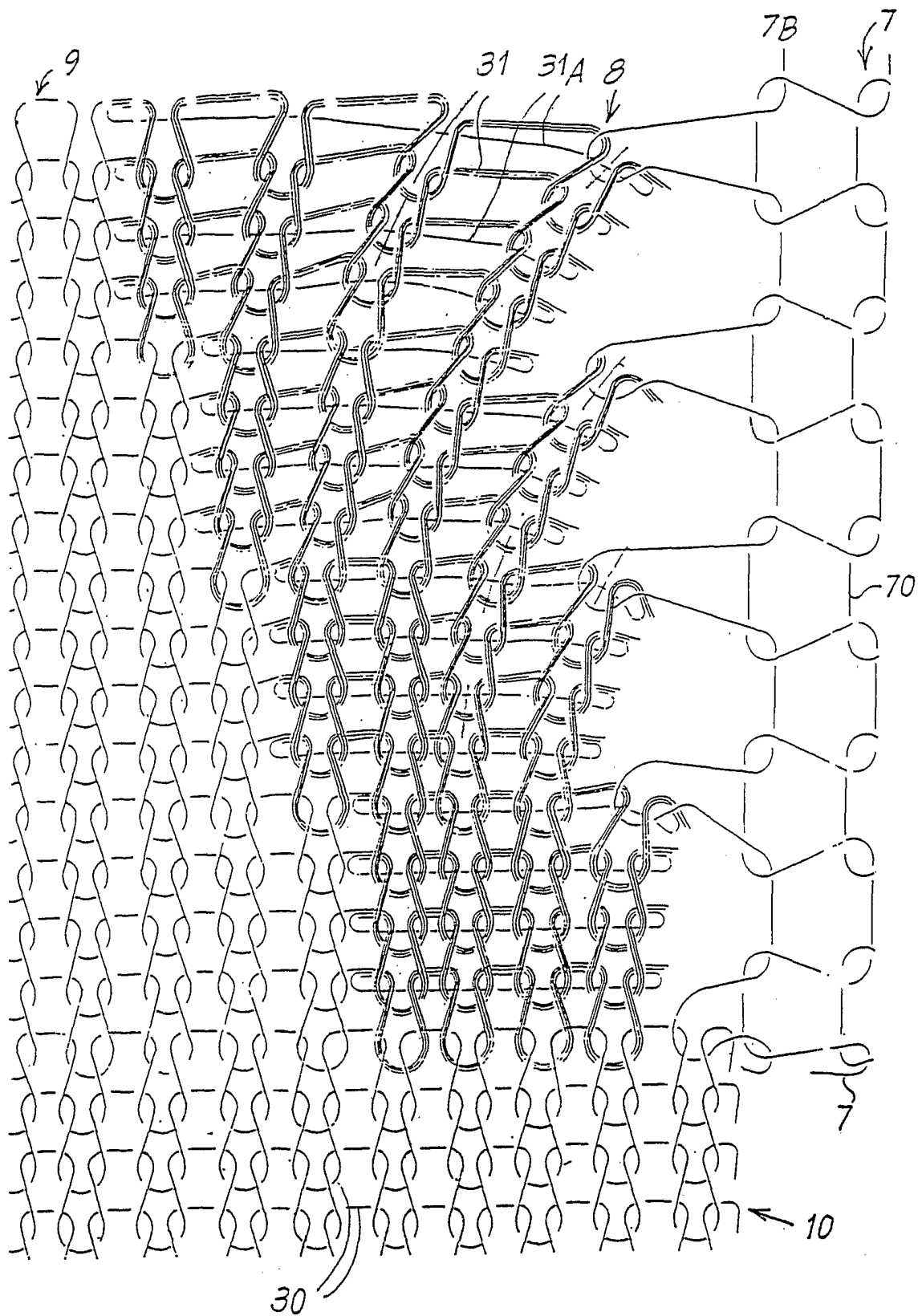
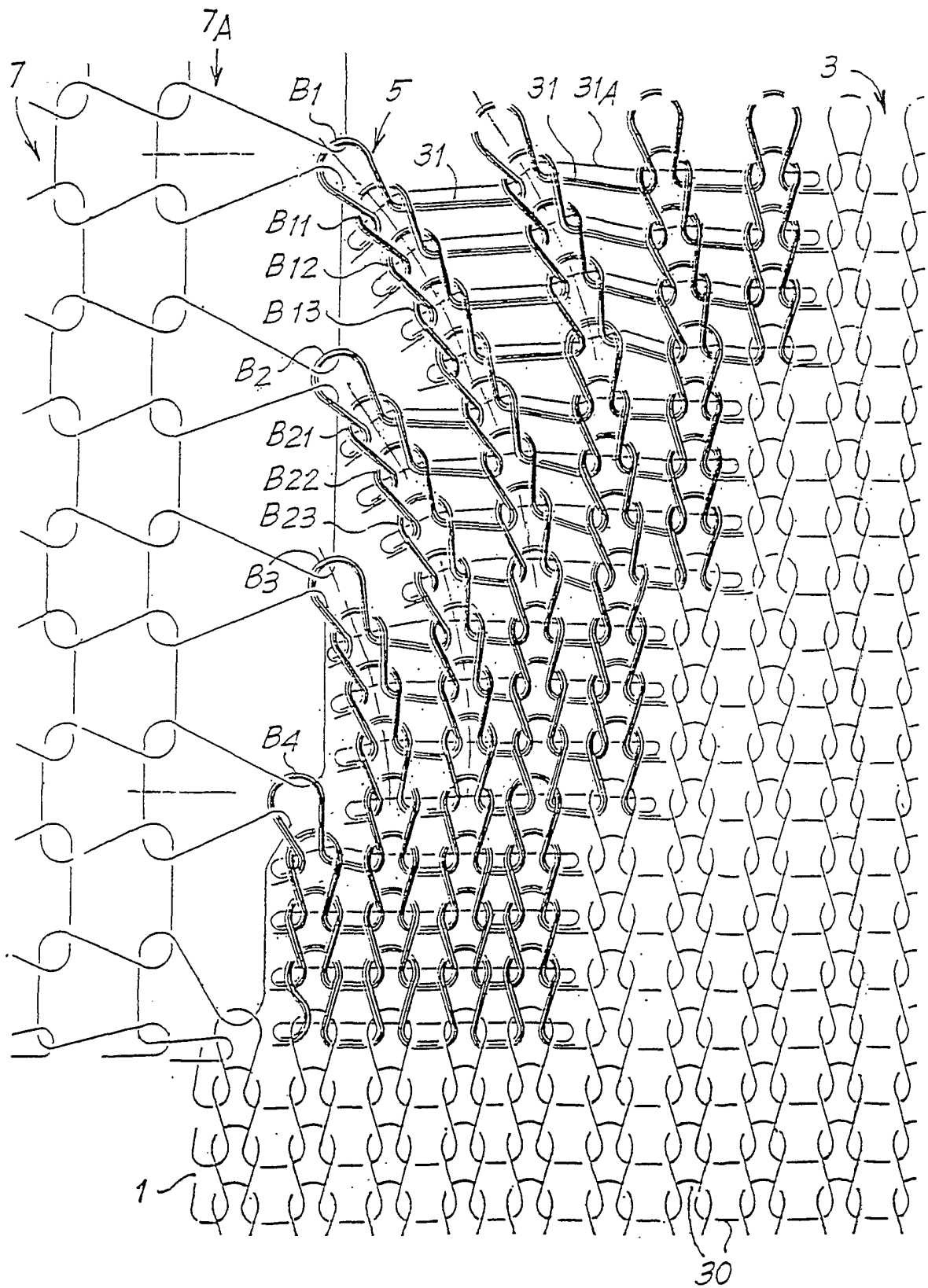


Fig. 13B



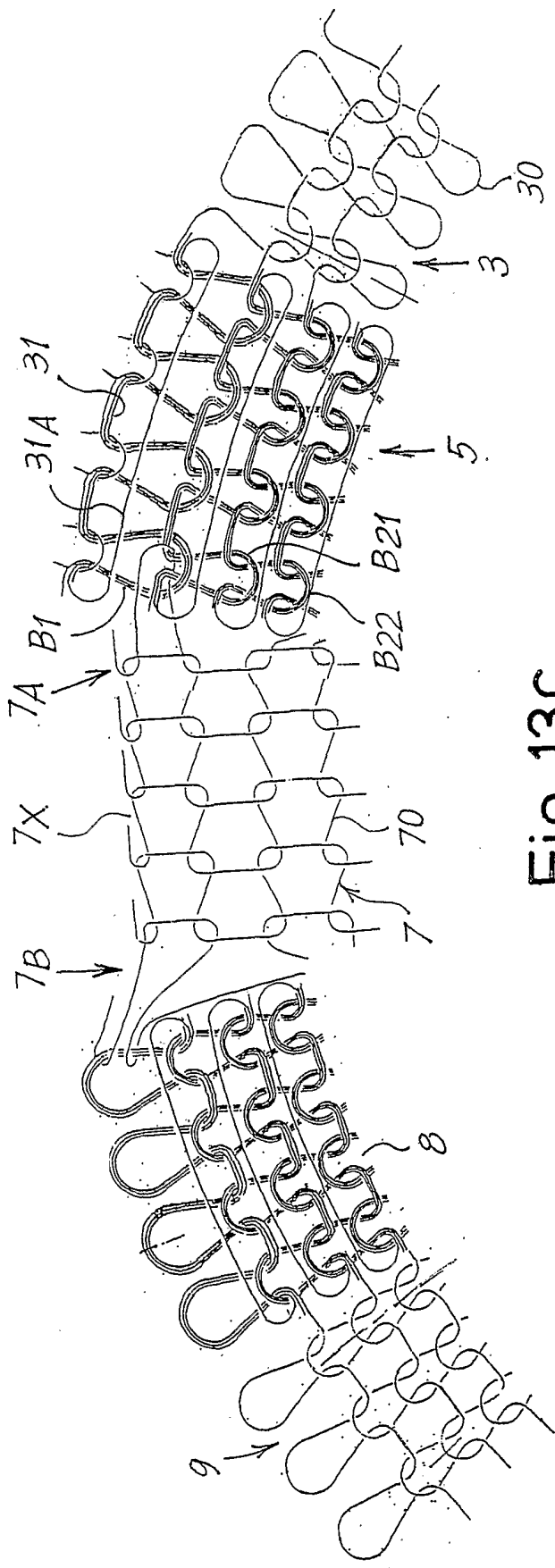
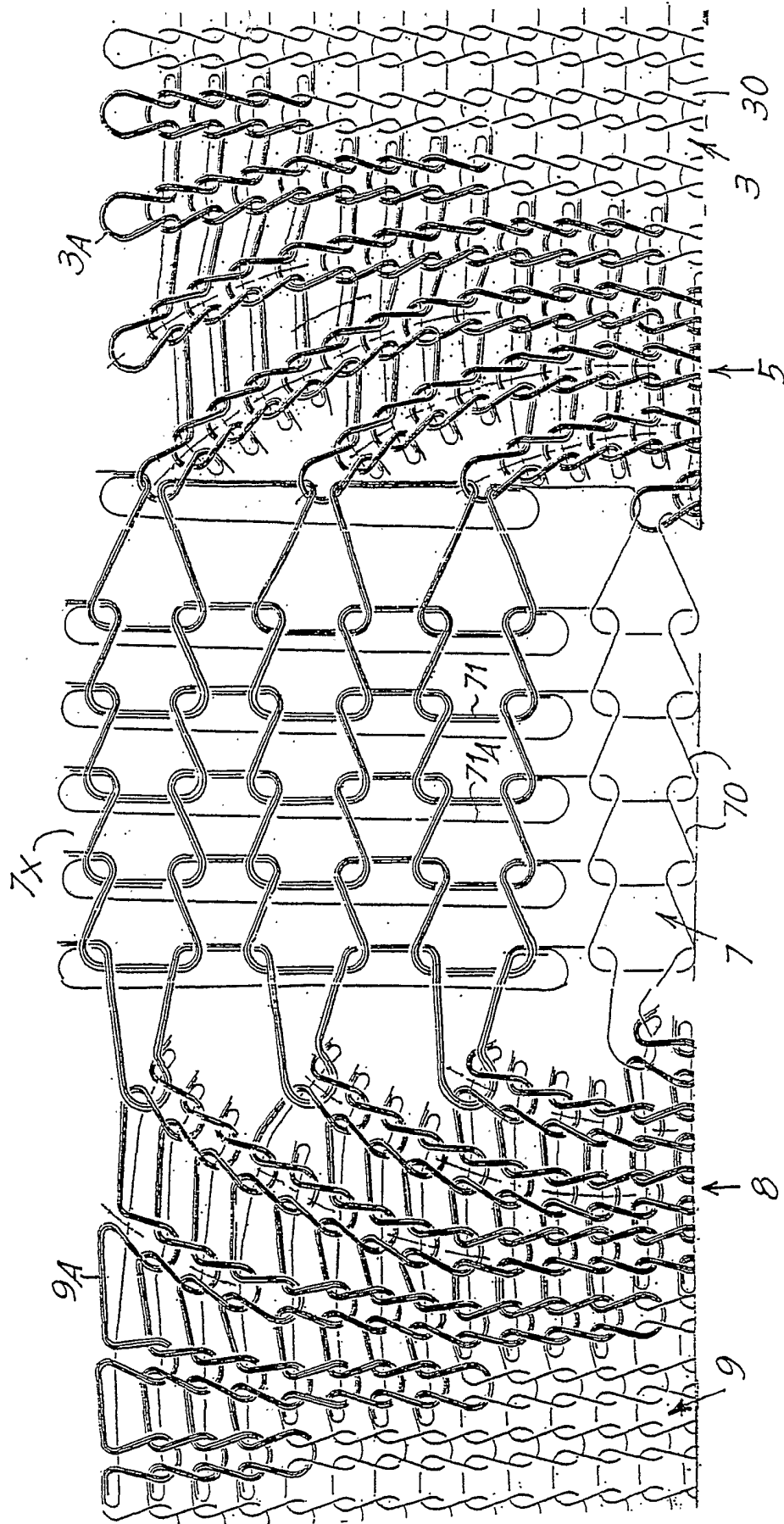


Fig.13C

Fig. 14



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Fig.15

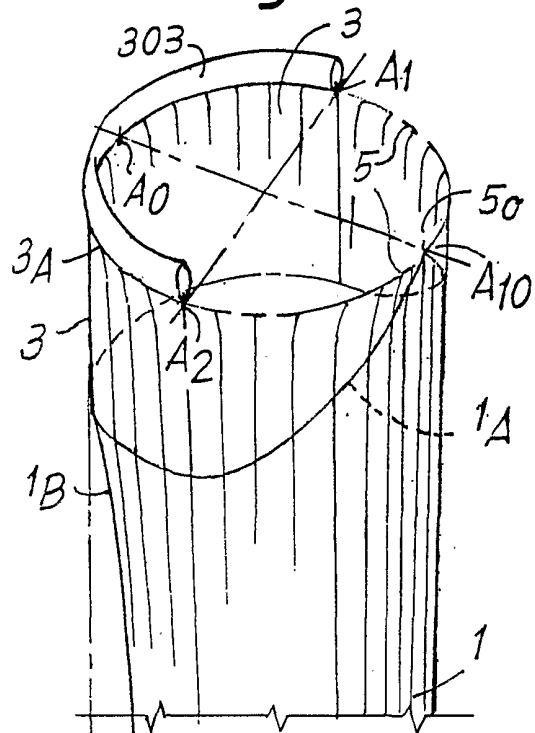


Fig.16

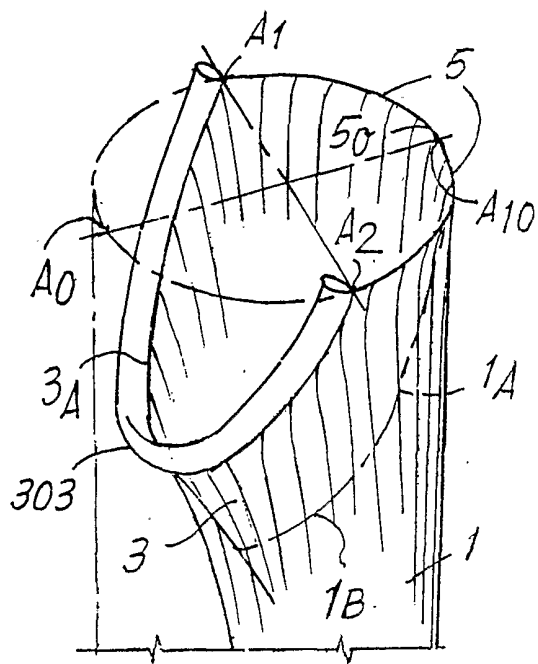


Fig.17

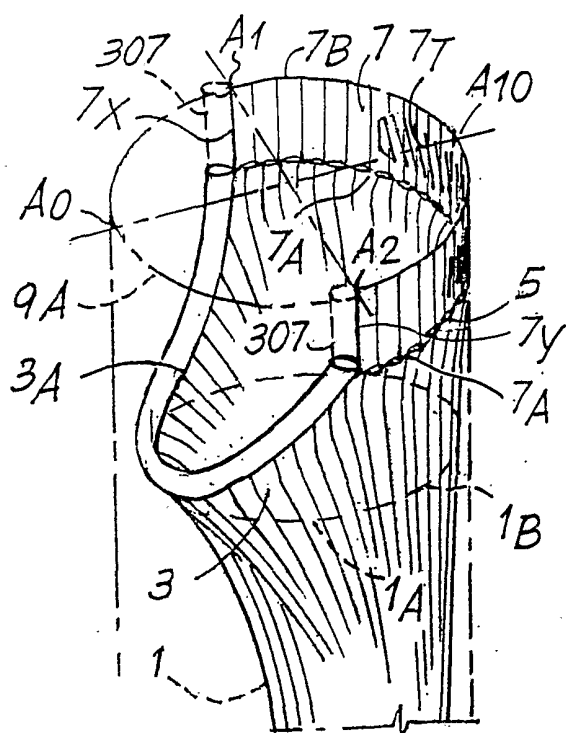


Fig.18

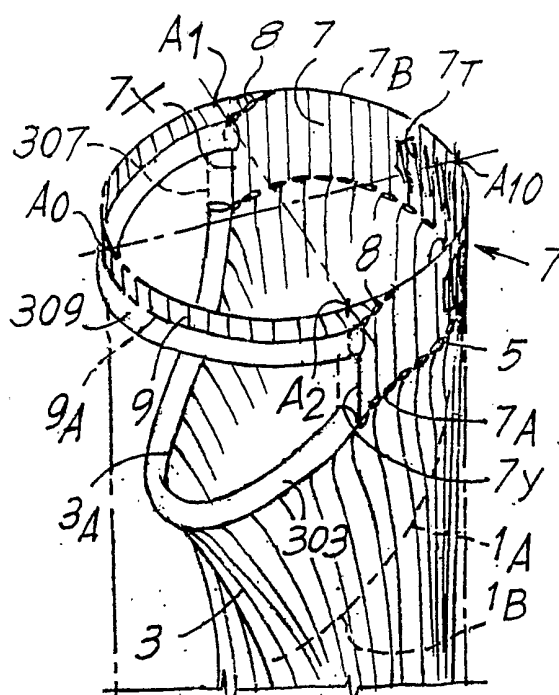


Fig. 19

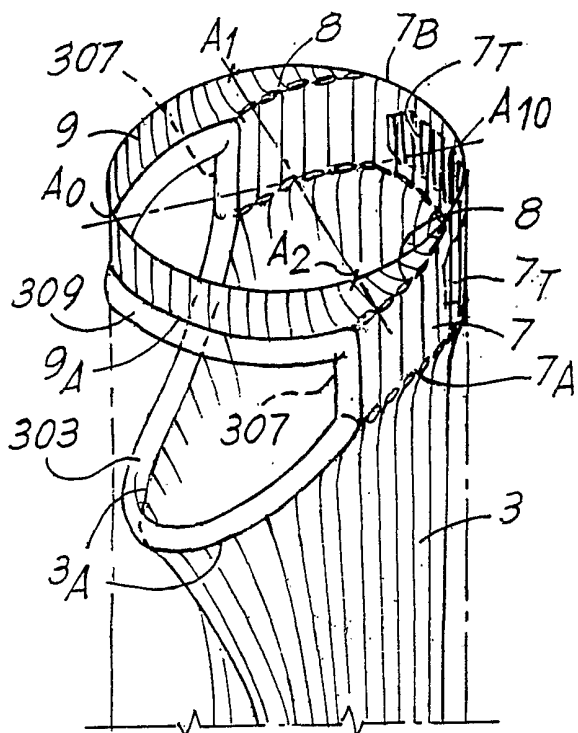


Fig. 20

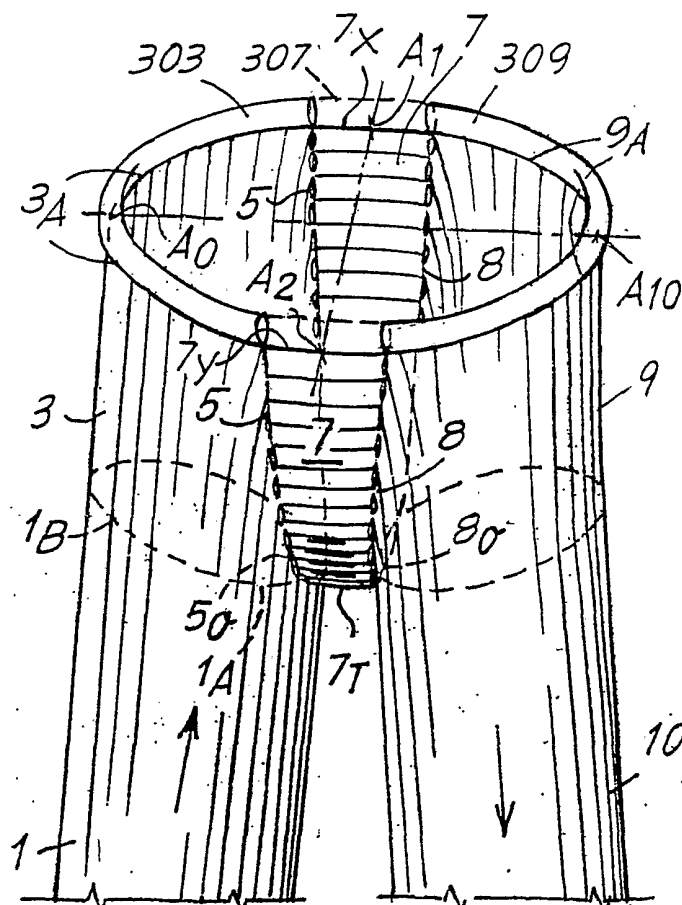
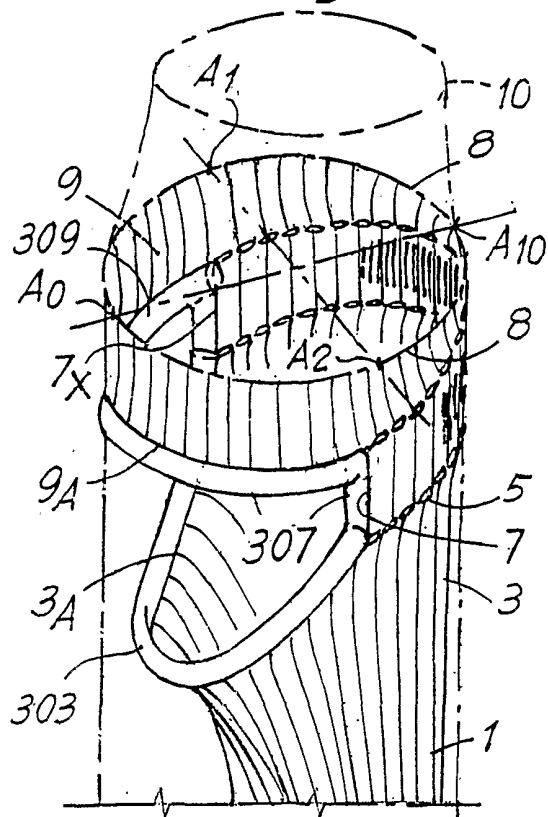
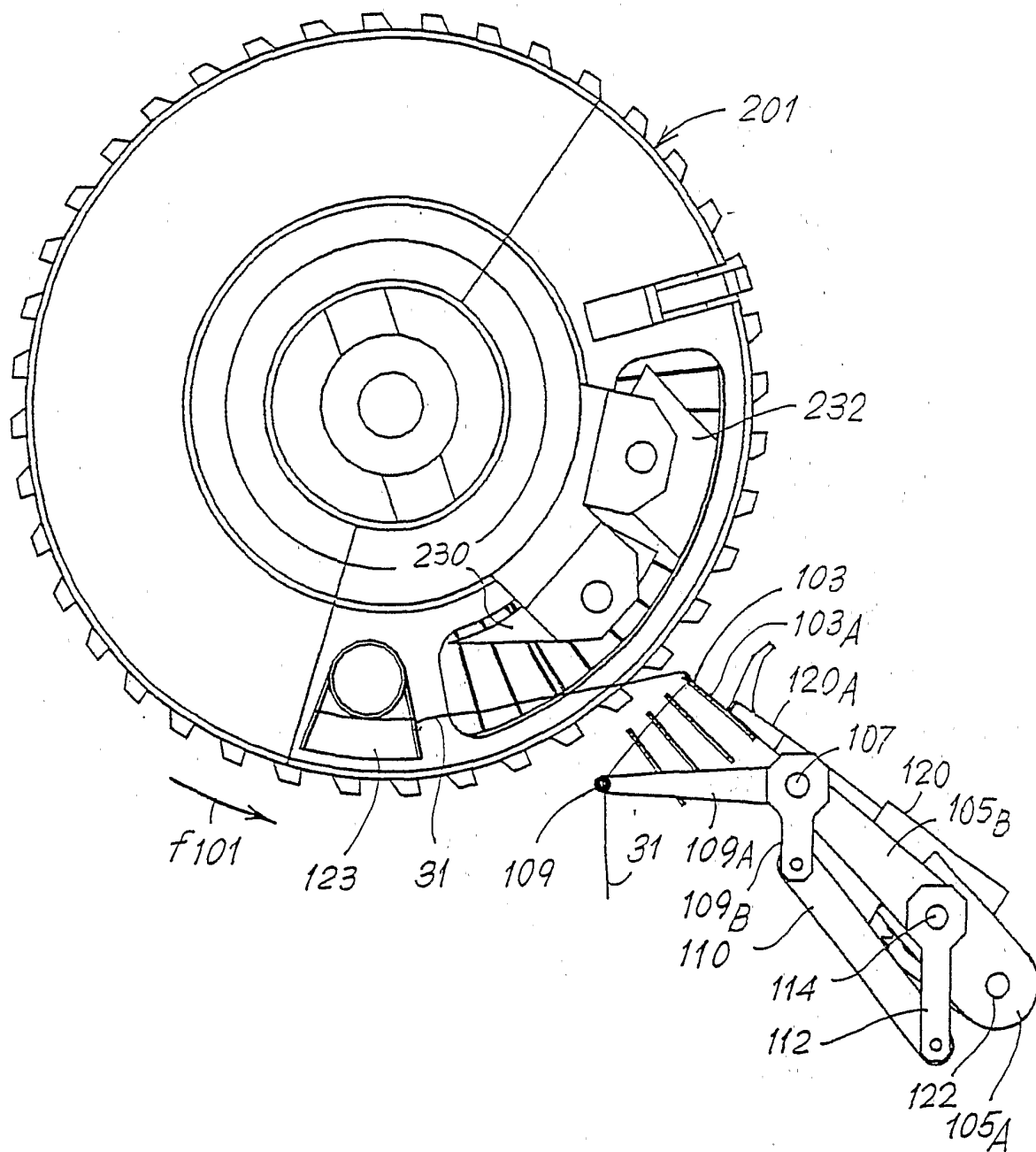


Fig. 21

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Fig.22



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Fig. 23

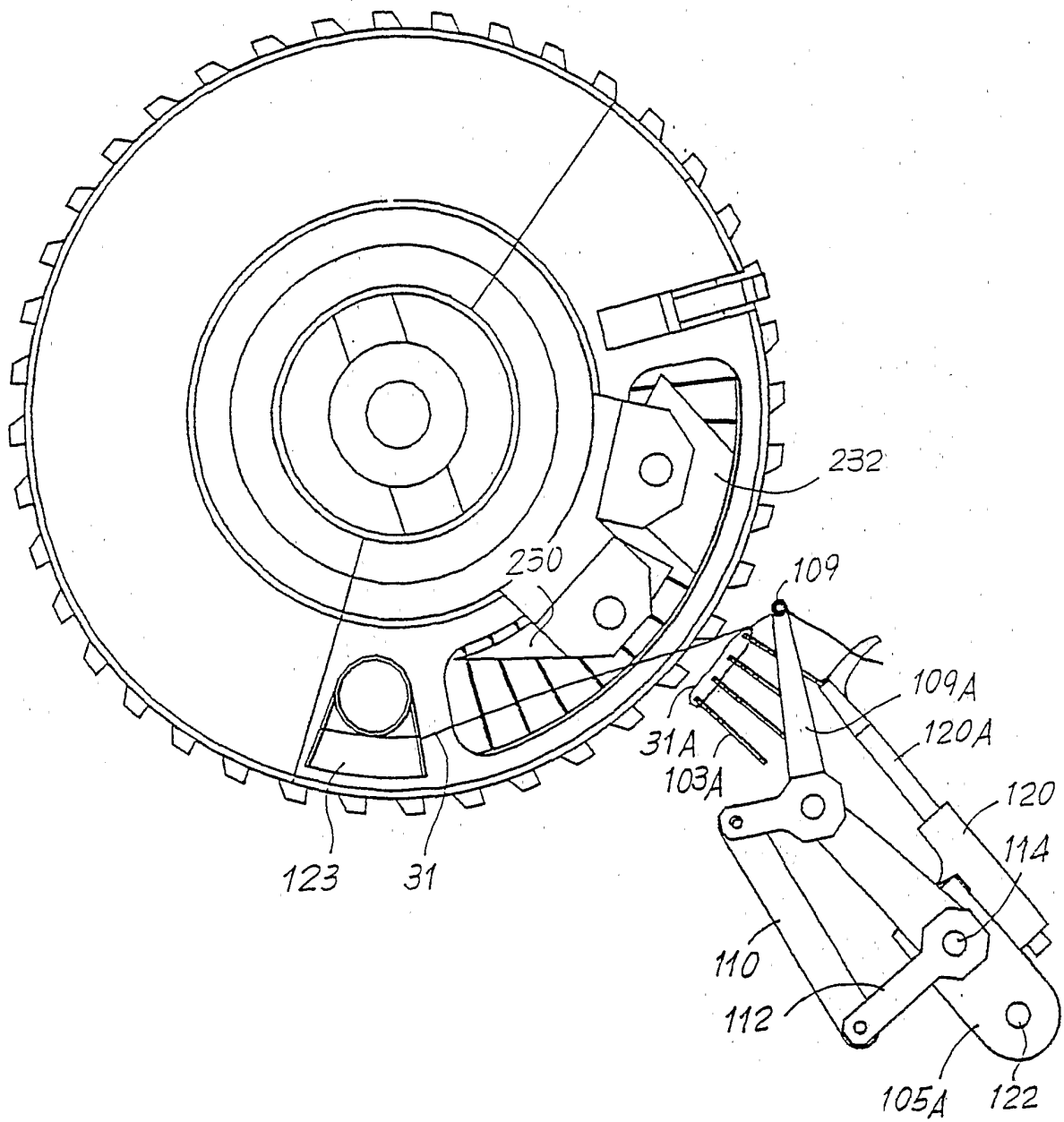
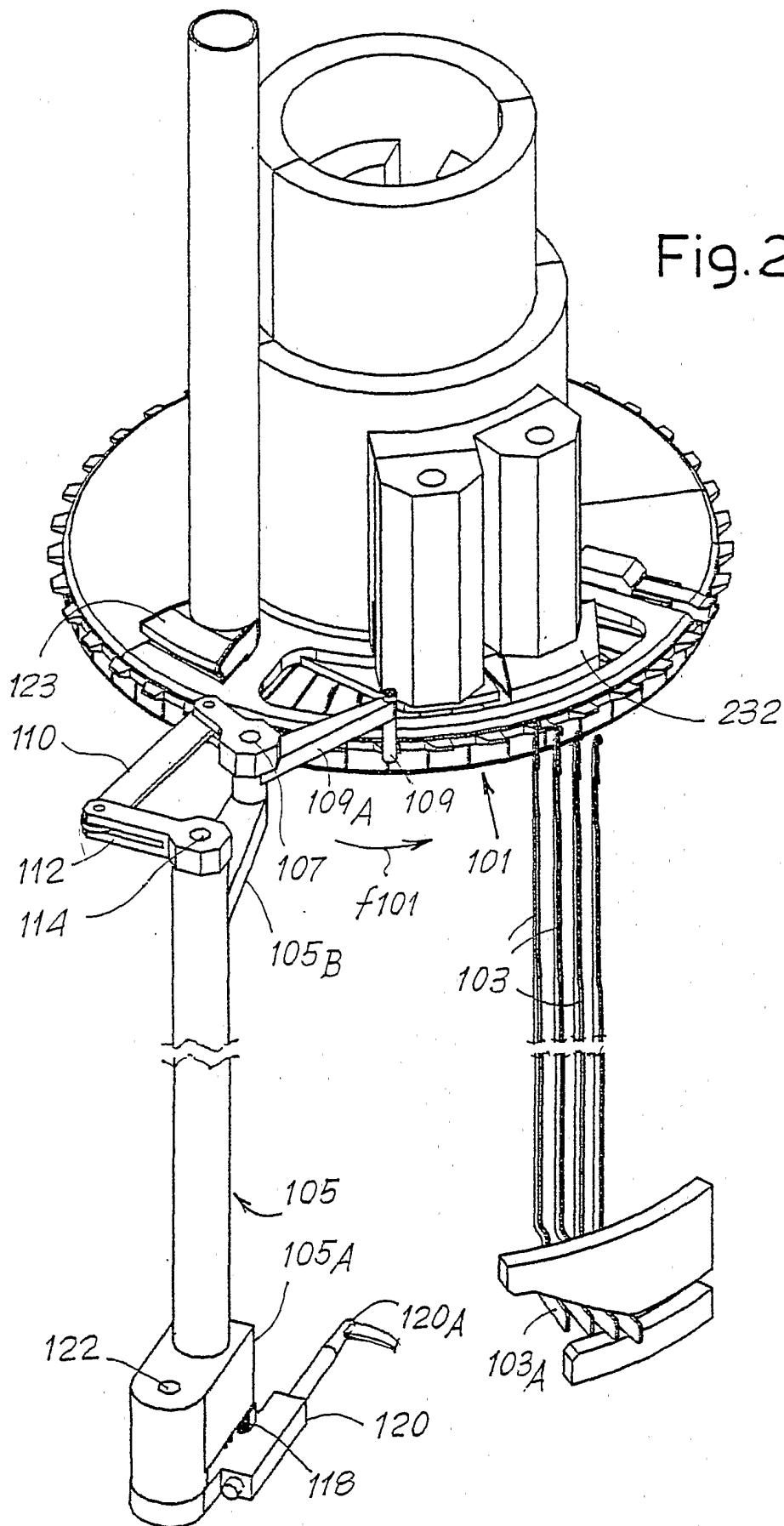


Fig.25



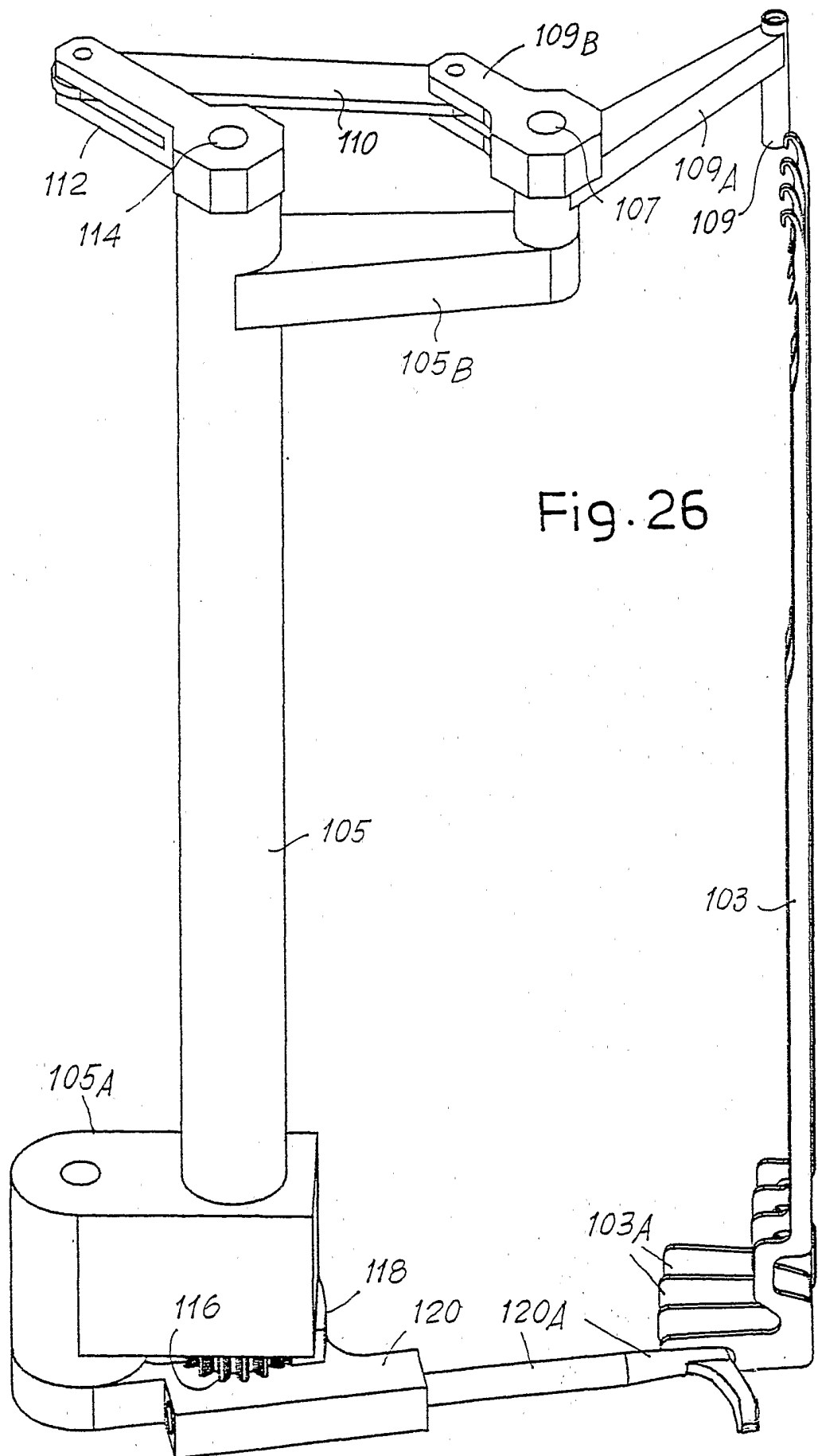


Fig. 27

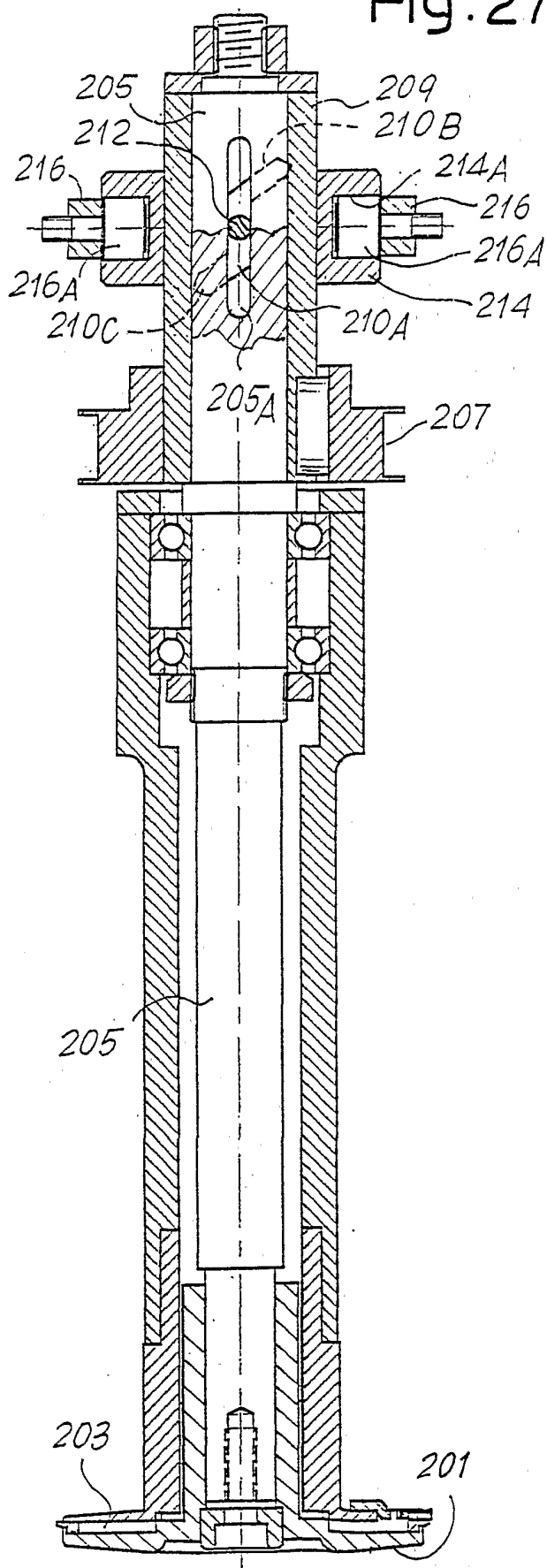
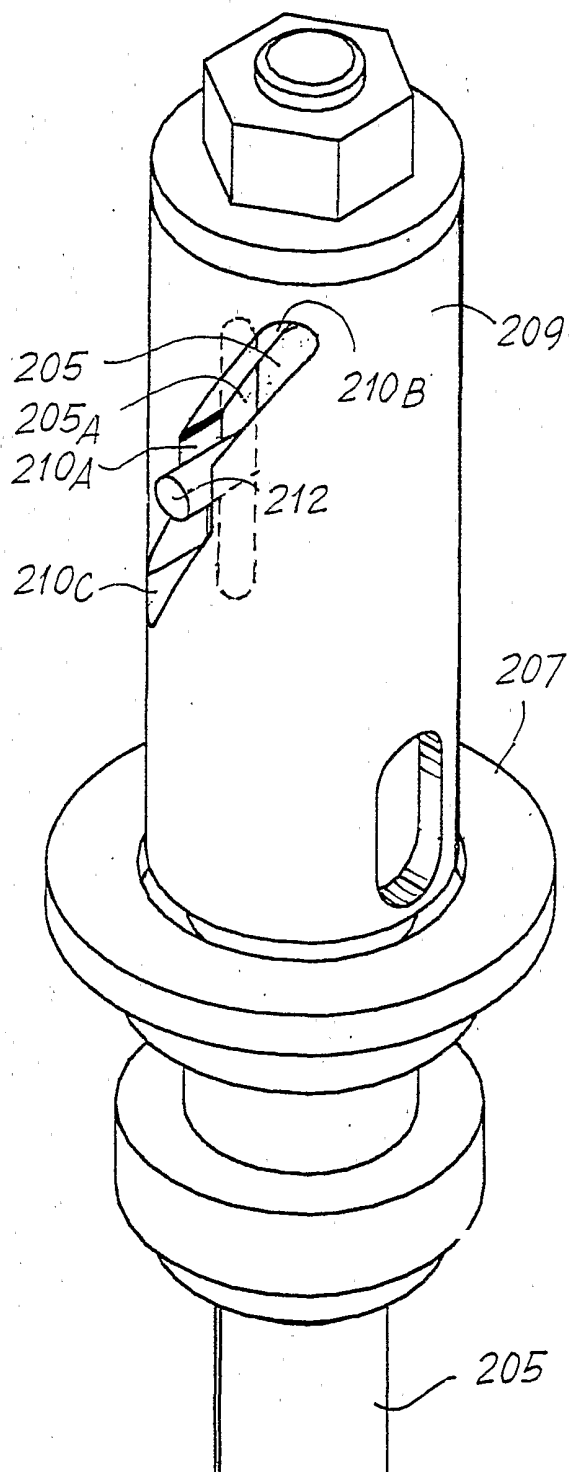
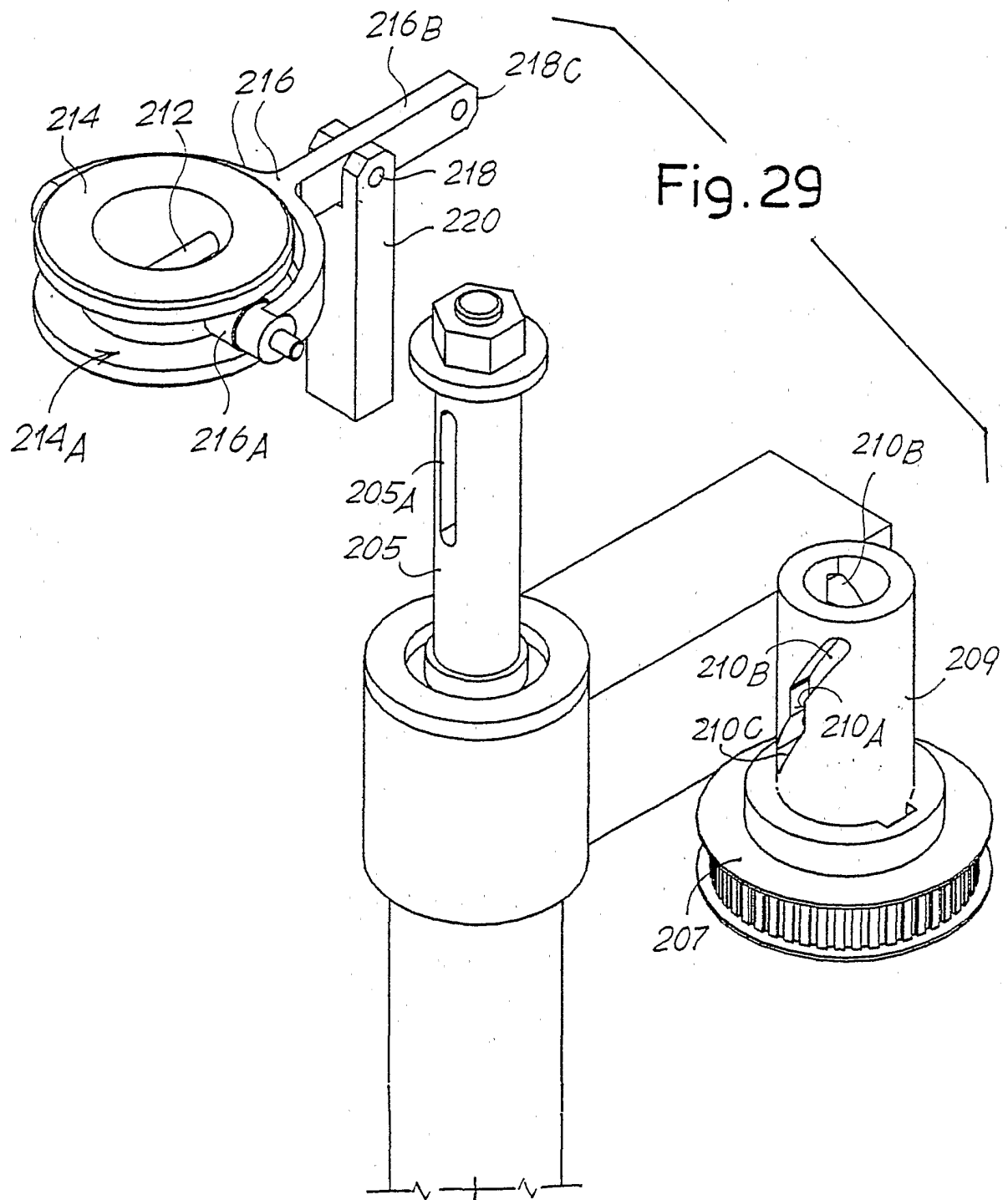
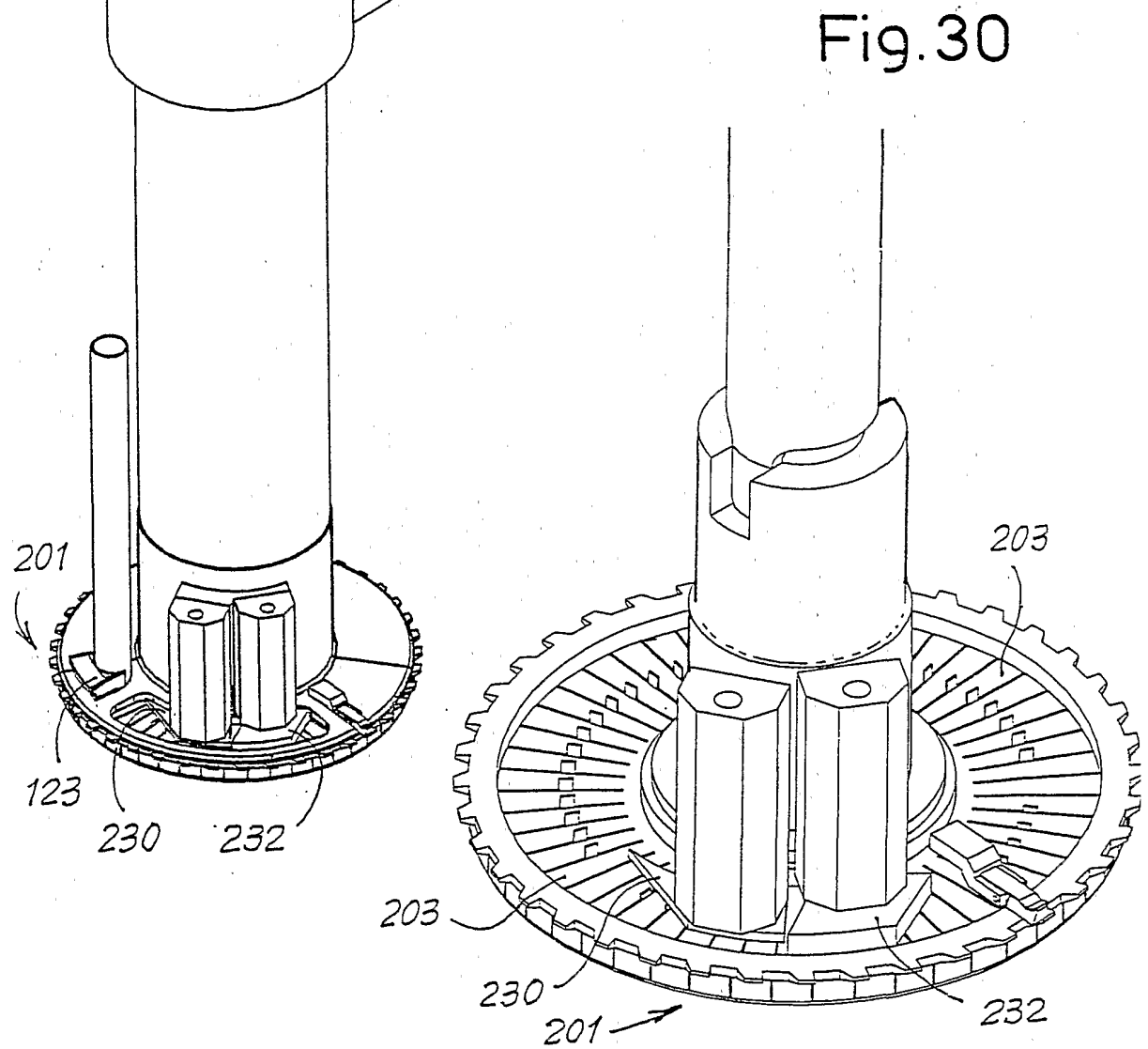
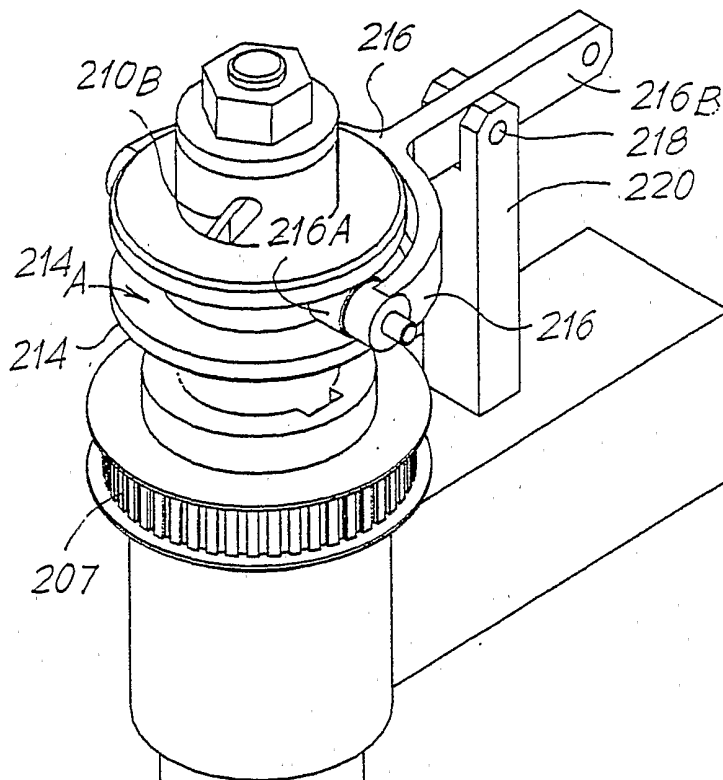


Fig. 28





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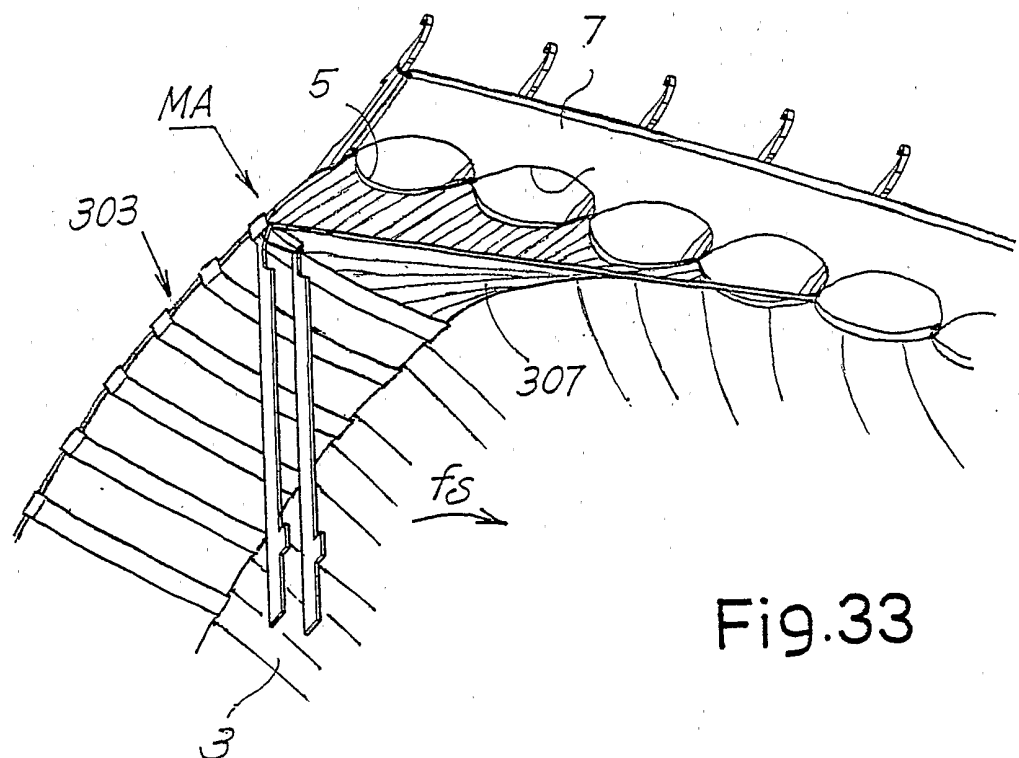
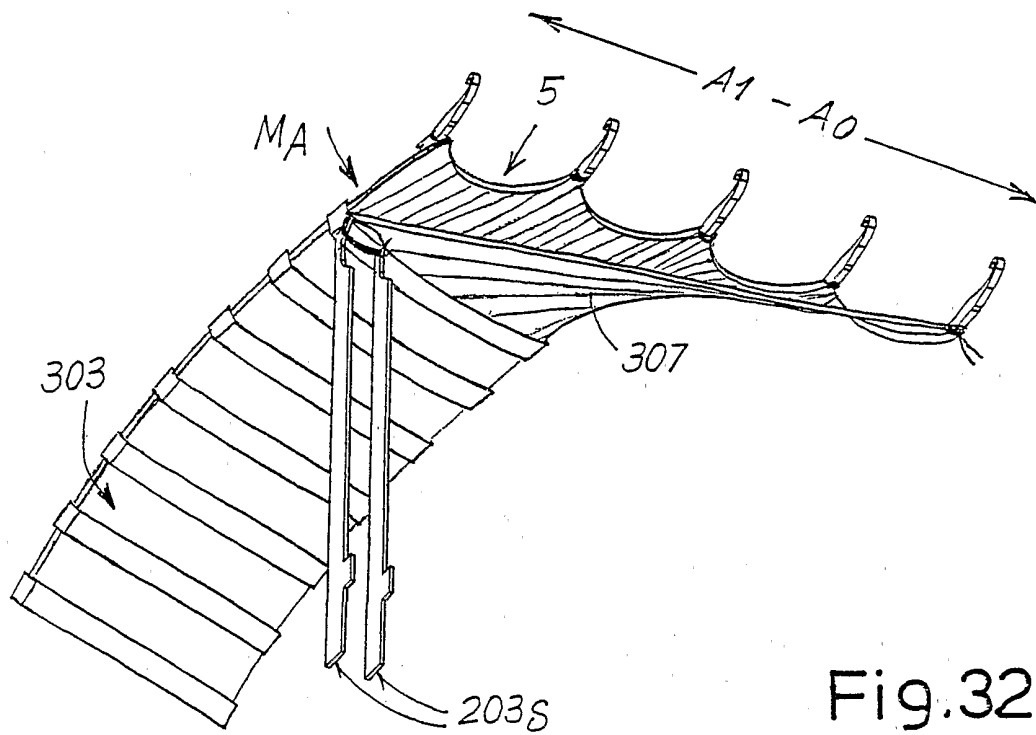


Fig.34

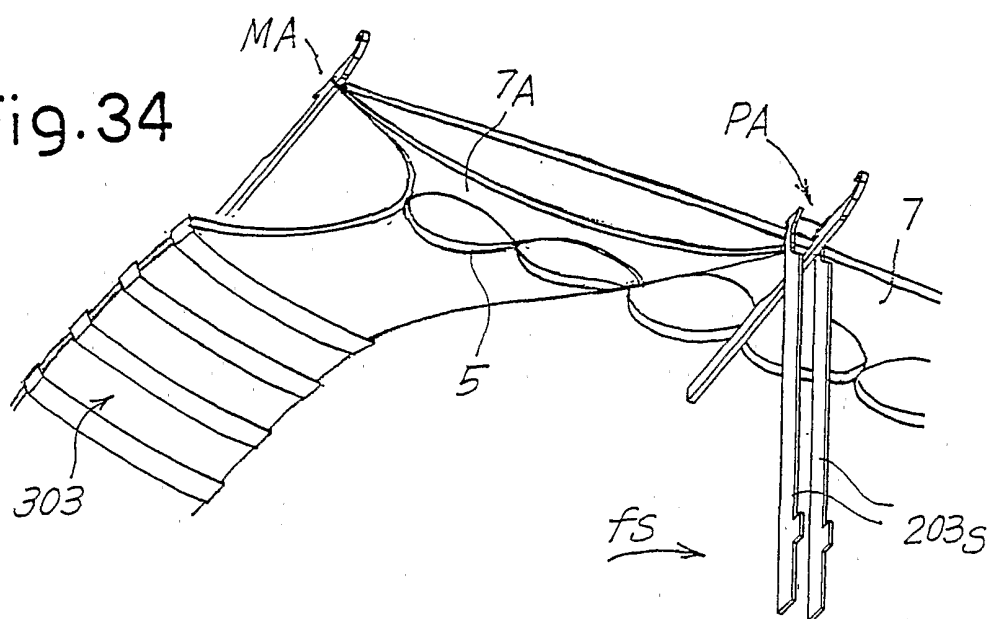


Fig.35

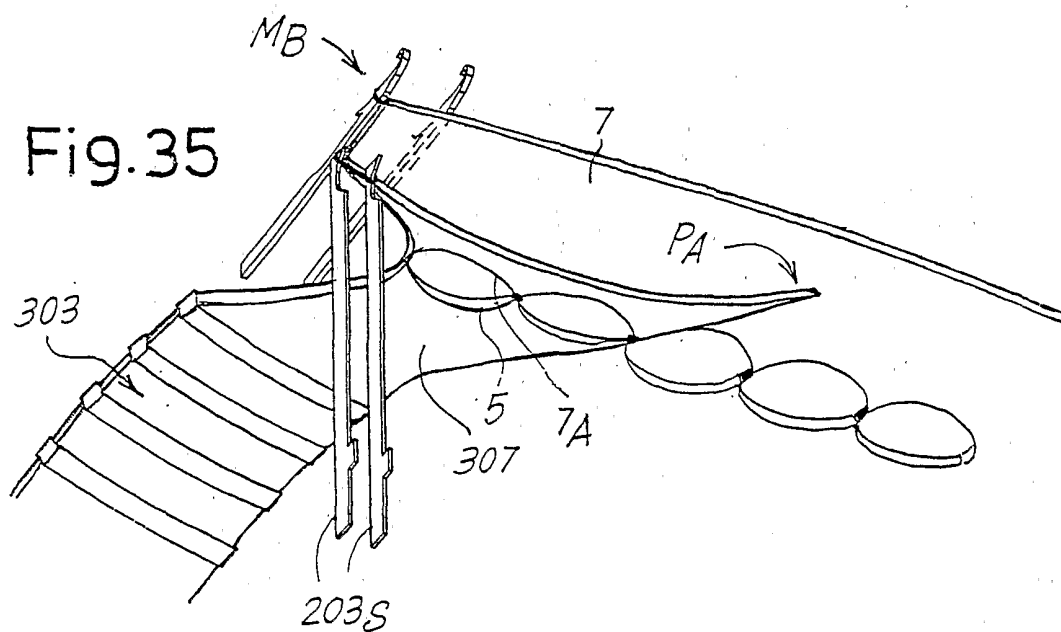


Fig.36

