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## EUROPEAN PATENT APPLICATION

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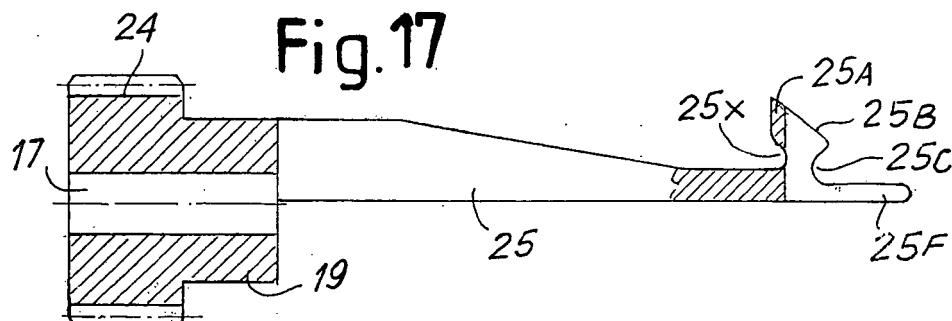
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### (54) Device and method for closing the toe at the end of tubular hosiery articles

(57) To transfer the stitches from a first needle arc (7X) to a second opposed needle arc (7Y), a overturnable semicircular sector (19) presents elements (25) terminating in a bifurcate way (25F) (flanking inside the respective sinkers (11) the relevant needle (7X) of the first arc), each

of which has an upper fork projection (25A) embracing the needle (7X) and forming a rear recess (25X) and a front recess (25C) suitable to engage an end stitch (MI) formed by the corresponding needle (7X), said stitch (MI) then being transferred and engaged on a corresponding needle (7Y) of the second needle arc.



## Description

**[0001]** The invention relates to a device, which is combined with a circular knitting machine, for producing the closure of tubular hosiery articles produced by this machine.

**[0002]** Attempted solutions to this problem have not proved satisfactory. Solutions in which the articles are transferred from the production machine to a separate device have proved somewhat unsatisfactory and/or too costly and/or too bulky, especially if combined with each single machine.

**[0003]** The invention solves these problems, and also achieves other objects and advantages, which are apparent from the text below.

**[0004]** The device in question - for closing the end of hosiery articles on the same circular machine on which they are produced - is of the type of those that adopt a sector- generally semicircular - to transfer the stitches from a first needle arc to a second opposed needle arc, as defined in the Italian patent application no.FI2006A000025 of 21.01.2006.

**[0005]** According to the invention, elements terminating in a bifurcate way are provided in said sector, each of which flanks - inside respective sinkers - the relevant needle of the first arc; each of said shaped elements terminating in a bifurcate way superiorly presents a fork projection embracing the needle and forming a rear recess and two front recesses, suitable to engage an end stitch formed by said needles.

**[0006]** There are also provided:

- means to raise and lower the needles of the first arc to unload said end stitch, which thus remains engaged on said fork projection;
- means to rotate said sector through approximately 180° and to take the end stitches engaged on said recesses to correspond with the needles of the second arc; and
- means to raise said needles of the second arc to a retained level so that each of them maintains the stitch formed thereby and to engage also the corresponding stitch engaged on said recesses and to thus form ranks of double closing stitches with the needles of the second arc.

**[0007]** Advantageously said fork projection presents the upper surface inclined.

**[0008]** A profile can also be provided, suitable to ensure raising of the latch of the needle, during initial lowering of the needle to release the stitches that are to be transferred from the first needle arc to the second needle arc, regardless of the presence of the released stitch.

**[0009]** Other characteristics are defined in the secondary claims below.

**[0010]** The invention also relates to a process for closing the end of hosiery articles on the same circular machine that produced them, with a sector - mostly semi-

circular - for transfer of the stitches from a first needle arc to a second opposed needle arc, as defined in the relevant claims.

**[0011]** The invention will be better understood from following the description and accompanying drawing, which shows a non-limiting practical example of the invention. In the drawing:

Figs. 1 to 3 show in an axial section the upper part of the needle cylinder with accessories and with the device of the invention, in three subsequent arrangements;

Figs. 4, 5 and 6 are local sections according to IV-IV, V-V and VI-VI of Fig. 1;

Fig. 7 shows the area indicated by the arrank  $f_{VII}$  of Fig. 1, in a step prior to transfer;

Figs. 8 and 9 are local sections in arrangements subsequent to that of Fig. 7;

Figs. 10, 11 and 12 show, analogously to Fig. 7, two of the arrangements prior to transfer;

Figs. 13, 14 and 15 show the area indicated by the arrow  $f_{XI}$  of Fig. 3, in subsequent operating steps implemented after transfer;

Figs. 16 and 17 show in a isolated way a plan view of a portion of the semicircular sector isolated, without stitches and with stitches;

Fig. 18 is a local section according to XVIII-XVIII of Fig. 16;

Figs. 19 and 20 show an enlarged detail of Fig. 18, viewed from the line XIX-XIX of Fig. 20, complete with relevant components, and a view from the line XX-XX of Fig. 19.

**[0012]** In the drawing, the reference 1 indicates a motor cylinder which rotates to draw in rotation - by means of tabs 3 or equivalent members - the needle cylinder 5, in the external longitudinal channels 5A of which the needles 7X and 7Y slide. The conventional collar 9 with radial channels 9A for sliding of the sinkers 11 is combined superiorly with the needle cylinder 5. Arrangement is customary.

**[0013]** The reference 13 indicates a cylinder which is coaxial and which rotates with the motor cylinder 1 and with the needle cylinder 5; two diametrically opposed supports 15 are provided on the upper edge 13A thereof, on which a semicircular sector 19 is pivoted with diametrical pins 17; said sector 19 is capable of overturning through approximately 180° to be arranged alternately corresponding to a first approximately semicircular needle arc 7X and at a second and opposed needle arc 7Y. To control overturning of the sector 19 alternately, a cylinder 21 is provided around the cylinder 13; the upper edge 21A of the cylinder 21 presents at least one tooth 23 which meshes with a tooth 24 of the sector 19 and coaxial to the pins 17. The cylinder 21 can rotate with the cylinders 13 and 5 through the action of the motor cylinder 1, as a constraining pin 27 is provided. The cylinder 21 can be angularly displaced by a few degrees with respect

to the cylinder 13, to control overturning of the sector 19 through the toothings 23 and 24.

**[0014]** The two cylinders 13 and 21 and the sector 19 can be raised and lowered together axially with respect to the needle cylinder, for purposes that will be explained below; this is permitted by a vertical slot 1Y of the cylinder 1, through which the pin 27 that draws the two cylinders 13 and 21 in rotation passes. Also the needle cylinder 5 with the sinkers 11 can be axially displaced, to obtain prompt dimensional variations of the stitches of the tubular knitted fabric of the article. The cylinder 21 presents a limited slot 21X (Fig. 5), so that it can be made to rotate with respect to the other cylinders 13 and 1.

**[0015]** A customary tubular guide 31 is provided inside the cylinder 13, to implement pneumatic tensioning of the article being formed, with a suction current.

**[0016]** Each sinker 11 presents the customary shaped slot 11A, to cooperate with the hook of the needle 7X and 7Y, for customary knitting of the tubular article of the sock or other equivalent article.

**[0017]** At the end of forming of the tubular fabric, the toe of the article can be closed, if necessary after forming a pocket with the needles of the first arc, with continuous motion or with alternating motion of the needle cylinder. The sector 19 must then be overturned with the end edge formed by the first needle arc 7X, until the last stitches formed by the needle arc 7X are combined with the last stitches formed by the second needle arc 7Y. This is implemented by the special structure of the sector 19, suitable to cooperate with the sinkers and with the needles.

**[0018]** The sector 19 - according to the invention - can be moved between a lowered and inactive position below the area in which the shaped slots 11A of the sinkers 11 are located, and a raised and active position (Figs. 2, 8, 12) almost at the level of said shaped slots 11A. In the lowered position and in the arrangement of the sector 19 in correspondence of to the needles of the first needle arc (Figs. 1, 2, 7), the circular machine can form the article in the conventional manner, with or without the end pocket for the toe to be closed.

**[0019]** The sector 19, along the arcuate extension thereof, presents a plurality of radial appendages 25, each terminating with a pair of radially extending shaped elements 25F (see in particular Figs. 19 and 20); the two elements 25F of each pair extend approximately radially to flank one of the needles 7X of the first needle arc in the first arrangement (Figs. 1 and 2) and also one of the needles 7Y of the second needle arc, in the second overturned arrangement (Fig. 3) of the sector 19; the two shaped elements 25F of each pair are located between the relevant needle 7X and the two sinkers 11 which flank the needle and which cooperate therewith. The two shaped elements 25F of each pair superiorly present - in the arrangement in correspondence of the first needle arc 7X - a projection 25A which in the plan view extends in a radially oriented U-shape open toward the outside (see in particular Figs. 16 to 18) with an upper edge 25B which - when the sector 19 is in the raised arrangement

of Figs. 2, 8, 9 - approximately follows the profile of the shaped slot 11A of the relevant sinker; said edge 25B extends outward (with respect to the axis of the cylinders) with two edges 25C sunken toward the end of the element 25, 25F following approximately laterally the bottom of the slot 11A of the sinkers but projecting slightly with respect to said slot 11A.

**[0020]** In the placement described, with the element 25, 25F from the arrangement of Figs. 7 and 10 with the needles 7X maintained lowered without taking up thread, the sinkers 11 are moved away according to f19 (Fig. 11). In this manner, the last stitch M1 remains engaged on the element 25, 25A, so that the fabric ending with the rank of stitches MI can be easily transferred to the needles 7Y of the second needle arc, with overturning of the sector 19 about the pins 17.

**[0021]** The needles 7Y of the second arc are maintained idle and lowered, with the last stitch Mo engaged thereon. The needles 7X of the first needle arc are lowered without taking up thread, so that the last formed stitches MI remain engaged as specified above between the recesses 25C and 25X; these stitches MI are stressed by pneumatic tensioning through suction from the tube 31. To ensure that the latch of the needles 7X is lowered on the end thereof, said element 26 is provided, which promptly ensures raising of the latch of the needles 7X that start to be lowered; therefore the needles 7X safely release the stitch MI, which remains retained between the recesses 25X and 25C.

**[0022]** At this point - to actuate transfer of the stitches MI to the needles 7Y - the cylinder 13 and therefore the sector 19 are raised and through the toothings 23, 24 the sector 19 is overturned through 180° about the pins 17 drawing the stitches MI, which remain pneumatically tensioned and thus in an elongated and also enlarged arrangement, being engaged on the respective projections 25A extending with a radially oriented U-shape.

**[0023]** After overturning of the sector 19 (as indicated by the broken lines in Fig. 3) until reaching the position indicated in Figs. 3, 13, 14, the shaped elements 25A are positioned so as to embrace the relevant needles 7Y of the second needle arc. At this point, the needles 7Y of the second needle arc are raised inside the space of the respective projections 25A to a limited level (retained level) in which said needles 7Y maintain the stitch Mo of the last rank of stitches produced thereby but they come (fig. 14) so that they are able also to engage - together with the stitch Mo - the relevant stitch MI, which is enlarged by the respective projection 25A and by the pneumatic tensioning applied by the tube 31; in this manner the stitches Mo and MI are both engaged by the relevant needles 7Y of the second arc. At this point said needles 7Y of the second arc - with alternating motion or with continuous motion, and with final cut of the thread, form further ranks of stitches, in particular tight stitches and a final loose stitch or another solution, to in any case prevent unraveling of the finishing ranks of the article, for example closure of the final end of the article. The article-

when finished - is released.

[0024] With inverse movements, all parts are returned to the initial conditions.

[0025] It is understood that the drawing only shows an example provided purely as a practical arrangement of the invention, which may vary in forms and arrangement, without however departing from the scope of the concept on which the invention is based. Any reference numerals in the appended claims are provided purely to facilitate reading thereof with reference to the above description and to the drawing, and do not limit the scope of protection represented by the claims.

## Claims

1. A device for closing the end of tubular hosiery articles on the circular machine that produced them, with a sector (19) - substantially semicircular - to transfer the stitches from a first needle arc (7X) to a second opposed needle arc (7Y), comprising in said sector (19) elements (25) terminating in a bifurcate way (25F), each of which flanks - inside respective sinkers (11) - the relevant needle (7X) of the first arc, **characterized in that** each of said elements terminating in a bifurcate way (25F) superiorly presents a fork projection (25A) oriented approximately radially with respect to the needle cylinder embracing the needle (7X), said fork projection (25A) forming a rear recess (25X) and two front recesses (25C) for engaging an end stitch (MI) formed by said needles (7X) of the first needle arc; being also provided with: the customary means for raising and lowering the needles (7X) of the first arc to unload said end stitch (MI), which thus remains engaged on said fork projection (25A); means (17, 15, 24) to rotate said sector (19) through approximately 180° about a diametrical geometrical axis of the cylinder and to take the end stitches (MI) engaged on said recesses (25C; 25X) in correspondence of the needles (7Y) of the second arc; means to raise said needles (7Y) of the second arc to a retained level to maintain the stitch (Mo) formed by each of these needles and to also engage the corresponding stitch (MI) engaged on said recesses (25X and 25A) and to thus form a rank of double closing stitches (MI- Mo) with the needles (7Y) of the second arc; and means to move the sinkers (11) radially away, in the operation of forming said end stitches (MI).
2. Device as claimed in claim 1, **characterized in that** said fork projection (25A) presents the upper surface (25B) inclined.
3. Device as claimed in claim 1 or 2, **characterized in that** it comprises a profile (26) suitable to ensure raising of the latch of the needles (7X) during initial lowering of each needle (7X), in the operation prior

to transfer of the stitches (MI) to the needles (7Y) of the second needle sector.

4. Device as claimed in at least claim 1, **characterized in that** it comprises means to maintain said shaped elements (25) in an excluded lowered arrangement until the time of end closing of the article and to lift them to engage the stitches on said fork shaped elements (25, 25A).
5. Device as claimed in claim 4, **characterized in that** it comprises a unit (13, 15) on which said sector (19) is articulated, said assembly being capable of rotating with the needle cylinder (5) and to be raised and lowered axially with respect to said cylinder (5) to reach a lowered idle position and a raised active position and to engage the stitches (MI) of the needles (7X) of the first arc and to transfer them to the needles (7Y) of the second arc engaging an end stitch (Mo) thereof.
6. Device as claimed in at least one of the preceding claims, **characterized by** comprising a tubular member (13, 13A, 23) capable of following raising and rotation of the needle cylinder (5) and to perform a partial rotation with respect to the needle cylinder (5) to control overturning of said sector (19).
7. Device as claimed in at least one of the preceding claims, **characterized in that** the means to raise and lower sinkers and needles are controlled to form tight end stitches and at least one final loose stitch in the first needle arc (7X), and to form with the needles (7Y) of the second needle arc close stitches tightened on both edges that are in a closing step and at least one final loose stitch.
8. A process for closing the end of hosiery articles on the circular machine that produced them, by means of transfer of stitches formed by a first needle arc (7X) to the needles (7Y) of a complementary opposed needle arc, **characterized in that**:
  - the end stitch (MI) of each of the needles (7X) of a first needle arc is engaged on a respective U-shaped element (25, 25A) rearwardly flanking each respective needle (7X) of the first needle arc;
  - **in that** the needles (7X) of the first arc are raised to unload the end stitches (MI), having engaged them on said shaped elements (25, 25A);
  - **in that** a sector (19) on which said shaped elements (25, 25A) are mounted is rotated through approximately 180° to take the stitches engaged on said shaped elements (245, 25A) in correspondence of with needles of the second arc; and

- **in that** said needles (7Y) of the second arc are raised to the retained level of the last stitch (Mo) thereof to also engage the corresponding stitches (MI) disengaging them from the shaped elements (24, 25A), to form ranks of double closing stitches (MI, Mo). 5

9. Process as claimed in claim 8, **characterized in that** said shaped elements (25, 25A) are maintained in an excluded arrangement until the steps for end closing of the article. 10

10. Process as claimed in at least one of claims 8 and 9, **characterized in that** tight end stitches and at least one final loose stitch (MI) are formed for release 15 by the needles (7X) of the first needle arc, and **in that** tight stitches are formed on the two edges connected in the closing step and at least one final loose stitch by the needles (7Y) of the second needle arc. 20

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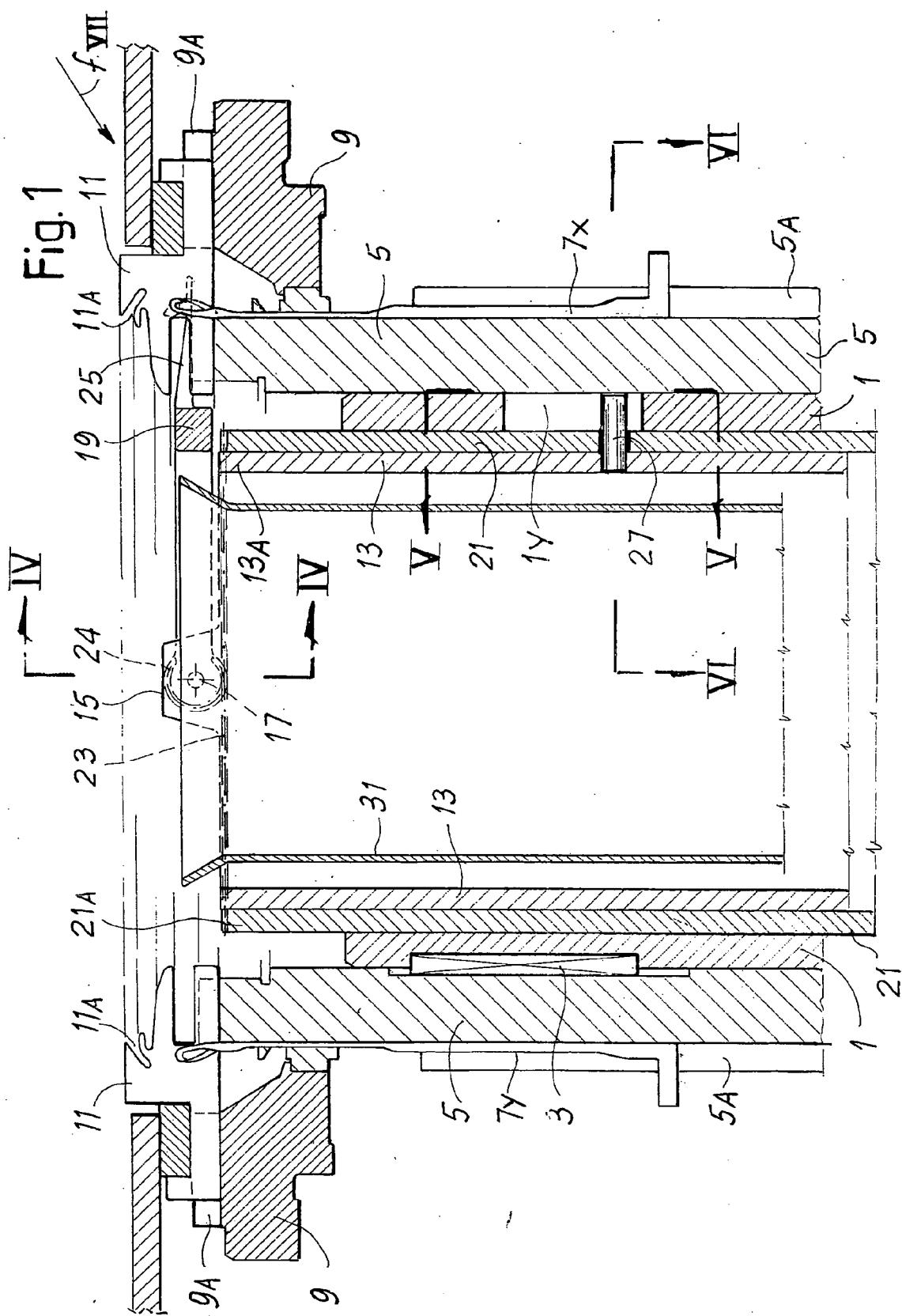
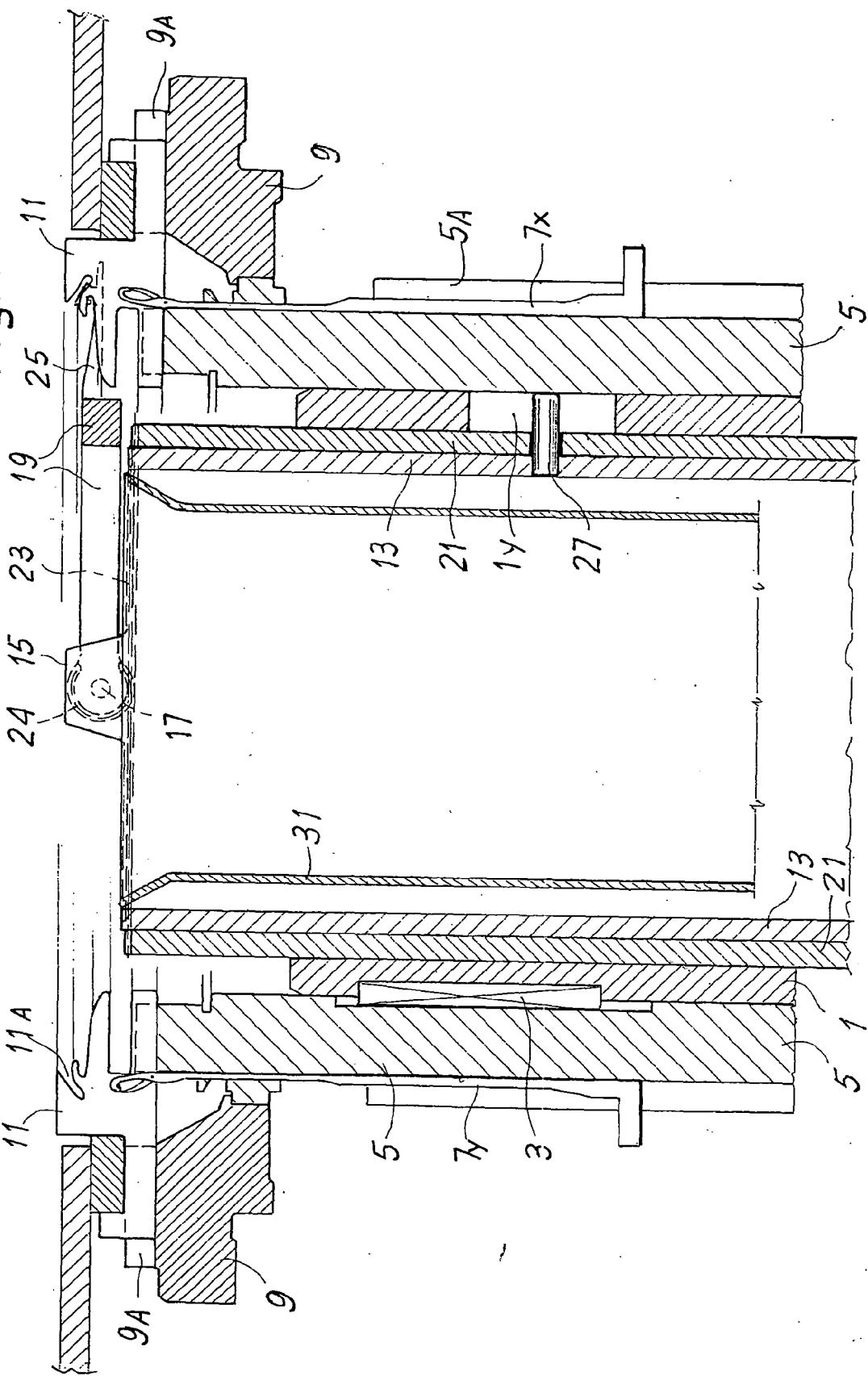
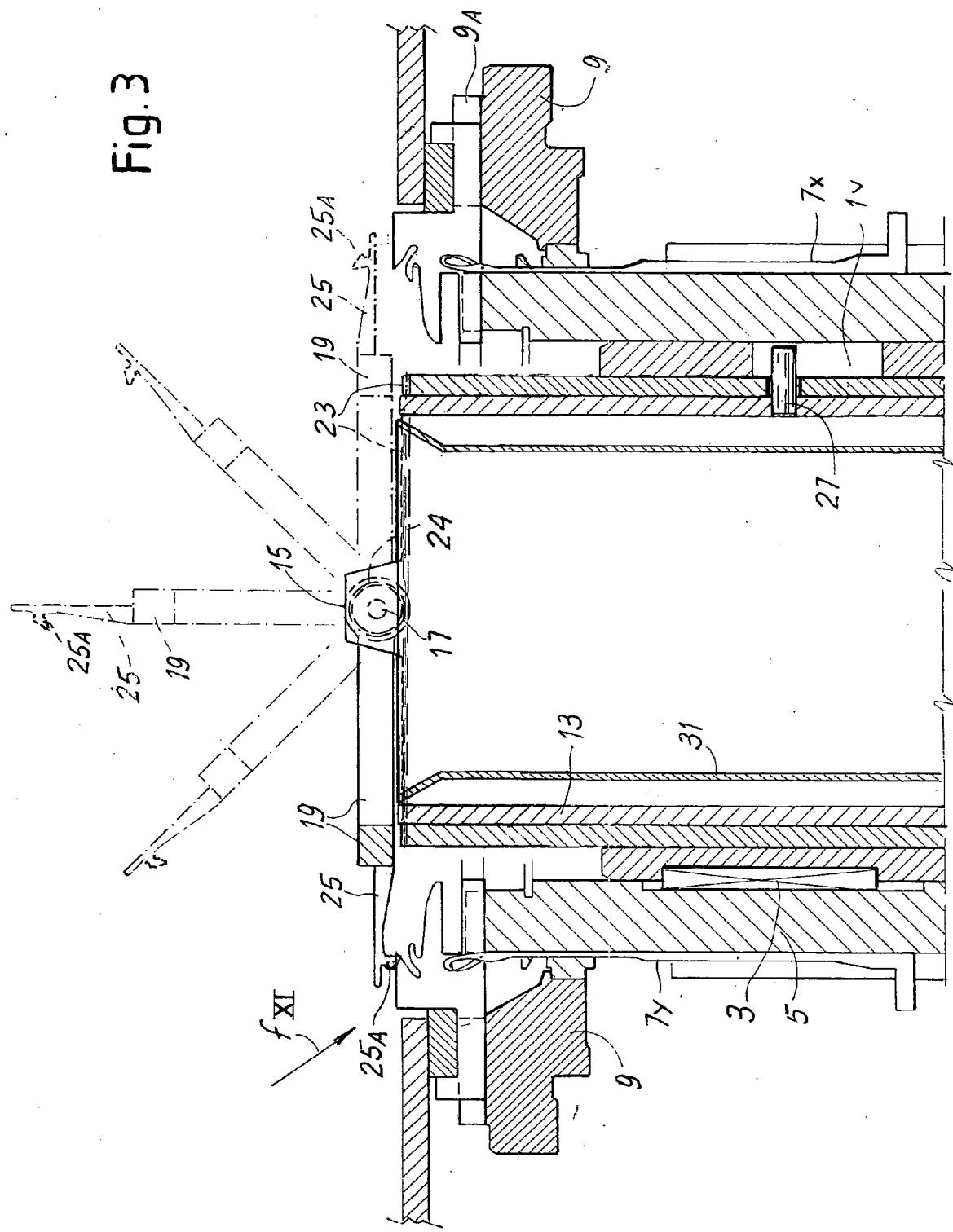


Fig. 2



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九  
正



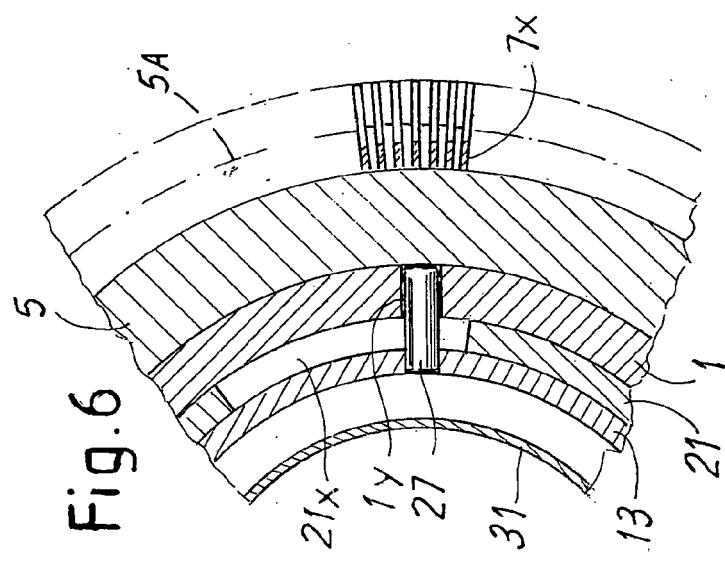
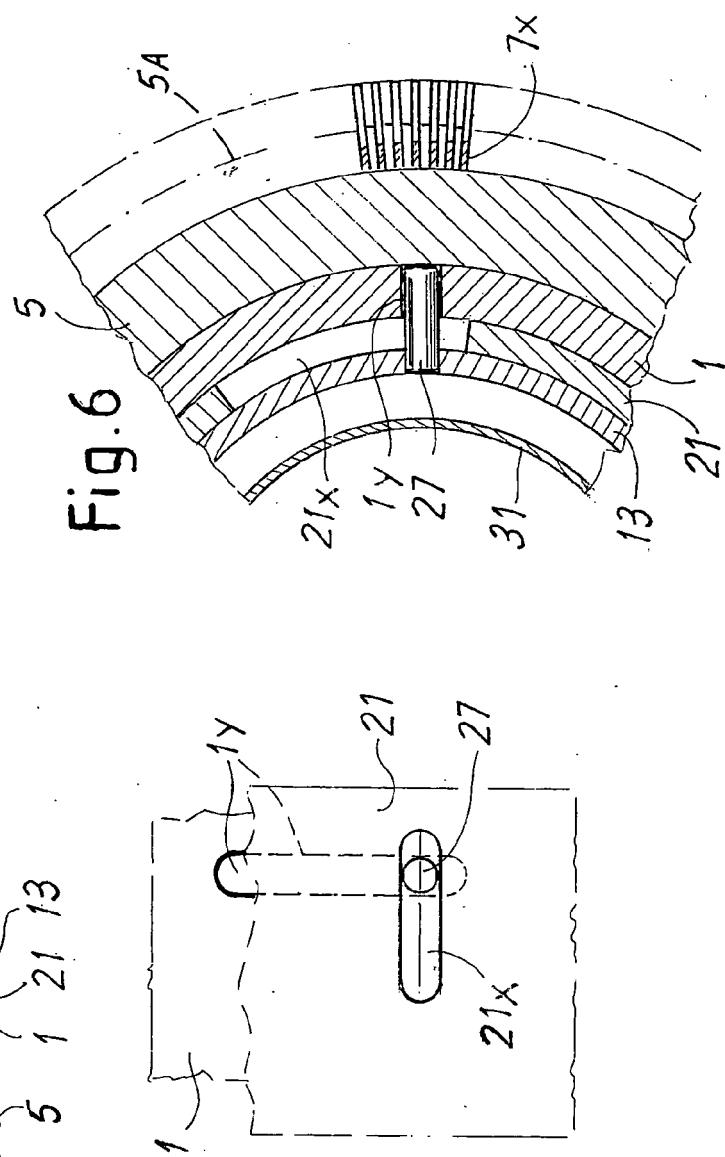
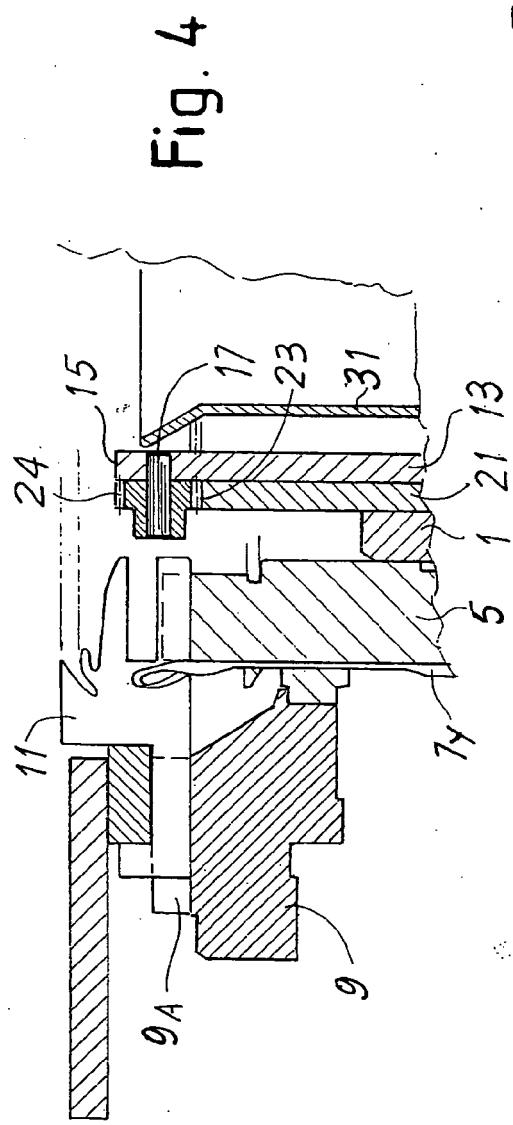


Fig. 7

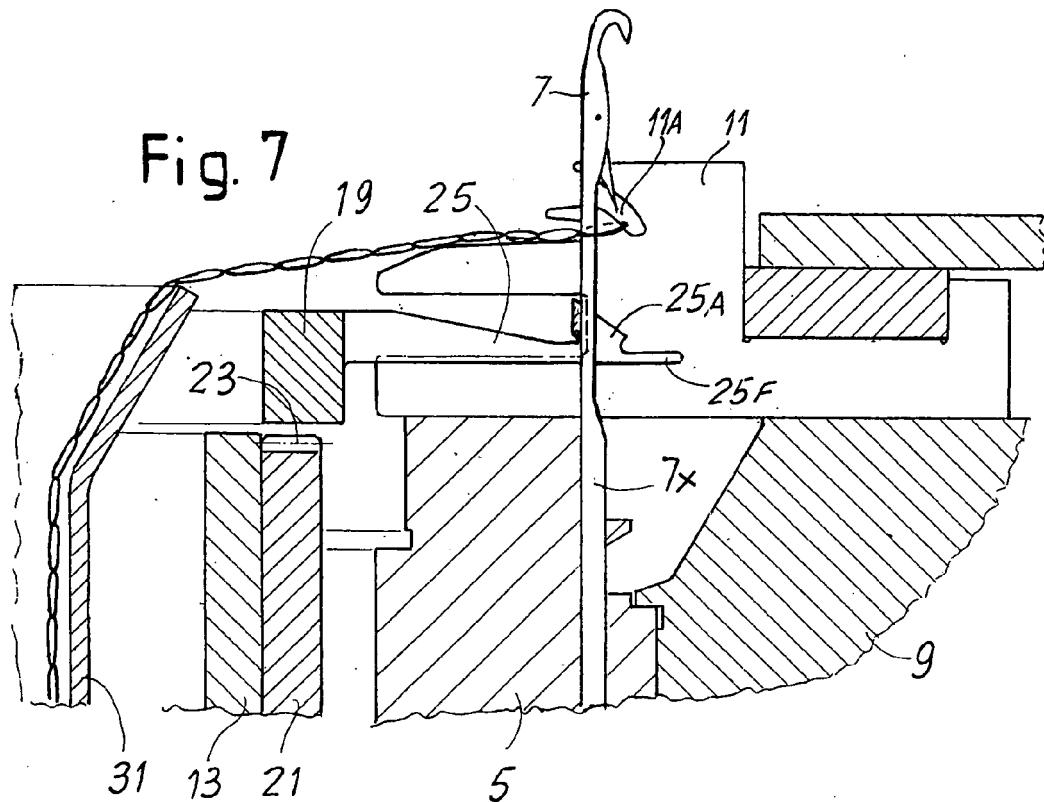
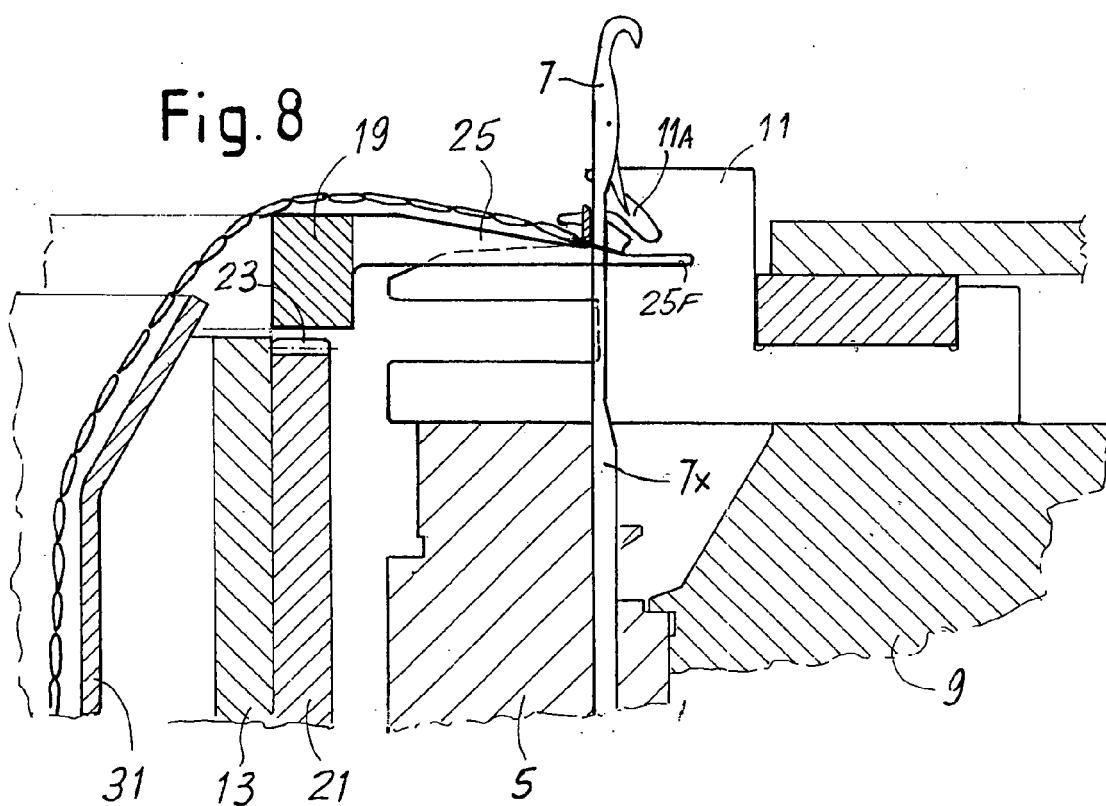
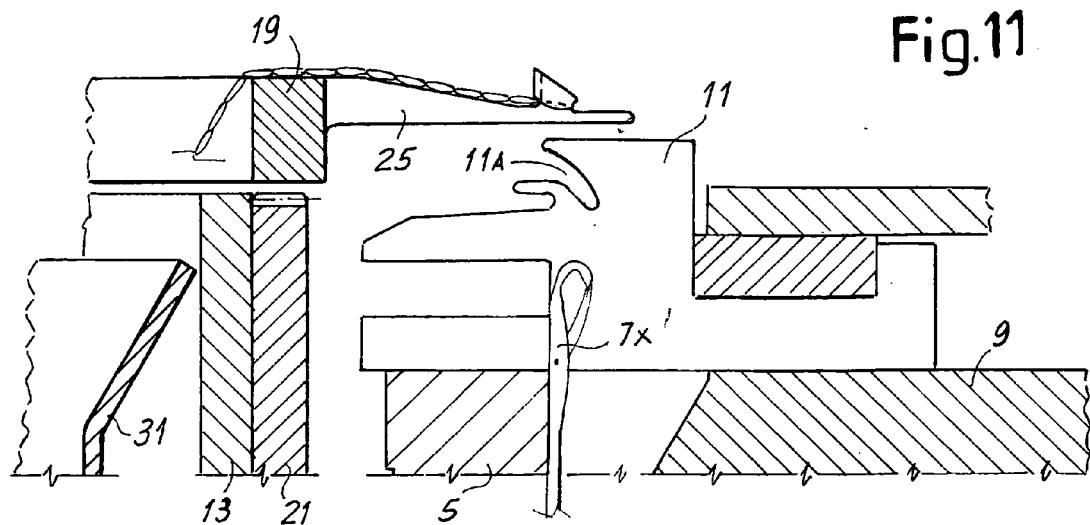
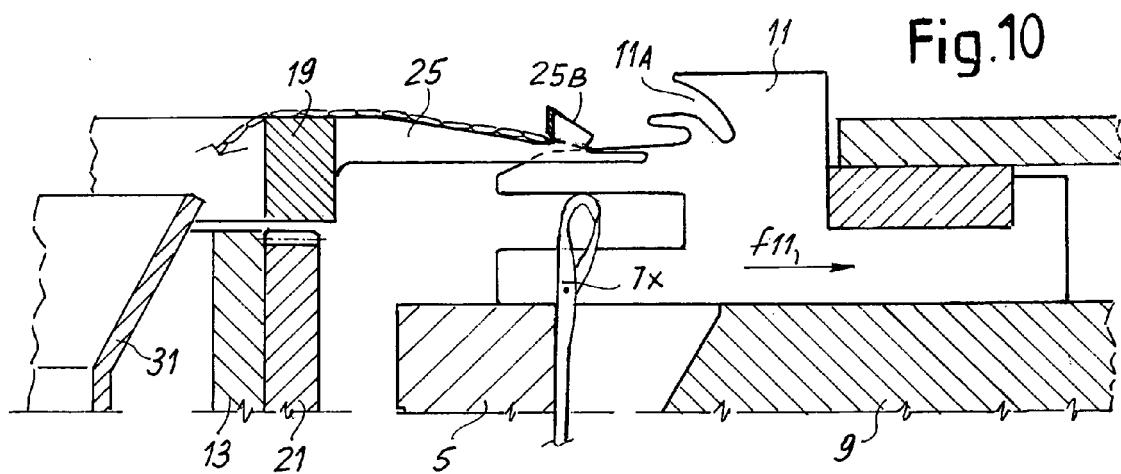
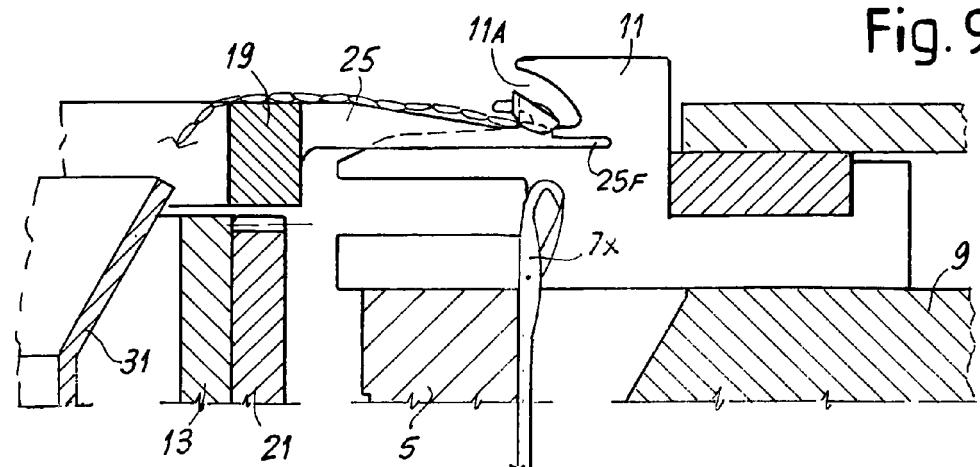


Fig. 8





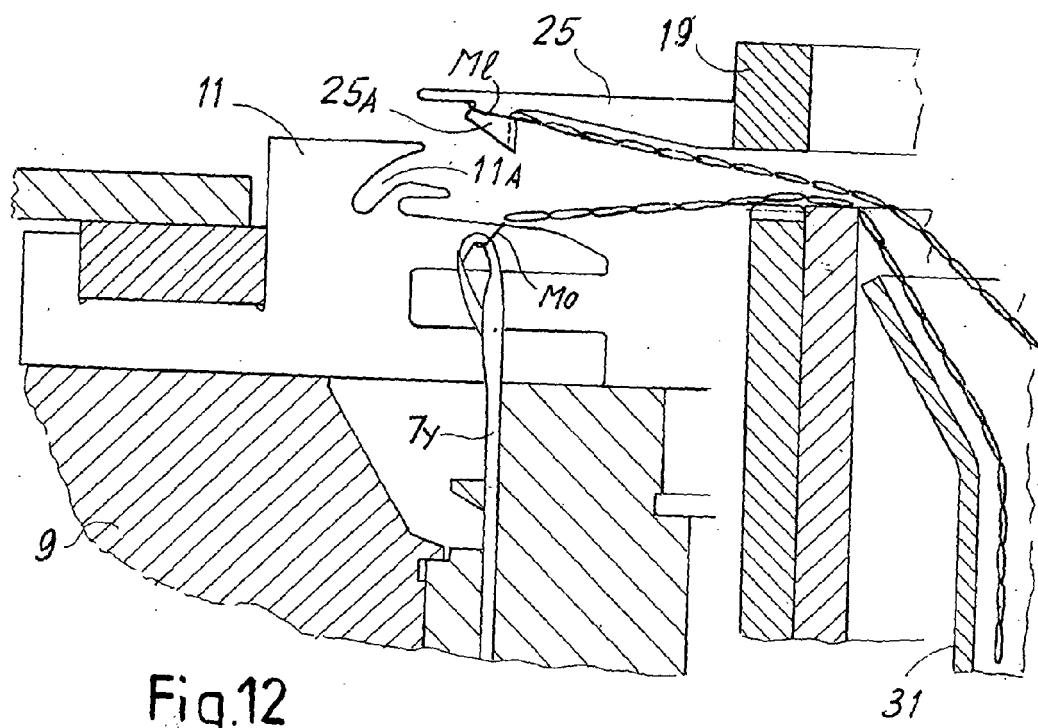


Fig.12

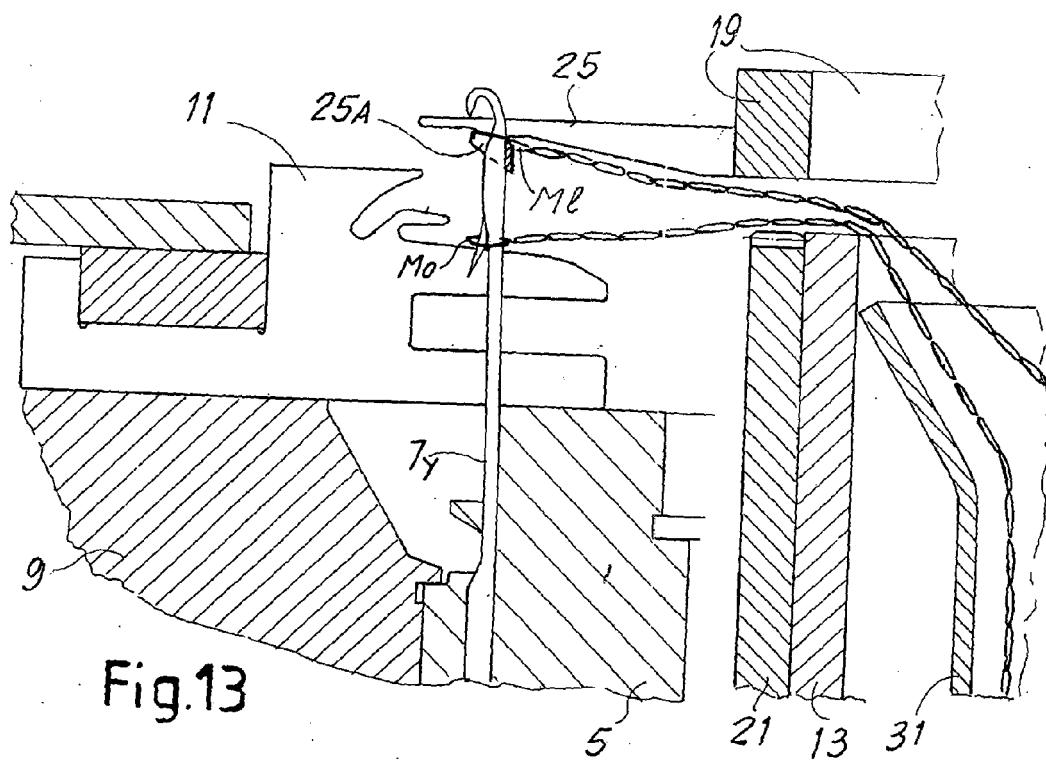
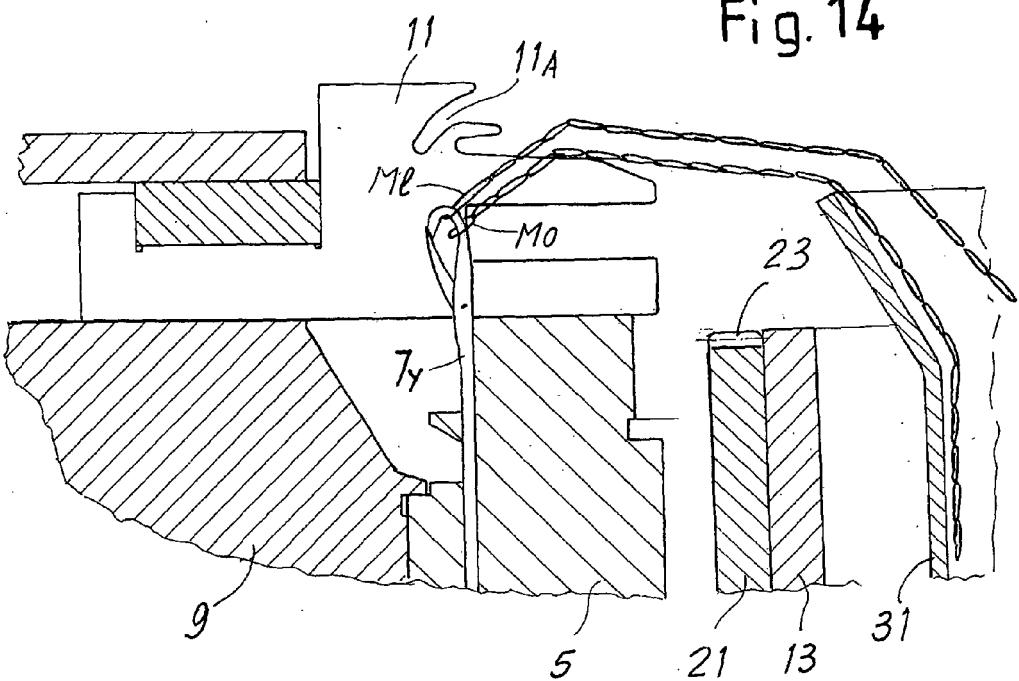


Fig.13

Fig. 14



XVII

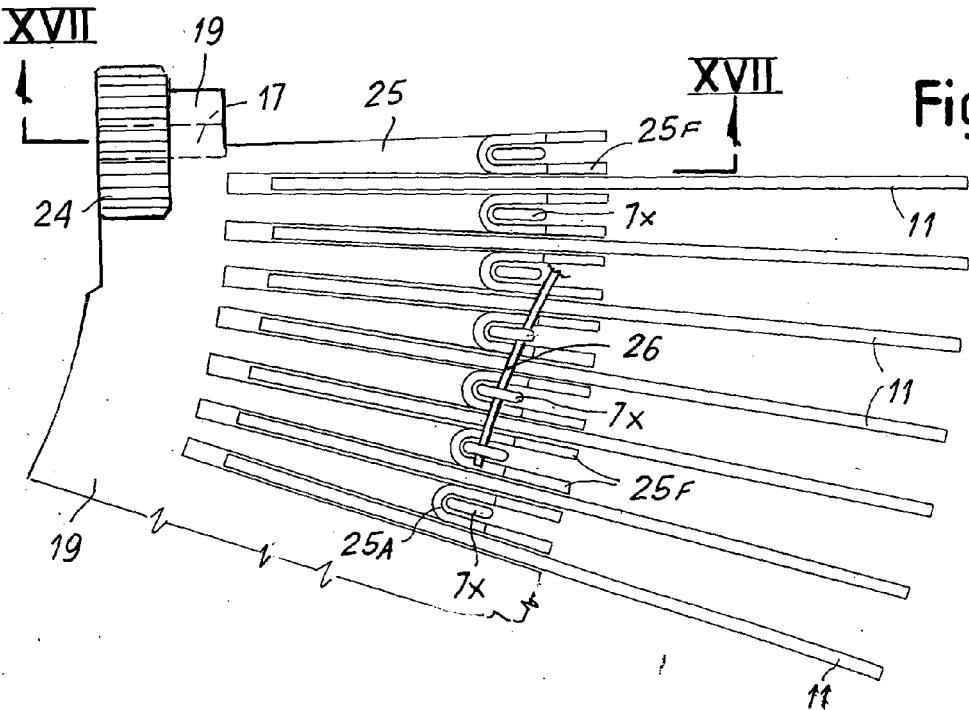


Fig. 15

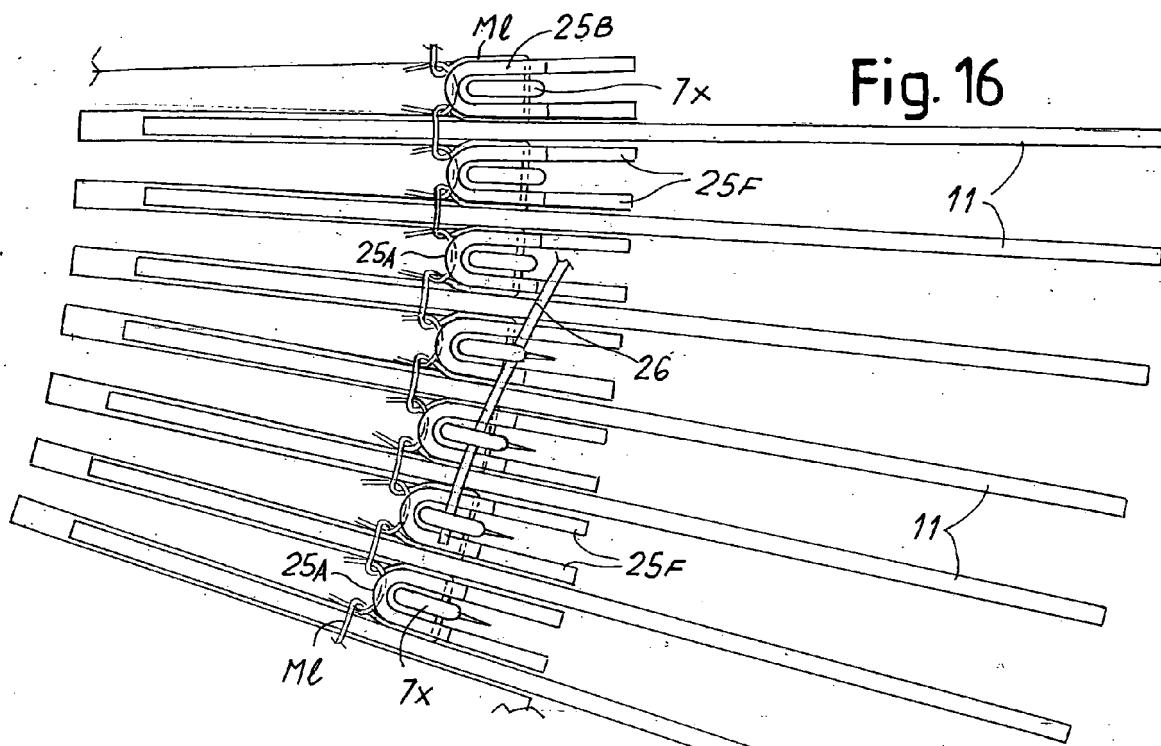


Fig. 16

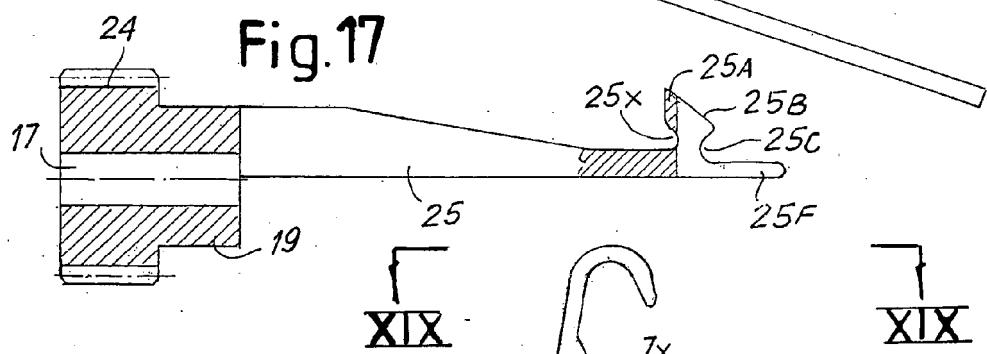


Fig. 17

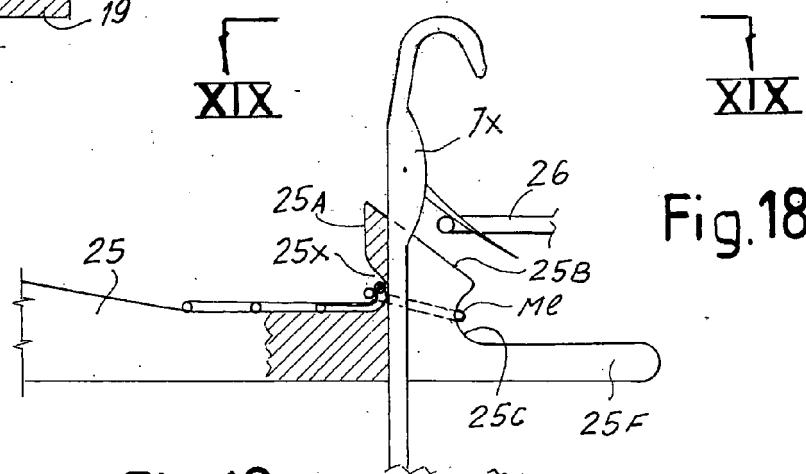


Fig. 18

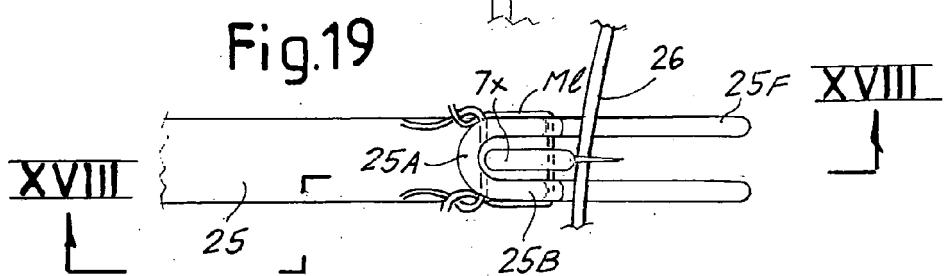


Fig. 19



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Application Number  
EP 08 42 5797

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2	The present search report has been drawn up for all claims		
Place of search		Date of completion of the search	Examiner
Munich		27 May 2009	Pieracci, Andrea
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	
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EP 08 42 5797

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