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(71) Applicant : **PRETTY POLLY LIMITED**
Unwin Road
Sutton-In-Ashfield, Nottinghamshire (GB)

(72) Inventor : **Hancock, John**
10 Landsdowne Avenue
Mansfield Nottinghamshire NG18 4QJ (GB)

(74) Representative : **Dealtry, Brian**
Eric Potter & Clarkson St. Mary's Court St. Mary's Gate
Nottingham NG1 1LE (GB)

(54) Multi-feed circular knitting machine.

(57) A circular knitting machine having a plurality of knitting stations and a plurality of needles, at least one knitting station having a raising cam (20), a stitch cam (16) and a landing cam (18) co-operating with the stitch cam, at least the landing and/or stitch cam being movably mounted for radial movement relative to the axis of rotation of the machine between a normal operating position and a retracted position, the needles of the knitting machine including a group of needles having relatively long butts (22) and at least one further group having relatively short butts (24), said relatively short butts (24) being such that when said cam is at its retracted position the short butts are able to pass said cam without contact therewith whereas the relatively long butts (22) are such as to be capable of contacting said cam when in its retracted position.

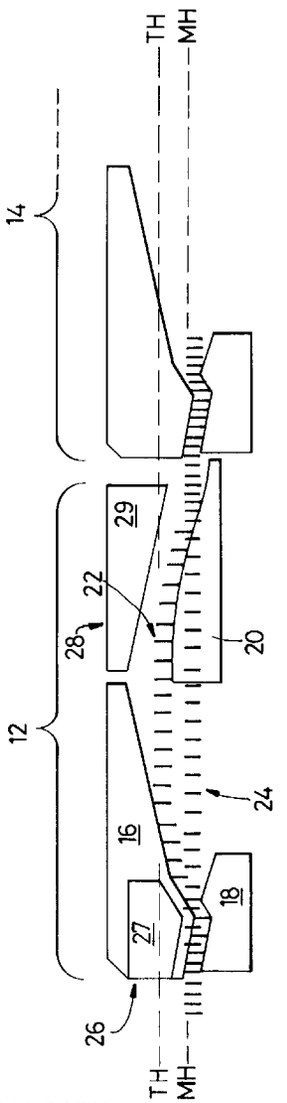

Fig.1

EP 0 541 380 A1

The present invention relates to a multi-feed circular knitting machine and a method of operating such a machine.

When knitting articles in which it is desired to lay-in or knit in elastomeric yarns such as Lycra (RTM), it is known to feed in the Lycra at a knitting station so that certain needles pass by the yarn feed associated with the knitting station at tuck height or higher respectively so as to pick-up the Lycra whilst other needles pass by at miss-knit height so as not to pick-up the Lycra. If the needles passing the knitting station are at tuck height the Lycra is laid into the knitted structure. This is generally performed for the knitting of stockings or tights.

A problem associated with laying in Lycra in the above manner is that the knitting machine has to be slowed down during the laying in procedure. This is undesirable as it reduces the production capability of the knitting machine.

Slowing down of the knitting machine is necessary since those needles passing by the knitting station at miss-knit height tend to either (i) engage the landing or upthrow cam associated with the knitting station and are raised thereby before engaging the associated stitch cam or (ii) engage the stitch cam. Whether it is the landing or stitch cam which is engaged tends to depend upon the make of knitting machine.

If the knitting machine is run at normal speed, needles hitting the landing cam or stitch cam are thrown into contact with these cams and the resulting vibration can cause needle breakage. Accordingly, in practice, the machine is run at a slower speed to reduce the likelihood of needle breakage occurring in this manner.

According to one aspect of the present invention there is provided a circular knitting machine having a plurality of knitting stations and a plurality of needles, at least one knitting station having a raising cam, a stitch cam and a landing cam co-operating with the stitch cam, at least the landing and/or stitch cam being movably mounted for radial movement relative to the axis of rotation of the machine between a normal operating position and a retracted position, the needles of the knitting machine including a group of needles having relatively long butts and at least one further group having relatively short butts, said relatively short butts being such that when said cam is at its retracted position the short butts are able to pass said cam without contact therewith whereas the relatively long butts are such as to be capable of contacting said when in its retracted position.

Preferably all the needles have single butts.

Preferably the raising cam is also movably mounted for movement to a retracted position corresponding to the retracted position of the landing and/or stitch cam.

Preferably a face cam is provided adjacent to the landing or upthrow cam for slidingly contacting the shank of the needles so as to retain the needles within their tricks on retraction of the landing and/or stitch cam to its retracted position.

Preferably, if the raising cam is retractable, a further face cam is located adjacent thereto for slidingly contacting the shank of the needles.

According to another aspect of the present invention there is provided a cam assembly for a circular knitting machine, the cam assembly including a body for mounting on the knitting machine, the body including a stitch cam and an associated landing cam, the landing cam and/or stitch cam, being movably mounted on the body for movement between an extended position for engagement with all needles of the knitting machine and a retracted position for engagement with a selected group of needles. Preferably the stitch cam and landing cam are both movably mounted for movement between extended and retracted positions.

Preferably the stitch and landing cams are mounted on a common support which is movably mounted on the body.

According to another aspect of the present invention there is provided a method of knitting an article on a circular knitting machine having a plurality of knitting stations, the method including at at least one knitting station retracting a landing and/or stitch cam to permit needles arriving at the knitting station at miss-knit height to pass thereby without the butts of those needles engaging said cam.

In order to lay-in a yarn during knitting at said at least one knitting station a group of needles are raised to at least tuck height and a further group of needles are located at miss-knit height. Preferably needles of said group and said further group are arranged alternately and preferably all needles have a single butt.

Various aspects of the present invention are hereinafter described with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a knitting station according to one embodiment of the present invention;

Figure 2 is a schematic side view of a cam assembly according to a first embodiment of the present invention;

Figures 3 and 4 are plan views of the cam assembly shown in Figure 2 shown in a retracted and extended position respectively;

Figure 5 is a plan view of a cam assembly according to a second embodiment of the present invention;

Figure 6 is an end view taken in the direction of arrow A of the stitch and face cams;

Figure 7 is a side view of the embodiment shown in Figure 5; and

Figures 8 and 9 are views similar to Figure 5 showing the stitch and face cams at different ra-

dial positions.

Referring initially to Figure 1, there is shown, in part, a development of a cam cylinder of a circular knitting machine.

The cam cylinder includes first and second knitting stations 12,14 respectively (only part of knitting station 14 being shown).

Knitting station 12 is constructed in accordance with the present invention and includes a retractable stitch cam 16, a retractable landing or upthrow cam 18 and a retractable raising cam 20.

In the illustrated embodiment, the raising cam 20 is a tuck cam for raising selected needles to tuck height TH and the stitch cam 16, landing cam 18 and raising cam 20 are all shown at their retracted positions.

A group of needles having relatively long butts 22 engage the raising cam 20 when in its retracted position and so rise to pick up yarn. A further group of needles having relatively short butts 24 do not engage the raising cam 20 and so pass thereby at miss-knit height MH. On reaching the retracted landing cam 18 these needles pass thereby without contacting the landing cam 18 and also pass the stitch cam 16 without making contact therewith. Accordingly these needles are unaffected by the landing cam 18 and stitch cam 16 so the machine may be operated at full speed without exposing these needles to possible breakage.

In order to enable the landing cam 18 and stitch cam 16 to be retracted without causing the needles to pull out of their tricks a face cam 26 is provided. The face cam 26 is fixedly mounted and has a face 27 which slidingly contacts the shanks of the needles. Accordingly on retraction of the stitch and landing cams the face cam 26 maintains contact with the shanks of the needles and thereby retains the needles within their tricks.

Preferably a face cam 28 is provided adjacent to the raising cam 20. The face cam 28 has a radially inner face 29 which slidingly engages the shanks of the needles and retains the needles within their tricks on retraction of the raising cam.

A first embodiment of the cam assembly is illustrated at 50 in Figures 2 to 4 which includes the stitch cam 16 and landing cam 18.

The assembly 50 includes a support block 51 which is adapted for attachment to the frame of the knitting machine (not shown).

The stitch cam 16 and landing cam 18 are each mounted onto a support member 53 which has a guide portion 54 slidingly received in a groove 56 formed in a support body 57. The guide portion 54 and groove 56 are preferably of dove-tail cross-section as shown such that the support member 53 is able to move in the axial direction of the knitting machine but is restrained from moving in the radial direction of the knitting machine.

A piston and cylinder assembly 60 is mounted on the support body 57 and drivingly connected to the support member 53 for raising or lowering it. Such movement is performed for altering the amount of draw of the needles for effecting loose or tight stitches.

The support body 57 has a guide portion 61 depending from its lower surface which is located in a guide channel (not shown) formed in the upper surface of the support block 51 and which extends generally in the radial direction of the knitting machine. The guide portion 61 and guide channel are preferably of dove-tail cross-section so as to restrain movement of the support body 57 in an axial direction relative to the support block.

Preferably the support body 57 is biased in a radially inwards direction by resilient means such as a spring (not shown) so as to locate the stitch cam 16 and landing cam 18 at their radially inner position for normal knitting with all needles. (Figure 4).

Preferably retraction means, for example a cam operated cable (not shown), is connected to the support body 57 via a connector 69 for causing retraction of the support body 57 in a radially outwards direction in order to move the stitch cam 16 and landing cam 18 to their retracted position whereat short butted needles pass by without contact (Figures 2 and 3). An adjustable stop 65 is provided, preferably in the form of an adjustable set screw, for limiting the radial inward movement of the support body 57 and thereby define the retracted position of the stitch and landing cams.

The face cam 26 is mounted on the radially inner end of the support block 51 and so remains in a fixed position during movement of the support body 57 or member 53.

In operation, in order to lay-in an elastomeric yarn such as Lycra (RTM) at knitting station 12 the raising cam 20, stitch cam 16 and landing cam 18 are all moved radially outwardly to their retracted position.

Accordingly, only the needles having relatively long butts 22 are now raised by the raising cam 20 on leaving knitting station 14. These needles are raised to tuck-height TH and thereby pick-up the elastomeric yarns and are subsequently lowered by the stitch cam 16. The needles having relatively short butts 24 pass by raising cam 20, stitch cam 16 and landing cam 18 without contact. Accordingly, the machine may be operated at full speed.

It will be appreciated that raising cam 20 may be replaced by a clearing cam which raises needles to clearing height.

A second embodiment of the cam assembly is illustrated at 100 in Figures 5 to 9 and includes a fixed face cam 126, a stitch cam 116 and a landing cam 118. Cams 116,118 are retractable to enable laying in of yarns to take place.

As seen in Figure 6, the leading edge 113 of the

face cam 126 preferably extends obliquely to the path of travel T of the needle butts up to and preferably above the tuck height TH of the needle butts, more preferably to a position above knitting height KH of the needle butts.

Preferably the edge 113 merges into the upper edge 114 at a pointed corner portion 115. Preferably the corner portion 115 is rounded in a radially outward direction of the knitting machine. In this way the corner portion 115 does not present a flat face extending in a radial plane of the knitting machine and facing the direction of travel of the needles and provides a lead-in for needles projecting slightly above their tricks. As the needles pass by the corner 115 in direction T they are acted upon in the axial direction by a progressively wider portion of the face 127 of cam 126.

Location of the leading edge 113 above tuck or knit height enables the cam 126 to act as a stitch cam for lowering needles in the event that a raised needle hits cam 126.

Both the stitch cam 116 and landing cam 118 are mounted onto a support member 153 which has a guide portion 154 slidingly received in a groove 156 formed in a radially movable support body 157. The guide portion 154 and co-operating groove 156 are both preferably of rectangular cross-section. This enables the guide portion 154 to be precision ground for a close tolerance fit within the groove 156 and thereby eliminate play in the direction of rotation of the knitting needles.

The guide portion 154 is retained within the groove 156 by virtue of a fixing bolt 190 which is secured at one end in guide portion 154 and projects through a slot (not shown) in the support body 157 to receive an adjustable locking nut assembly 191.

The locking nut assembly 191 is adjusted to draw the end face 192 of portion 154 into abutment with the base of the groove and to maintain that abutment during sliding motion of the guide portion 154 within the groove 156. Accordingly play in the radial direction of the knitting machine is eliminated.

The precision fit of the guide portion 154 in groove 156 ensures accurate positioning of the stitch cam 116 and landing cam 118 during vertical adjustment of the guide portion 154. Vertical adjustment of the guide portion 154 is achieved using a piston and cylinder assembly (not shown) in a similar manner to that described above in relation to the first embodiment; stop adjustment screws 158 being provided for adjusting the limits of vertical adjustment.

The support body 157 has a guide portion 161 depending from its lower surface which is located in a guide channel 162 formed in the upper surface of a main support block 151 and which extends generally in the radial direction of the knitting machine.

The guide portion 161 and guide channel are preferably of rectilinear cross-section and the guide portion 161 is arranged to be a precision fit within the guide channel so as to ensure sliding movement therein without play in the direction of rotation of the knitting needles. This is preferably achieved by precision grinding of the sides of the guide portion 161.

The guide portion 161 is retained within the channel by means of a cover plate 163 secured to the support block 151 so as to span the guide channel 162. The cover plate 163 serves to maintain the guide portion 161 in abutment with the base of the channel 162 and thereby eliminate play in the axial direction of the knitting machine.

The support body 157 includes an abutment portion 167 and is biased in a radially inwards direction by resilient means, preferably in the form of a spring 165. The spring 165 is supported on a rod 168 which is secured at one end to abutment portion 167 and slidingly passes through a support block 183 to receive a stop, preferably in the form of lock nuts 140. The lock nuts 140 on engaging the support block 183 define the radially innermost limit of travel of the abutment portion 167 and hence support block 151 in the radially inwards direction of the knitting machine. When the support block 151 is at its radially innermost limit position the stitch and landing cams 116,118 respectively are located at their radially inner position for normal knitting with all needles as described above. Due to the adjustment available using lock nuts 140, this position can be accurately set. This position is illustrated in Figures 5 and 7.

Retraction means preferably in the form of a cam operated cable 181 is provided which on actuation pulls the support body 157 in a radially outwards direction until the abutment portion 167 abuts against an adjustable stop 170 mounted in a support block 183 fixed to the support block 151. When the abutment portion 167 abuts against stop 170, the stitch and landing cams 116,118 are located at a fully retracted position whereat the butts of the knitting needles pass without making contact.

In order to enable the cams 116,118 to be returned to their radially inner rest position for normal knitting, intermediate stop means 175 are provided to define a discrete intermediate stop position. This position is illustrated in Figure 9. In this way the cams 116,118 may be returned into the path of the knitting needles in 2 stages and thereby facilitate entry of the cams whilst reducing the risk of needle damage. The stop means 175 preferably include a movable stop member 176 having a shaft portion 177 slidably received in the abutment portion 167. The shaft portion 177 has at one end a head 178 which can abut against the radially inner face 169 of the abutment portion 167.

The end of the shaft portion 177 opposite to head 178 has an abutment end face 196, preferably defined by a head 194, and is attached to a cam operated cable 195 which extends through a rigid sleeve 198 mounted on support block 183. When cable 181

is operated, cable 195 is operated also to move end 196 of shaft 177 into abutment with the end 197 of a sleeve 198. The sleeve 198 is preferably screw threadedly received in block 183 so that the axial position of end 197 relative to the block 183 can be adjusted, this axial position of end 197 and spacing of head 178 from end 197 is such that when the abutment portion 167 contacts stop 170 the head 178 is spaced from face 169 by a predetermined distance ID. This is shown in Figure 8. The distance ID determines the position at which the support body 151 is stopped at its intermediate stop position and can be adjusted by adjusting the axial position of sleeve 198.

Thus when laying-in is required, both cables 181 and 195 are retracted to cause radial outward retraction of the stitch and landing cams 116,118 and to set the stop means 175 i.e draw stock 176 into contact with sleeve 198. This is shown in Figure 8. To return to normal knitting, initially cable 181 is relaxed and the cable 195 is held by its associated cam. Accordingly support body 151 moves radially inwardly under the bias of spring 165 until face 169 of the abutment portion abuts against head 178. The support body 151 is then positively retained at this position (as shown in Figure 9) until cable 195 is relaxed to enable the support body 151 to then return to its radially innermost position.

The cam assembly 100 is manufactured and setup separately from the knitting machine. In order to accurately position the assembly 100 in the knitting machine the support block 151 is provided with dowels 300 (Figure 7) for reception in bores in the knitting machine frame.

The radial height of the face cam 126, ie the radial distance of face 127 from the needle cylinder is critical to ensure that needles are properly held in the tricks; in this respect the accuracy of the positioning of the radial height of the face cam 126 is preferably in the region of ±0.02mm.

This accuracy is achieved in accordance with the present invention by mounting the face cam 126 on a support post 200 manufactured from a relatively soft easily machinable material such as mild steel and setting the radial height of the face cam using the landing cam as a datum.

Accordingly, the support post 200 is mounted on the support block 151 so as to be easily removable and yet accurately remounted after removal. This enables the post 200 to be removed for replacement or machining for setting the position of the face cam 126.

The mounting is achieved in the illustrated embodiment by providing the support block 151 with a rebated recess 210 having an accurately machined face 211 which sets the radial height of face 211 to accurate tolerances.

The post 200 is secured to the support block 151 by a single removable bolt 220 having a chamfered head 221, the axis of the bolt 220 extending in the circumferential direction of the knitting machine, i.e. at right angles to the radial direction. The post 200 has an enlarged through bore having a chamfered mouth for accommodating the shaft of the bolt 220 with clearance so that on tightening of the bolt the chamfered head pushes the post 200 into tight abutment with both faces and so holds the post rigid relative to the support block 151. Preferably a dowel pin is provided extending parallel to the axis of the bolt 220 and passing through the post and into the support block 151.

The post 200 has a radially projecting arm portion 230 which has a terminal end abutment face 231 to which the face cam 126 is removably secured in abutment by for example a bolt 232.

To set the radial height position of the face cam relative to the knitting machine, initially the radial height of the face 118a of the landing cam 118 is accurately set with reference to a datum D, defined by dowels 300 (Figure 7). The radial position of the face cam 126 is then measured using face 118a as a datum. To adjust the position of the face cam 126 in a radially outwards direction, the post 200 and cam 126 are removed from block 151, the cam 126 is then removed from post 200 to expose end face 231 for grinding. The post 200 and cam 126 are then reassembled and the post 200 is remounted on the block 151. The radial height of the face cam 126 relative to the landing cam face 118a is again measured. If further radial outward adjustment is required, the above sequence is repeated. If a radial inward adjustment is required, the post 200 is replaced by another post 200 having a longer radial cam portion 230 to thereby position face cam 126 at a radially inner position relative to face 118a and thereby enable the adjustment sequence involving grinding of face 231 recited above to be performed.

Claims

1. A circular knitting machine having a plurality of knitting stations and a plurality of needles, at least one knitting station having a raising cam, a stitch cam and a landing cam co-operating with the stitch cam, at least the landing and/or stitch cam being movably mounted for radial movement relative to the axis of rotation of the machine between a normal operating position and a retracted position, the needles of the knitting machine including a group of needles having relatively long butts and at least one further group having relatively short butts, said relatively short butts being such that when said cam is at its retracted position the short butts are able to pass said cam without contact therewith whereas the relatively long butts are such as to be capable of contacting

said cam when in its retracted position.

2. A circular knitting machine according to claim 1 wherein all the needles have single butts.

3. A circular knitting machine according to claims 1 and 2 wherein the raising cam is also movably mounted for movement to a retracted position corresponding to the retracted position of the landing and/or stitch cam.

4. A circular knitting machine according to any preceding claim wherein a face cam is provided adjacent to the landing cam for slidingly contacting the shank of the needles so as to retain the needles within their tricks on retraction of the landing and/or stitch cam to its retracted position.

5. A circular knitting machine according to claim 4, wherein the leading edge of the face cam in the direction of rotary movement of the needles extends obliquely to the path of travel of the needle butts upto and least tuck height of the needle butts.

6. A circular knitting machine according to claim 5, wherein said leading edge terminates at a corner portion which is rounded in a radially outward direction of the knitting machine.

7. A circular knitting machine according to any preceding claim wherein the raising cam is retractable and a face cam is located adjacent thereto for slidingly contacting the shank of the needles.

8. A cam assembly for a knitting machine, the cam assembly including a body for mounting on the knitting machine, the body including a stitch cam and associated landing cam, the landing cam and/or stitch cam being movably mounted on the body for movement between an extended position for engagement with all needles of the knitting machine and a retracted position for engagement with a selected group of needles.

9. A cam assembly according to claim 8 wherein the stitch and landing cams are mounted on a common support which is movably mounted on the body.

10. A cam assembly according to claim 9, wherein the support is provided with a guide portion and the body is provided with a groove for slidably receiving the guide portion, the guide portion and groove both preferably being of rectangular cross-section.

11. A cam assembly according to claim 8, 9 or 10 further including a face cam adjacent to the landing cam, the face cam being radially fixed and being contiguous with the landing and stitch cams when in their extended positions.

12. A cam assembly according to claim 11, wherein the face cam is detachably mounted on the body via a support post, the support post having a radially projecting arm portion to which the face cam is attached.

13. A method comprising knitting an article on a circular knitting machine having a plurality of knitting stations, the method including at at least one knitting station retracting a landing and/or stitch cam to permit needles arriving at the knitting station at miss-knit height to pass thereby without the butts of those needles engaging said cam.

14. A method according to claim 13 wherein at said at least one knitting station one group of needles are raised to at least tuck height and a further group of needles are located at miss-knit height.

15. A method according to claims 13 and 14 wherein the needles of said one group and said further group are arranged alternately.

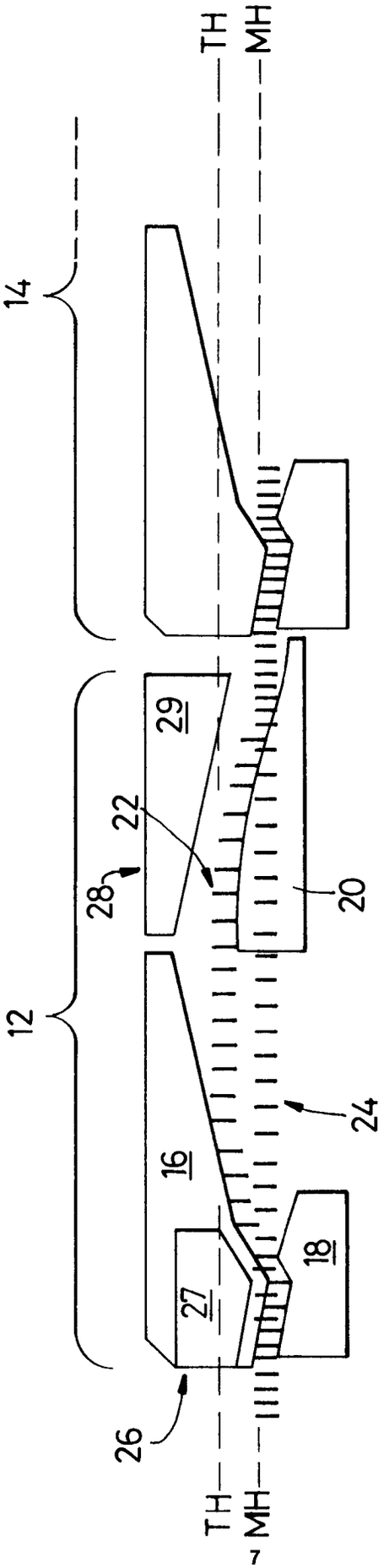

Fig.1

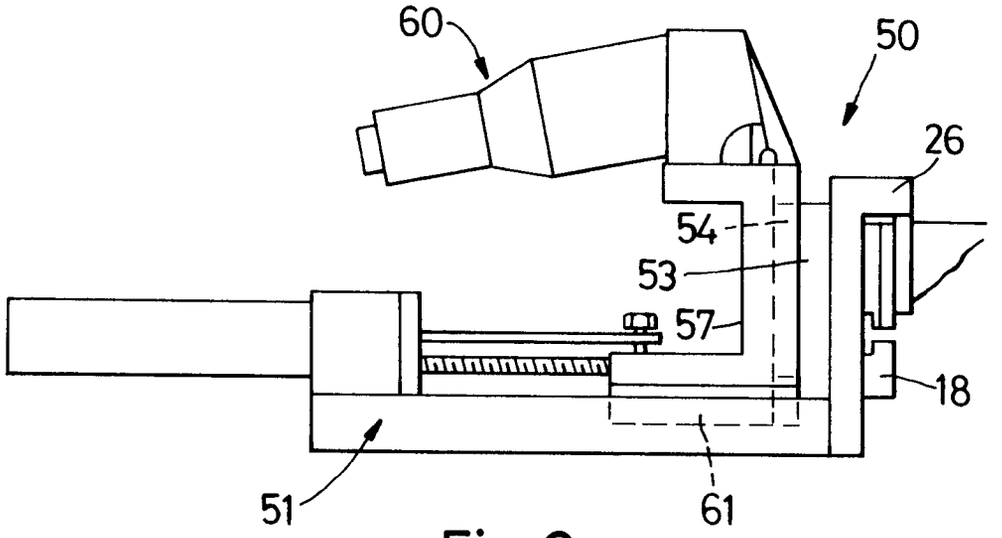

Fig.2

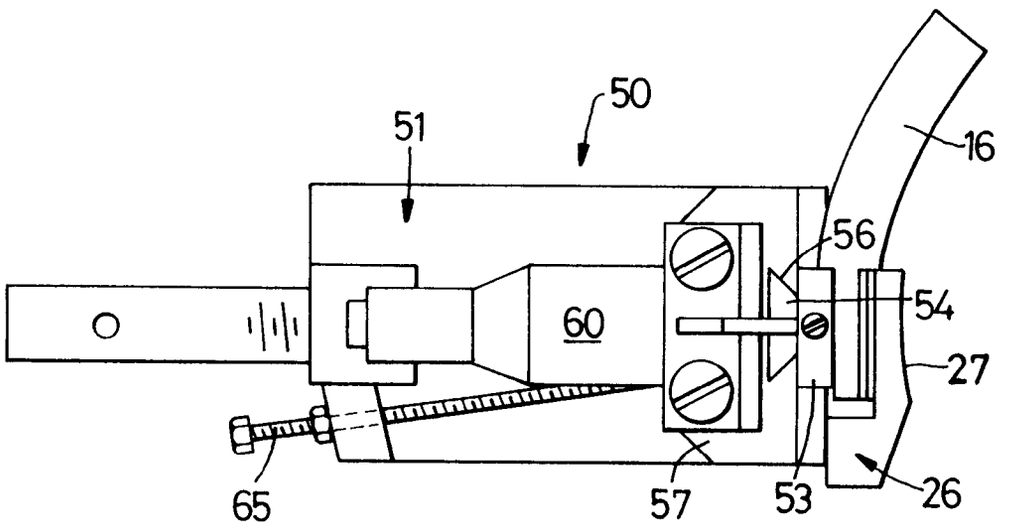

Fig.3

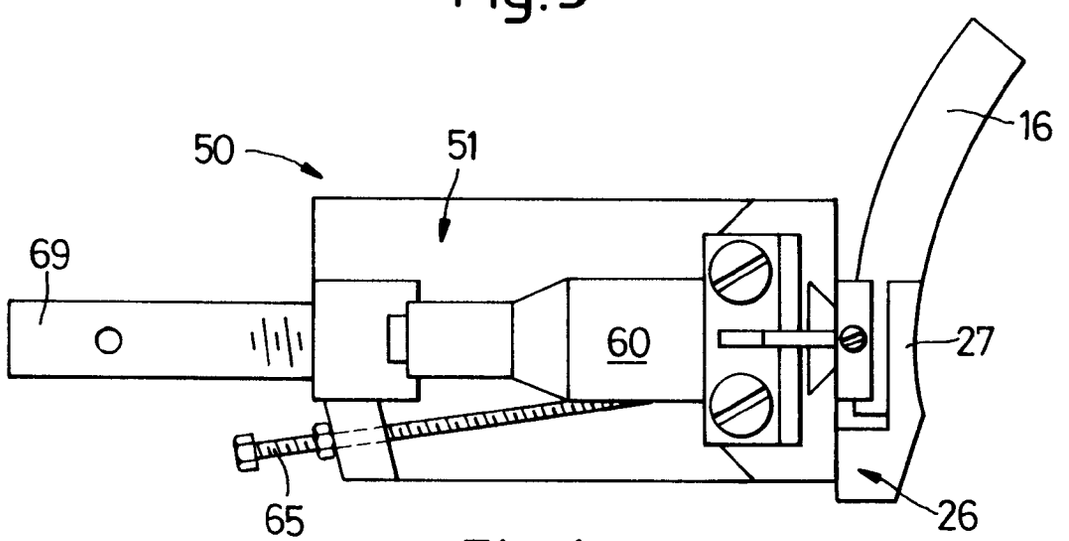

Fig.4

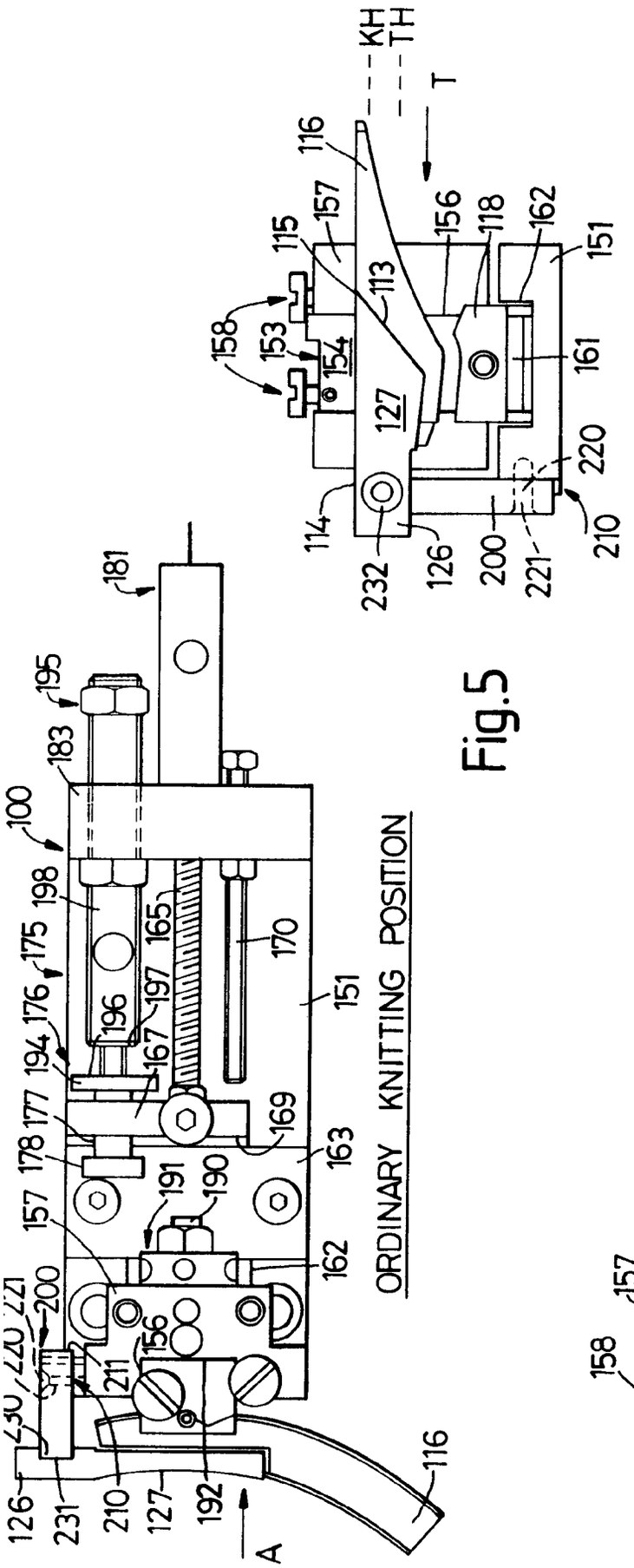

Fig.5

Fig.6

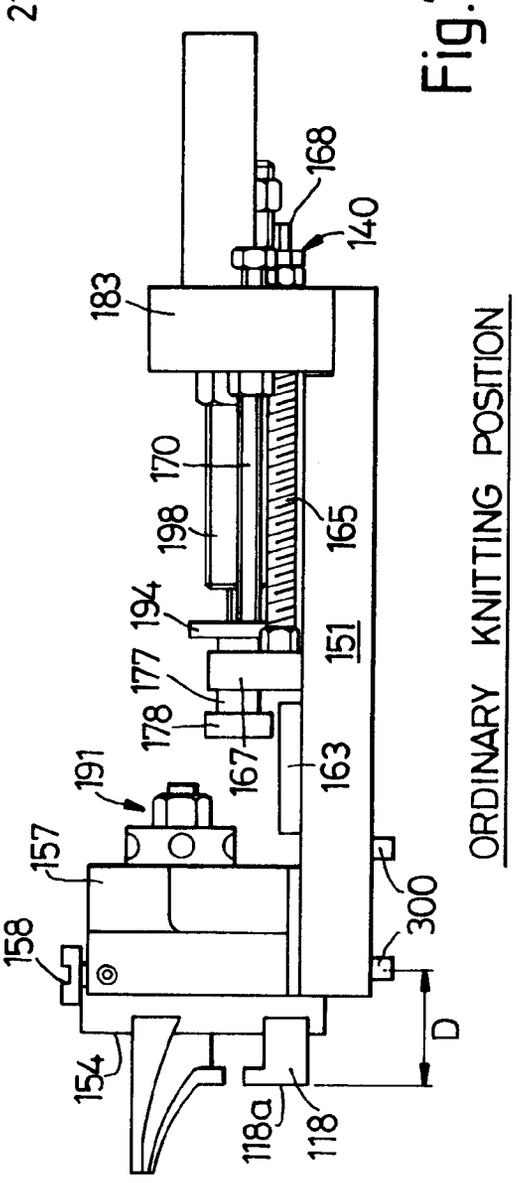

Fig.7

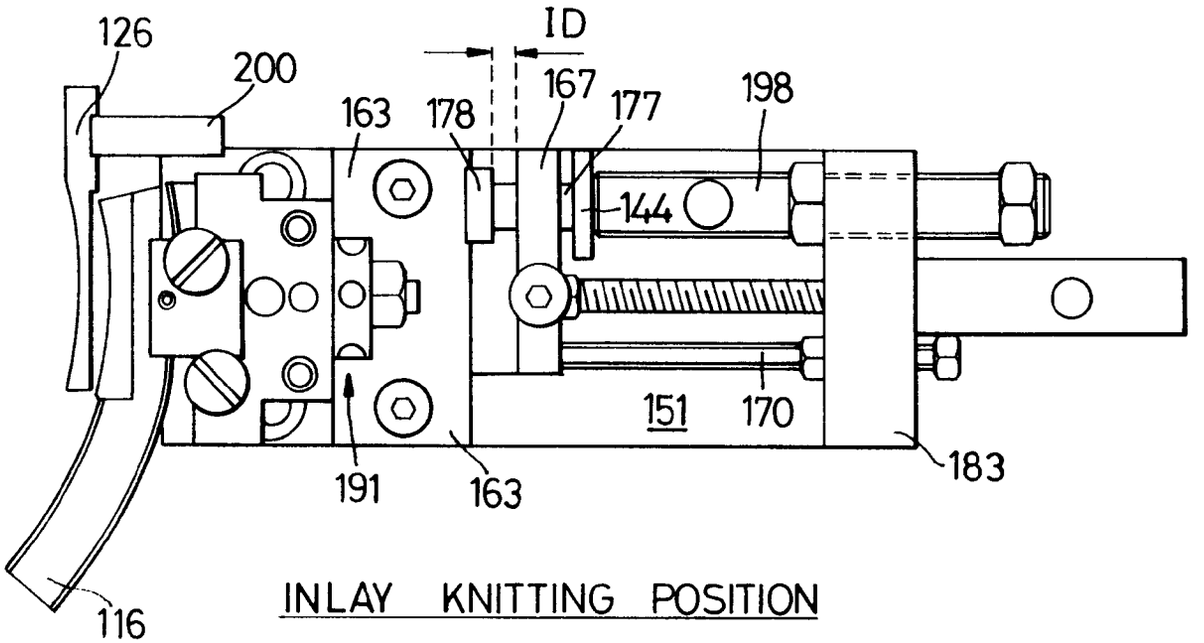
126
200
ID
167
163
178
177
198
144
151
170
183
191
163
116
INLAY KNITTING POSITION

Fig.8

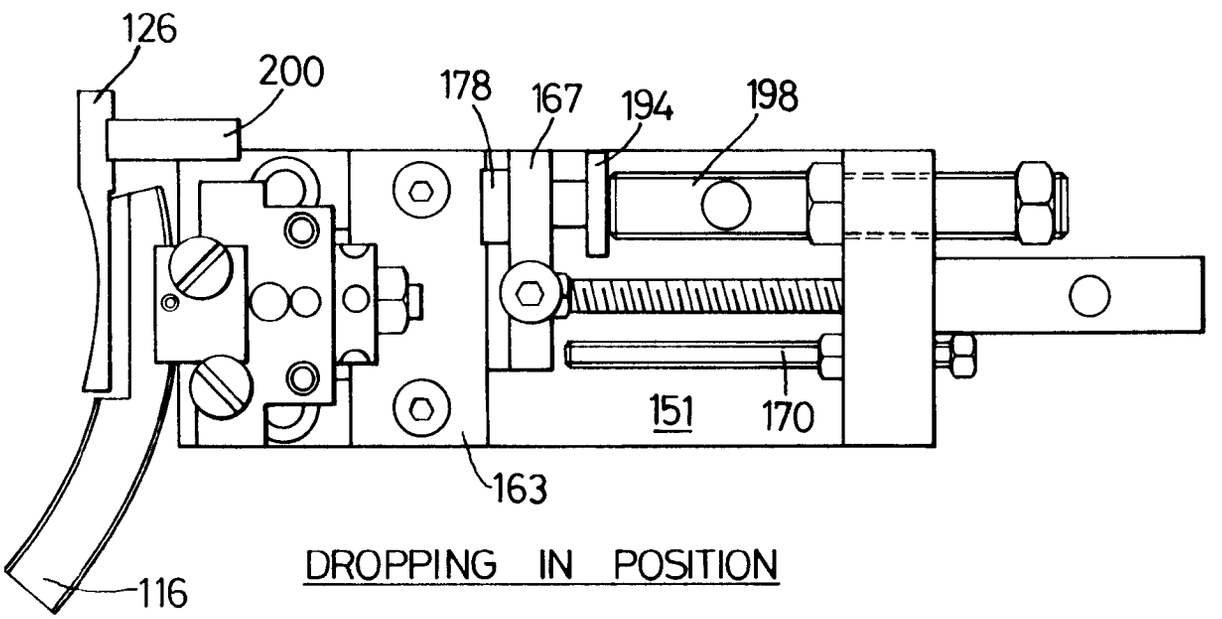
126
200
178
167
194
198
151
170
163
116
DROPPING IN POSITION

Fig.9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 92 31 0159

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	DE-B-1 144 872 (MASCHINEN-FABRIK CARL MERZ K.G.) * column 4, line 24 - column 5, line 33; figures 1-5 *	1,2	D04B15/32
A	FR-A-2 359 225 (BREMATEX S.P.A.) * page 4, line 22 - page 5, line 12; figures 1-9 *	1-3, 13-15	
A	GB-A-2 010 341 (MATEC S.P.A.)		
A	GB-A-2 209 039 (NAGATA SEIKI K.K.)		
A	US-A-2 260 579 (MILLER)		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 FEBRUARY 1993	VAN GELDER P.A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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