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(71) Applicant: **MEC-MOR S.p.A.**
Via Campagna 80
I-21056 Induno Olona (Varese)(IT)

(72) Inventor: **Tenconi, Riccardo**
Via Tallera 20
IT-21100 Varese(IT)

(74) Representative: **Modiano, Guido et al,**
MODIANO, JOSIF, PISANTY & STAUB Modiano & Associati Via Meravigli, 16
I-20123 Milan(IT)

(54) A knitwork tensioning device for a knitting machine.

(57) To hold down the loops when the needles (4, 5) move out to pick up the yarn in a knitting machine, a tensioning device (1) is proposed which comprises a plurality of tensioning elements (8) supported at one end (9) inside the machine one beside the other along the needle bed(s). The other ends (10) of the tensioning elements (8) are movable from a home position, whereat they not interfere with the knitwork (7), into a position of engagement, whereat they press the knitwork (7) against one surface of the needle bed whereon the knitwork (7) is laid as it is being formed. During the operation, the tensioning elements (8) may undergo a deflection, or a translation proper, which results in tensioning the knitwork (7). They are controlled by respective pins (14) actuated by a cam (17) which is driven of relative motion to the supporting structure for the tensioning elements (8).

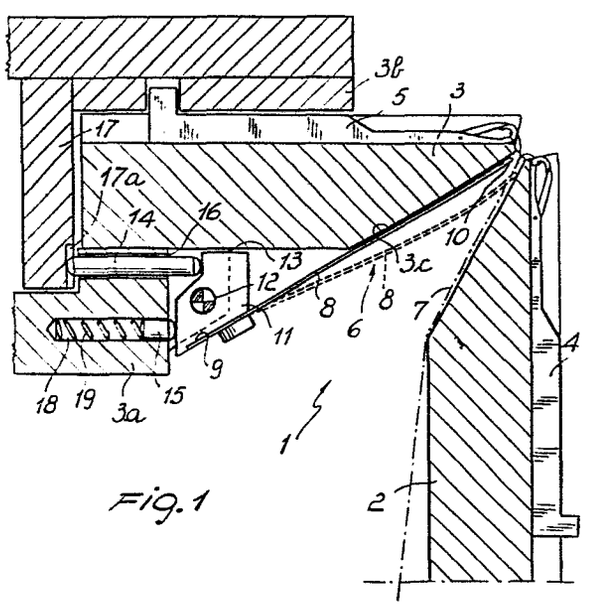

Fig. 1

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"A KNITWORK TENSIONING DEVICE FOR A KNITTING MACHINE"

This invention relates to a knitwork tensioning device for a knitting machine.

It is a well known fact that tensioning of a knitwork while being knit on a knitting machine is accomplished by means of opposed tensioning rollers which are located at a distance from the needles within the machine, as disclosed for example in Italian Patent No. 828 958, which relates to a circular knitting machine.

Such devices generally provide a tension force which is applied across the region between the rollers and needles, and hence, owing to the separation and elasticity of the intervening knitwork, can not always prevent the knitwork loops being formed from following the needle movements. Where knit fabrics are formed which have patterns including short and long knitwork loops, then a different tension is exerted on the two loop types, as due to their different elasticity, and this may easily result in faulty loops.

Moreover, in the instance of circular knitting machines adapted for knitting a fashioned open fabric, wherein the middle needles are kept in constant knitting engagement, whilst along the fabric edges the needles are driven into and out of operation to follow a required contour, tensioning can only be effected across the region where the needles are in constant knitting operation, and no tension is applied along the fabric sides.

It could be possible to obviate, at least in part,

such problems by placing the tension rollers closer to the needles, but this is mostly impossible by considerations of available room, especially with dual needle bed machines.

It is a primary object of this invention to provide a knitwork tensioning device for a knitting machine, which can obviate such prior problems and limitations, it being able to hold back and effectively tension the knitwork across the formation regions thereof, and accordingly, positively prevent the exiting needles from dragging the loops therewith.

A further object is to provide such a device which is of simple construction and may be advantageously incorporated to any type, whether circular or flat, of knitting machine, and may also be used in combination with conventional roller devices.

These and other objects such as will be apparent hereinafter are achieved by a knitwork tensioning device for a knitting machine having at least one needle bed, comprising a knitwork engagement and tensioning means located within the knitting machine, the device being characterized in that said means comprises a plurality of tensioning elements of substantially plate-like configuration supported at one portion thereof and each having an opposed portion located in the proximity of the needles, said opposed portion being movable between a knitwork disengagement position and a knitwork engagement and tensioning position in cooperation with a knitwork bearing surface on said needle bed.

Advantageously, a device of the above type allows the knitwork to be held directly in the proximity of the needles, thus preventing them materially from dragging the knitwork loops therewith in their exiting movements. A somewhat elastic construction of the tensioning elements, such as in the form of reed-like flexible elements, affords advantageous flexing capabilities for such elements, thereby it becomes possible to provide, through a simple articulated support of the individual elements and a rotational movement thereof, first an engagement of the knitwork with the needle bed inner surface, and secondly, upon the elements flexing as a result of a further slight rotation, automatic application of a gentle tension on the knitwork on the needle bed inner surface. However, it would also be possible to impress on the tensioning elements a translatory movement substantially in the same direction as the needle bed, such that the knitwork being formed is engaged and tensioned by a dragging action. The construction including individual tensioning elements cooperating with a bearing surface for the knitwork being formed, advantageously enables said elements to span the whole area of knitwork formation, and to also utilize the device for contoured open fabrics, by virtue of the tensioning elements being caused to act directly on the knitwork being formed. The tensioning element width may vary according to individual requirements, with the tensioning elements being allowed to simultaneously engage several loops in one course.

Further features and advantages of the invention will be more readily understood from the following detailed description of two preferred embodiments thereof, given herein by way of example only with reference to the accompanying illustrative drawings, where:

Figure 1 is a fragmentary axial sectional view through a circular knitting machine of the cylinder and dial type, incorporating a device according to a first embodiment of the invention;

Figure 2 is a sectional view similar to that of Figure 1 but having needle beds which are more relieved inwardly;

Figure 3 illustrates diagramatically the operation of the device shown in the preceding Figures over a developed length of the machine, together with the needle pattern diagram;

Figure 4 shows a modified embodiment of the tensioning elements;

Figure 5 is an axial sectional view similar to Figure 1, but showing a further embodiment of this device, in the rest position thereof;

Figure 6 shows the device of Figure 5 in the operating position thereof;

Figure 7 is a developed diagram of the pattern of the control cams for the device shown in Figures 5 and 6 relatively to the needle movements; and

Figure 8 is a detail view of the device of Figures 5 and 6.

In conjunction with the accompanying drawings, reference will be made in the description which follows to a circular knitting machine of the type having a large diameter cylinder and dial. However, it should be appreciated that the invention is not limited to that application but may be incorporated to dial-less single cylinder circular knitting machines as well as double cylinder and flat knitting machines, and to cylinder and dial circular machines for knitting open fabrics.

The knitting machine 1 (Figures 1 and 2) comprises a needle cylinder 2 and dial 3, wherein needles 4 and 5, respectively, are mounted slidably as driven in a conventional fashion. The machine 1 further comprises a means 6 for engaging and tensioning a knitwork 7, which means is located within the machine 1. Said means includes a plurality of reed-like tensioning elements 8, each supported at one end 9 inside the cylinder 2 and having an opposed end 10 located next to the needle 4,5. Said end 10 is configured for engagement with the knitwork 7, as explained hereinafter.

In the exemplary embodiment shown in Figures 1 and 2, the reed-like tensioning elements 8 each have their end 9 attached to a respective supporting element 11 in the form of a small block pivoted at 12 to a respective supporting bracket 13, the bracket 13 being fastened under the dial 3. It may be appreciated that in the embodiment shown, the reed-like tensioning elements 8 are laid side-by-side all around the axis

of the machine 1, that is, they have a limited width and their pivot axes 12 are laid along a broken line enveloping a circumference concentric with the axis of the machine 1.

On each supporting element or block 11, there are arranged a pin 14 and small pivot pin 15 acting in opposite directions. The pin 14 is movable in a respective radial seat 16 in the dial holding structure 3a and its remote end from that engaging with the block 15 is adapted to follow the profile of a cam 17 which is carried by the cam structure 3b of the machine and, accordingly, driven of relative motion to the supporting structure for the reed-like elements 8. In the example under consideration, the cam 17 is of the ring type. The small pivot pin 15 is accommodated within a blind seat 18, and is subjected to the action of a spring 19, provided in the seat 18, to keep constant the engagement of the block 11 with the pin 14 and hence the engagement of the latter with the cam 17.

In the inoperative or home position, as shown in full lines in Figure 1, each reed-like element 8 is arranged to bear on the inside bevel 3c of the dial 3, the pin 14 contacting then a depression 17a in the cam 17. One end 10 of each reed-like element 8 barely clears the outer circumference of the dial 3 without hindering the movement of the knitwork 7 through the gap between the cylinder 2 and dial 3. The knitwork 7 is pulled down by its own weight, or alternatively by a gentle action tensioner, not shown.

As at the formation area of the knitwork 7, the needles 4 of the cylinder 2 are raised (and the needles 5 of the dial 3 thrust outwards) and the knitwork loops are to be held back to prevent them from being dragged away by the needles 4,5, the radially outermost profile of the cam 17 becomes operative to push the pins 14 slightly outwards and cause the supporting block 11 of the respective reed-like elements 8 to perform a partial rotation. This rotational movement results in the ends 10 being moved into a position of engagement with the knitwork 7, which is clamped between said ends 10 and the internal surface of the cylinder 2 on which the knitwork 7 rests. The cam 17, and consequently the thrust on the block 11, are designed to also impress on the reed-like elements 8 a deflection (position shown in full lines in Figure 2 and dash lines in Figure 1), thereby there occurs a slight downward displacement of the ends 10 across the internal surface of the needle bed, which thing leads to a slight tension being applied to the knitwork loops. In this way, with the knitwork loops being held up and stretched in the very proximity of the needles, any movements of the loops is effectively prevented and the loops move past the respective needle latches of the exiting needles, and hence, into a position where they can be positively discharged on the successive re-entering movement of the needles 4,5.

As shown in Figure 3, the engagement phase of the knitwork 7 is limited to the phase of outward movement of the needles 4,5, whereas during the re-entering

phase of the needles the reed-like elements 8 are returned to an inoperative condition wherein the knitwork 7 is allowed to move down prior to being re-engaged at the following course.

The relieve provided in the needle beds of Figure 2 advantageously increases the space available for inserting the knitwork between the needle beds and favors an increased pull after the clamping phase. In fact, in the disengaged position, the reed-like elements 8 are housed in the relieve of the dial 3, and in the engaged position, they engage the knitwork 7 in the relieve of the cylinder 2. Thus, the increased travel distance of the ends 10 of the reed-like elements 8 results in a stronger pull being applied on the knitwork 7.

Figure 4 illustrates a reed-like element 8' having a hooked working end which can penetrate the courses and increase the pull force.

In the embodiment shown in Figures 5 to 8, a circular knitting machine 21 has a needle cylinder 22 and dial 23, with respective needles 24 and 25. The means 26 for engaging and tensioning the knitwork 27, again located within the machine, comprises a plurality of tensioning elements 28 of substantially plate-like configuration and being each supported at one portion within the cylinder 22 , each element having an opposed portion located in the proximity of the needles 24, 25.

Each tensioning element 28 is pivoted at 29 to a respective first supporting element 30 in the form

of a lever pivoted, in turn, at 31 to a supporting block 32 attached to the dial holder 23a. Acting on the remote end of the lever element 30 from the end having the tensioning element 28 pivoted thereto, is one end of a rod-like control element 33, passed vertically through the dial 23 and dial holder 23a and having its other end engaged with the bottom profile of a ring cam 34, which is attached to the cam structure 23b of the machine and hence driven of relative motion to the supporting structure for the tensioning elements 28. A spring 35 is placed between each tensioning element 28 and lever element 30 so as to pull the tensioning element 28 toward the dial 23. The spring 35 is only required to overcome the action due to the weight of the tensioning element 28, and will accordingly be a rather weak one. A more powerful spring 36 is arranged to act between the lever element 30 and a fixed point 37 to maintain the lever element 30 in contact with the rod-like element 33, and hence, the latter in contact with the ring cam 34. A stop 38 defines the home position of the lever element 30.

The lower end of each tensioning element 28 is connected, allowing a degree of play, through a respective link 39, to one end of a respective second lever element 40, pivoted at 41 to the supporting block 32 and having a peripheral section 42 in contact with one end of a rod-like control element 43. The latter is passed vertically through the dial 23 and dial holder 23a close to the rod-like element 33,

and engages at its other end with the bottom profile of a ring cam 44, attached to the cam structure 23b. A spring 45 tends to hold the lever element 40 engaged with the rod-like element 43 and the latter with the cam 44.

The tensioning elements 28 are of course arranged along a broken line, similarly to the reed-like elements 8. They may also be likened to reed-like elements, but having a greater thickness than the elements 8.

The profile of the cams 34 and 44 for each yarn feed location is shown in Figure 7 where the needle pattern during the knitting phase is also shown schematically, similarly to the embodiment first-described hereinabove. The cam 34 has a profile including a substantially sharply downward sloping section 34a, a short horizontal section 34b, and a gently upward sloping section 34c followed by a long horizontal section 34d. The cam 44 has a substantially sharply downward sloping section 44a located slightly upstream of the section 34a (in the direction of movement of the needles), a horizontal section 44b as far as the end of the downward sloping section 34a of the cam 34, followed by a substantially vertical raising section 44c at the end of the downward sloping section 34a of the cam 34 and by a final horizontal section 44d.

The device shown in Figures 5-8 operates as follows.

On completion of the withdrawal movement of the

needles 24, 25, the device occupies the position indicated with full lines in Figure 5, and the rod-like elements 33 and 43 engage respectively with the sections 34d and 44d of the cams 34 and 44.

Thereafter, as the needles 24 barely begin to move up, the section 34a of the cam 34 comes into operation, and the tensioning elements 28 will move into the position indicated with dash lines in Figure 5, as allowed by the play between the links 39 and lever elements 40, and the various springs provided. On reaching the lowermost point in the downward sloping section 34a, the section 44c of the cam 44 becomes operative, and owing to the springs coming into play, the position indicated with full lines in Figure 6 is reached. The working end of the tensioning elements 28 will engage the knitwork and press it against the needle bed bearing surface. With a little delay, the upward sloping section 34c of the cam 34 comes into operation and the lever element 30, together with the spring 36, begins to lower its respective tensioning element 28 to engage with the knitwork 27, at the dash-line position of Figure 6, and apply a tension on the knitwork while the needles 24 are being raised and the needles 25 are moved out of their grooves. This position is maintained throughout the needle re-enter phase, by virtue of the stops 38 acting on the lever elements 30 and of the sections 34d and 44d of the cams 34 and 44, until the section 44a comes into operation to return the device to its initial position of Figure 5.

In comparison with the embodiment of Figures 1 to 4, it may be seen that the translatory movement of the tensioning elements 28 has been enhanced in the direction of the bearing surface for the knitwork 27 on the needle bed. That enhanced movement results from the tensioning elements 28 being articulately supported on respective lever-like supporting elements, also arranged to be movable, thereby the support point for the tensioning elements performs, with respect to the supporting block 32 carried by the dial 23, a translatory movement substantially in the direction of the knitwork bearing surface on the needle bed.

It should be appreciated that this translatory movement may also be accomplished through a different means from that shown in Figures 5-8. As an example, the tensioning elements could be each attached to a small block such as the block 11 in the embodiment of Figures 1-4 to support the block in an articulated fashion at one end of a lever pivoted to the structure which carries the needles of the dial 23. Another end of the lever, as well as the block itself, would then be controlled by respective rod-like elements under the action of suitably contoured cams and against the bias force of an elastic means, so as to move the tensioning elements with a component in the direction of the knitwork bearing surface on the needle bed.

In the embodiment shown in Figures 5-8, a pressure is exerted on the knitwork by the spring 45 along with a tension supplied by the spring 36. Advantageously, the springs 45 and 36 may be made adjustable.

It will be apparent from the foregoing description that the device according to the invention is made up essentially of clamps or grippers, one element whereof is formed by the reed-like element proper, and the other by the machine needle bed. This affords a marked simplification of the tensioning device.

The tensioning elements, which may be steel reeds, have a width dimension which depends in particular on the needle density and steepness of the lift cams therefor. More specifically, the tensioning elements will be made wider where the cams are less steep, and viceversa. In a practical embodiment with a large diameter circular knitting machine, optimum results have been obtained with reed-like elements 30 mm wide. Of course, it would be preferable to have their ends follow the curved line of circular machines, at least above a certain width of the reed-like elements and below a certain diameter of the machines.

Reference has been made hereinabove to a machine having the tensioning elements supported by the dial and acting against the cylinder. It should be understood, however, that the tensioning elements could be supported by the cylinder and arranged to act against the dial. Similarly, they could hold the fabric back against the slider ring, or against some other member attached to either the cylinder or dial. It may be appreciated, moreover, that a device according to this invention may also be incorporated to flat bed machines, as the skilled person in the art will recognize from perusal of the various drawing views. In the latter

case, the arrangement of the reed-like elements would be even simpler, they being all aligned therein.

It will be apparent from the description provided that with a very simple means, a proper formation of the knit fabric can be ensured, maintaining an effective tension force applied directly at the most critical area, where it would not be feasible to arrange conventional pulling means. Advantageously, moreover, the tensioning provided is not such that it can distort the knitwork loops.

The invention is susceptible to many modifications and variations without in any way departing from the scope of the inventive idea. Thus, as an example, in addition to the modifications described hereinabove, the reed-like elements 8 could have their ends 9 attached to the dial holder 3a and the pins 14 could be arranged to act directly onto the surface of the respective reed-like elements to deflect them into their working position. Return of each reed-like element to its home position would be ensured by the elasticity of the element itself.

CLAIMS

1. A knitwork tensioning device for a knitting machine having at least one needle bed, comprising a knitwork engagement and tensioning means (6, 26) located within the knitting machine (1, 21), characterized in that said means (6, 26) comprises a plurality of tensioning elements (8, 28) of substantially plate-like configuration supported at one portion thereof and each having an opposed portion located in the proximity of the needles (4,5;24,25), said opposed portion being movable between a knitwork disengagement position and a knitwork engagement and tensioning position in cooperation with a knitwork bearing surface on said needle bed.

2. A device according to Claim 1, characterized in that said tensioning elements comprise reed-like elements (8), and that associated with each said reed-like elements (8) is a pin (14) for moving said opposed portion (9), said pin (14) following the profile of a cam (17) driven of relative motion to the structure (3a) carrying said reed-like elements (8).

3. A device according to Claim 2, characterized in that said reed-like elements (8) are each attached to a respective supporting block (11) pivoted to one needle bed in the machine (1) and actuated by a respective one of said pins (14), on each said supporting blocks (11) there acting, in an opposite direction to said pins (14), respective spring loaded small pins (15) effective to maintain the blocks (11) in constant engagement with said pins (14) and, hence, said pins

(14) with said cam (17).

4. A device according to either Claim 2 or 3, characterized in that said cam (17) is designed to impress a deflection on said reed-like elements (8) for tensioning the knitwork (7) in the engaged position subsequently to engagement proper.

5. A device according to Claim 1, characterized in that said tensioning elements (28) are supported in an articulated fashion by at least a respective lever-like supporting element (30) pivoted to a supporting block (32) made rigid with the machine structure carrying the needles (24,25), thereby the support point of said tensioning elements (28) can perform a translatory movement substantially in the direction of the knitwork bearing surface on the needle bed.

6. A device according to Claim 5, characterized in that said tensioning elements (28) are each pivoted to one end of a respective first lever element (30), the other end whereof is subjected to the action of one end of a rod-like control element (33) passing vertically through the needle dial (23) and having the opposed end thereof held in constant engagement with the profile of a ring cam (34) attached to the machine cam structure (23b) driven of relative motion to the needles (24,25).

7. A device according to either Claim 5 or 6, characterized in that said tensioning elements (28) are connected with a degree of play allowed therebetween, through a respective link (39), to a respective second lever element (40) having a periph-

eral portion (42) in engagement with one end of a rod-like control element (43) passing vertically through the needle dial (23) and having the opposed end thereof constantly engaged with the profile of a ring cam (44) attached to the cam structure (23b) driven of relative motion to the needles (24,25).

8. A device according to Claim 6, characterized in that said control ring cam (34) for said first lever elements (30) has, for each machine yarn feed, a substantially sharply downward sloping section (34a), followed by a short horizontal section (34b), a gently upward sloping section (34c), and a final horizontal section (34d).

9. A device according to Claims 6, 7 and 8, characterized in that said control ring cam (44) for said second lever elements (40) comprises a substantially sharply downward sloping section (44a) followed by a horizontal section (44b) at said downward sloping section (34a) of said control ring cam (34) for said first lever elements (30), a subsequent substantially vertical raising section (44c) at the end of said downward sloping section (34a) on said control ring cam (34) for said first lever elements (30), and a final horizontal section (44d).

10. A device according to any of Claims 2 to 4, characterized in that said reed-like elements are each attached to a respective block pivoted to one end of a lever in turn pivoted to a supporting block attached to the needle carrying structure, said block and said lever being actuated by respective rod-like

control elements against the bias of an elastic means for moving said reed-like elements with a translatory component in the direction of the knitwork bearing surface on the needle bed.

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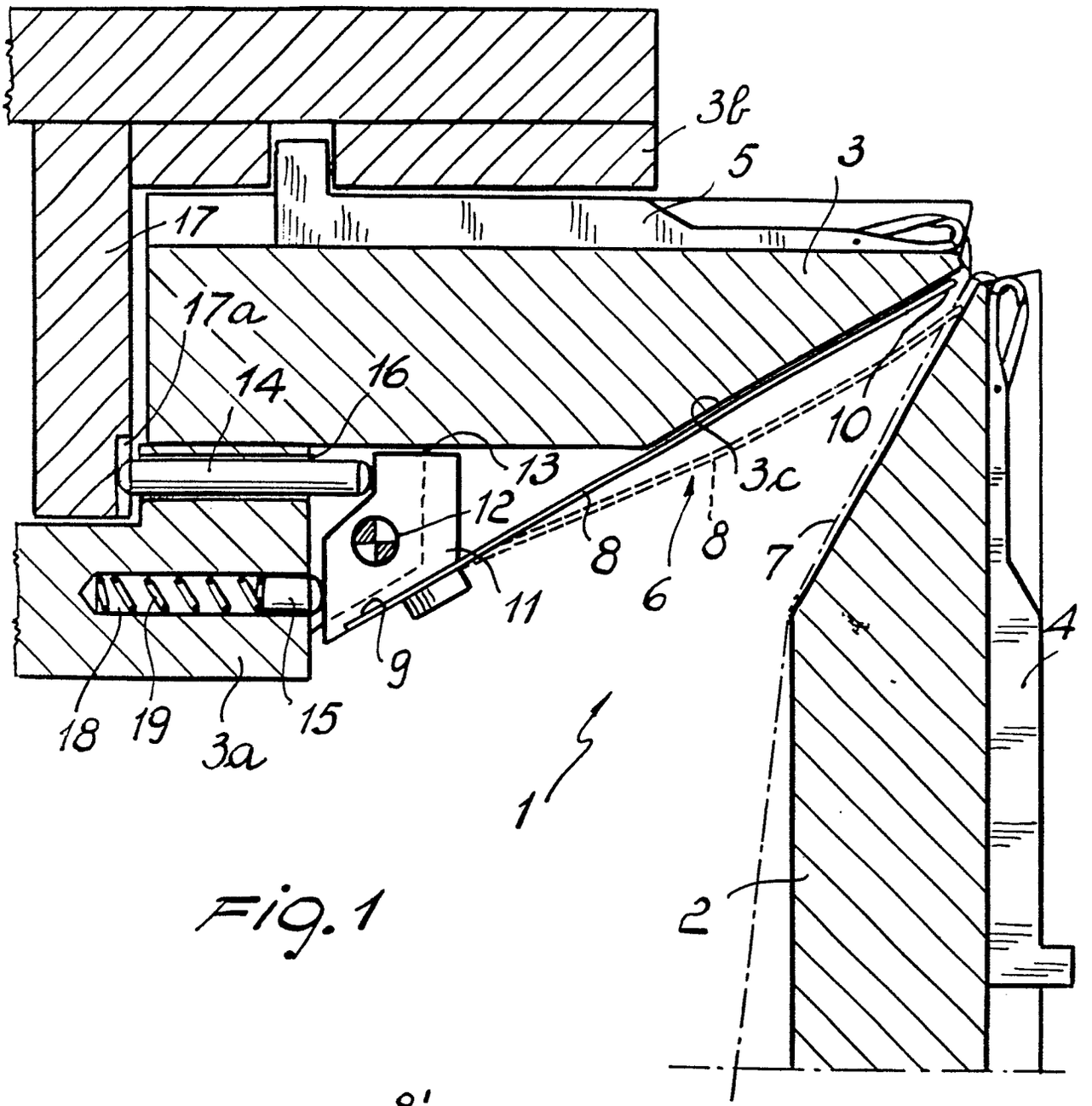

Fig. 1

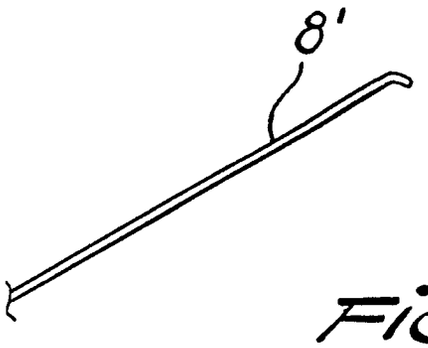

Fig. 4

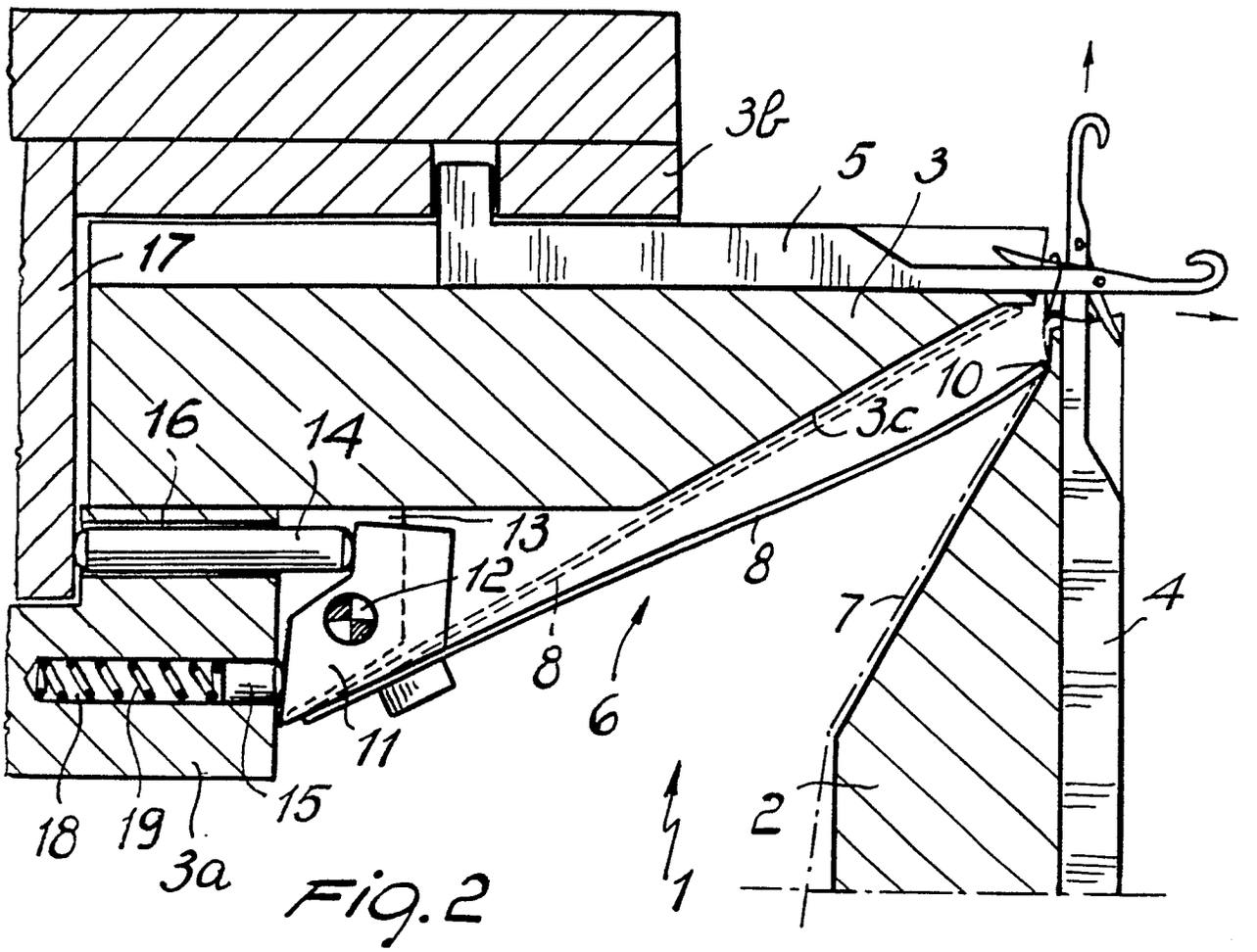
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Fig. 2

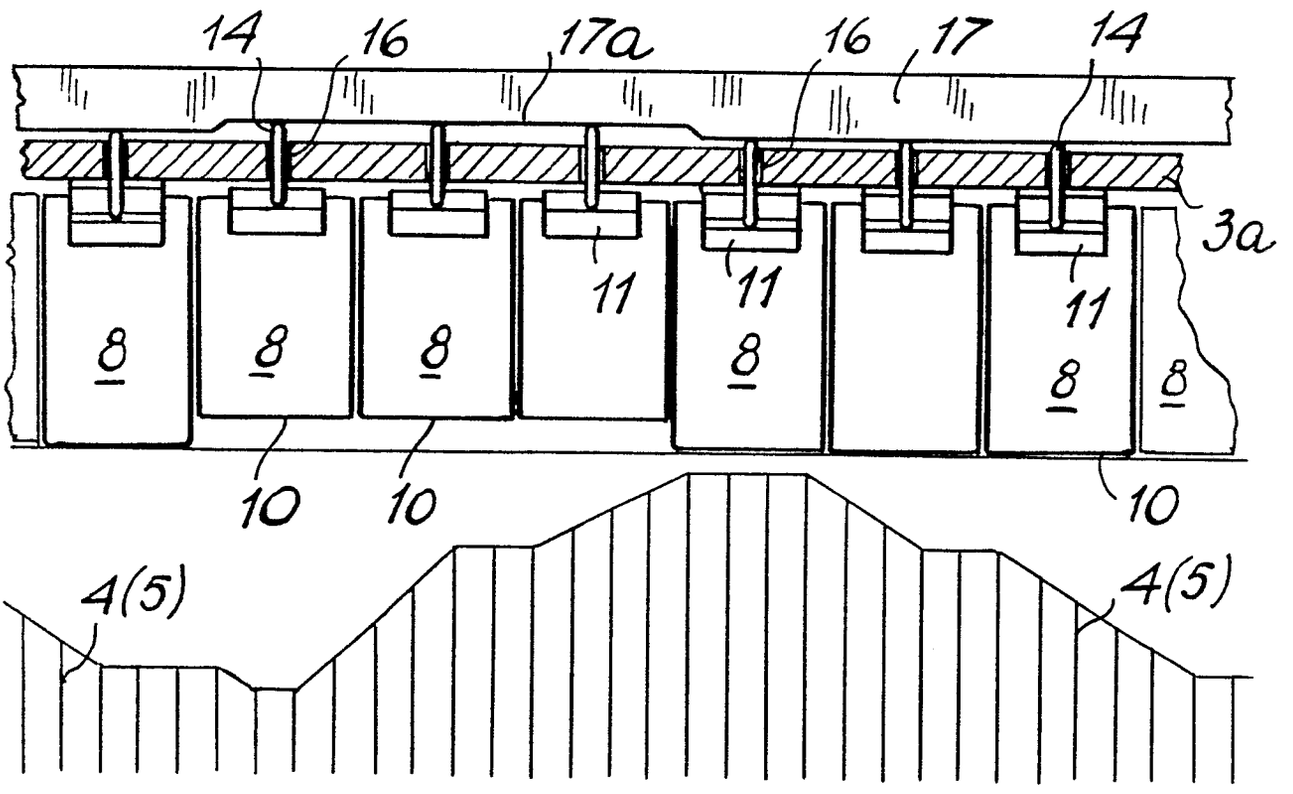
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Fig. 3

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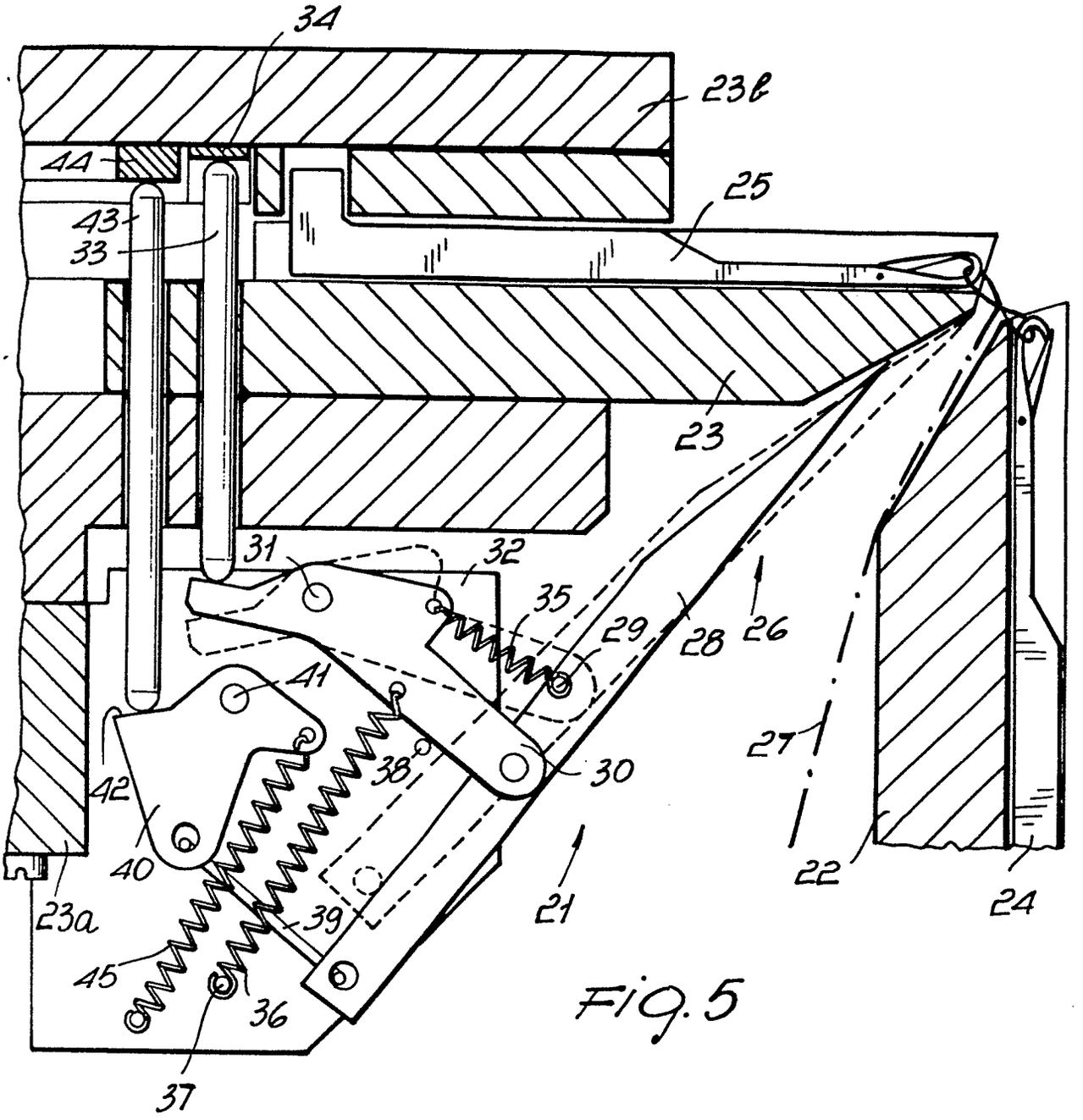

Fig. 5

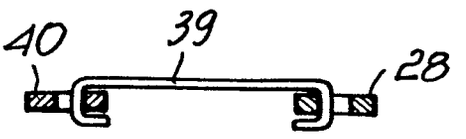

Fig. 8

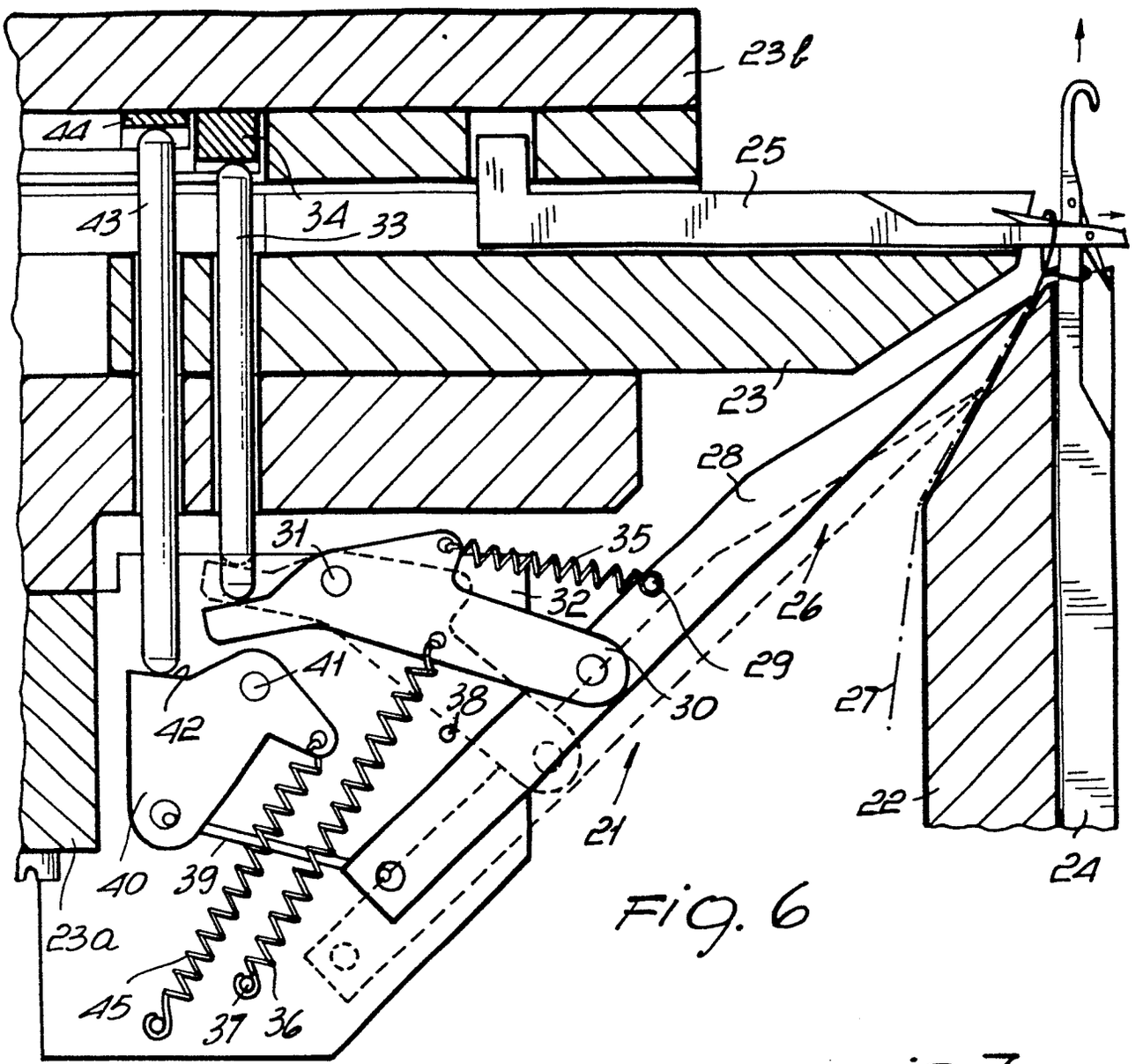
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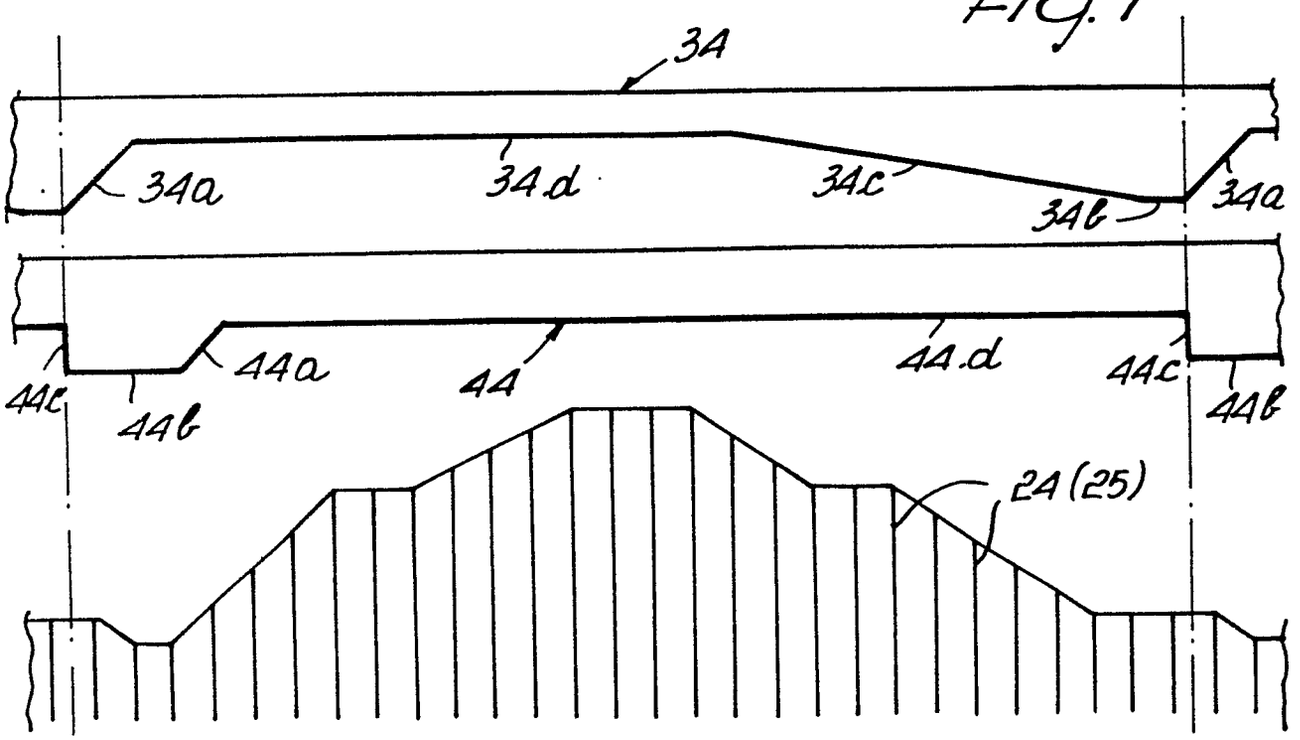
Fig. 6

Fig. 7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EUROPEAN SEARCH REPORT

0115060
Application number

EP 83 11 3042

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. ³)
X	DE-A-2 809 981 (ELITEX) * Page 7, line 25 - page 9, line 21; figures 1-4 *	1,2,4,8	D 04 B 15/88
A	GB-A-1 208 247 (LONATI) * Page 2, lines 80-85; figures 1-4 *	1,3,6	
A	DE-A-2 916 414 (ELITEX)		
A	GB-A-2 013 729 (STOLL)		
A	US-A-3 003 342 (KENT)		TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	FR-A-1 417 697 (SOLIS)		D 04 B
A	US-A- 218 460 (SHAW)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	09-04-1984	VAN GELDER P.A.

CATEGORY OF CITED DOCUMENTS

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