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(54) Improved automatic flat knitting machine.

(57) The machine includes: two flat needle beds, divergent from top to bottom, featuring transversal equidistant grooves, each one having thereinside, from top to bottom, a needle (3) featuring a butt (3a), an intermediate sinker (4) having a butt (4a), and a selecting sinker (5) having butts (5a,5b,5c); two carriages (13, 113) sliding upon the needle beds, each of which having at least two selecting units (S_1, S_2), the one of which faces the other carriage being made in such a way that it can select the selecting sinkers (5) during both strokes of the carriage run, and at least one operating unit (U_1, U_2) designed to shift upwards the intermediate sinkers (4) that have been already raised by the related selecting sinker (5), and designed to actuate the needles (3) that have already been pushed upwards by the associated intermediate sinkers (4); a device (100) removably fastened to said carriages (13,113) in a position located between the operating units of these latters, made in a way similar to said operating units and designed to cooperate with said adjacent selecting units (S_1, S_2) of the said carriages, in order to transfer and receive the fabric stitch to and from the other needle bed.

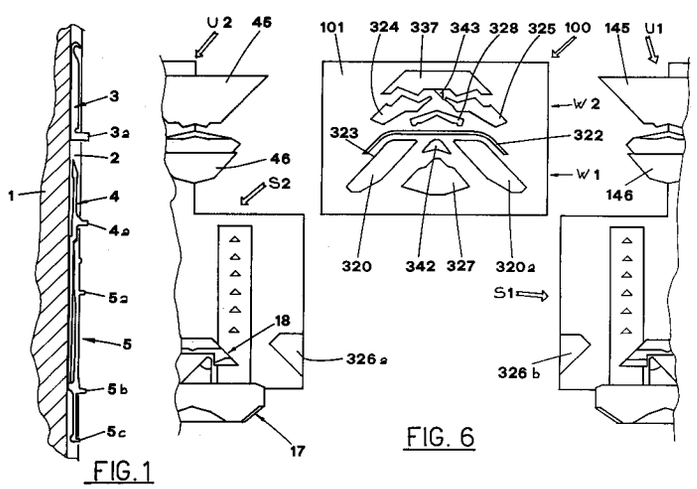

FIG. 1

FIG. 6

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It is known that in an automatic flat knitting machine there are two needle beds symmetrical and inclined with respect to a longitudinal, vertical plane, and divergent when considered from top to bottom.

Each of the two needle beds 1 (see Fig. 1) has equidistant, transversal grooves 2, which are perpendicular to the motion direction T of at least one carriage 13 (see Figs. 2 and 3). In each groove there are inserted, from top to bottom, a needle 3, whose butt 3a protrudes over the needle bed surface, an intermediate sinker 4 and a selecting sinker 5.

The intermediate sinker 4 features a butt 4a, while the actuating sinker 5 has three butts 5a, 5b, 5c namely first, second and third butt, when considered from top to bottom. All the sinkers 4, 5 butts protrude over the needle bed surface.

As pointed out in detail in Fig. 1, the sinkers 4, 5 are shaped in such a way that, as in the situation illustrated in the same Fig. 1, the raising of the sinker 5 causes the raising of the intermediate sinker 4, while the lowering of the latter causes the lowering of the selection sinker 5.

The raising of the selection sinker 5 causes the synchronical raising of the intermediate sinker 4 and, subsequently, the raising of the needle 3 by the intermediate sinker 4.

The sinker 5 is selected by means of related selection cams 6 carried by the carriage 13. In particular, each cam 6 (see US Patent No.4.534.186) is movable, perpendicularly in respect to the needle bed plane, from a rest position to the working one, and vice-versa.

In working position the cam 6 strikes the first butt 5a of the sinker. In the accompanying figures the selection cams 6 are arranged in two parallel groups G1, G2, described in the following, in each of which the cams 6 are lined up according to a plane perpendicular to the carriage movement.

In the carriage 13, below such groups, there are arranged, from bottom to top, a first section 7 of fixed cams (see US Patent No. 4.571.955) and a second section 8 of the fixed cams.

Relatively to the advancement direction F1 of the carriage 13, the section 7 is provided, in downstream direction, with two rising cams 7a,7b respectively located downstream of the symmetry planes of the two groups G1,G2, while the section 8 is provided with a rising cam 8a placed at a level over the cam 7a and downstream of the same cam 7a.

The groups G1, G2 and the sections 7,8 define a selection unit S_1 designed to raise the selection sinker 5 when the carriage 13 is translating according to F1.

When the carriage 13 moves according to F2, opposite of F1, in order to raise the selection sinker there is provided a selection unit S_2 formed by groups G1, G2 of the selection cams 6 and by two sections 17,18, whose rising cams 17a, 17b, 18a (according to the F1 direction) are turned to the opposite side in respect of the cited cams 7a,7b, 8a of the sections 7,8.

In the illustrative embodiment shown in Figs. 2,3, between the units S_1, S_2 there is provided an intermediate selection unit S formed by groups G1, G2 of selection cams 6 and by two sections 117, 118 performing the same functions as the sections 7, 8 and 17, 18; for this reason the section 118 is provided with a pivot cam 9.

Above the groups G1, G2 there are placed two operating units U_1, U_2 constituted by fixed and movable cams as stated in the US Patent No. 4.667.488; such units are symmetrical to a plane 10.

The cams of said units are grouped in two different bands W1, W2. The first band W1, adjacent to groups G1, G2 is designed to raise the intermediate sinker 4, only if the latter has already been shifted upwards by the sinker 5, and subsequently, to bring back downwards the same intermediate sinker.

The raising of the sinker 4 makes the needle 3 to raise so that it is actuated to carry out the well known operation phases, i.e. formation of the fabric stitch, formation of the carry-over stitch, transferring and receiving the fabric stitch to and from the other needle bed.

In order to highlight the technical problem considered by the present invention it is sufficient to take into consideration the operation phases related to transferring and receiving the fabric stitch to and from the other needle bed.

In Figs. 2 and 3, with A, B, C, D there are indicated the longitudinal lines of the needle bed that the butts 4a, 5a, 5b, 5c of the sinkers 4,5 run when the sinkers are at a rest position.

With Z there is indicated the line in which the butt 3a of the needle 3 lies when the needle is at rest.

In Figs. 2 and 3 there is shown the carriage 13 that moves according to F1, but in order to simplify the subject explaining, the carriage 13 is considered still and the needle bed 1 translating towards F2, since relative movements are involved.

With the help of Figs. 3, 4a, 4b the movement of the fabric stitch to another needle bed is now described.

In Fig. 3, P1 indicates the rest position of the sinkers 5, 4 and of the connected needle 3.

The selection cam 6 of the first group G1 in the working position is printed in bold; this cam strikes the first butt 5a of the sinker 5 and causes a light raising (position P2) of the sinker 5 and of the connected sinker 4.

This causes the rising cam 7a to strike the third butt 5c (with a further raising of the sinker 5) and subsequently, the rising cam 8a to strike the second butt 5b (position P3), that determines the maximum raising of the sinker 5.

In this configuration the butt 4a of the sinker 4 is located at the beginning of the rising channel 23 (formed by the cams 20, 21, 22 of the first band W1), while the butt 3a of the needle 3 is in the rest position Z.

The translation of the carriage 13 according F1 causes the gradual raising of the sinker 4 (that withdraws in respect of the sinker 5) with subsequent striking and raising of the needle 3.

In the position P4 the sinker 4 is in the position of maximum raising while the butt 3a of the needle downstream of P4 is forced to run along the path H (indicated with short dashes line) defined by the movable cams 24, 25 in operating position, in cooperation with the connected rispective cams 124, 125 and by the overlying fixed cam 37 (see the cited US Patent No. 4.667.488).

Fig. 4a shows the rest position of the needle 3; 3b indicates the hook of the needle, to which a loop 50a of the precedently formed thread is attached, and 3c indicates the tang of the needle.

The raising of the needle 3 up to the maximum level L1 of the path H makes the loop 50a to go beyond the tang 3c, up to placing it near a shoulder 3d made in the body of the needle.

An elastic sheet 3e, fastened to the needle body, delimits a seat 3f located in correspondence with said shoulder. A needle 70 of the other needle bed, suitably staggered in respect of the needle bed 1 relative to the needle 3, inserts into this seat 3f; the return of the needle 70 towards the relative rest position causes the loop 50a to remain hooked on the hook 70a of the latter needle 70.

The needle 70 is in position for receiving of the fabric stitch from another needle bed, that will be discussed in the following.

In a proper phase relationship with the movement of the loop 50a from the needle 3 to the needle 70, the same needle 3 is gradually lowered up to the relative rest position; during the initial lowering phase, the lower end of the needle 3 strikes the sinker 4 thus making it to move downwards, so that the butt 4a locates in correspondence with the external descending surface 120a of a cam 120, that is symmetrical to the cited cam 20; this brings the sinker 4 back to the rest position.

As far as the return of the sinker 5 to the rest position is concerned, there is provided a resetting cam 26 positioned between the sections 8, 118 of the units S_1, S.

This cam 26m that is symmetrical with reference to a vertical plane, strikes the second butt 5b in a way as to gradually bring the sinker 5 to the relative rest position.

Immediately upstream of the groups G1,G2 of the selection unit S, the sinkers 4,5 and the needle 3 are in the relative rest positions; therefore it is possible to select the sinker 5 by means of the selection cams 6 of the first group G1, so that the needle 3 is actuated (forming the fabric stitch, not described, and transferring the fabric stitch to another needle bed), while it is possible to select the sinker 5, by means of the selection cams 6 of the second group, so that the receiving of the fabric stitch from another needle bed is actuated, as illustrated with reference the the selection unit S_1, and with the help of Figs. 2,5a,5b,5c.

In Fig. 2, Q1 indicates the rest position for the sinkers 4, 5 and needle 3 assembly. The selection cam 6 of the second group G2, printed in bold, strikes the first butt 5a of the sinker 5 raising the latter in a way so as to place the relative third butt 5c in correspondence with the rising cam 7b (position Q2); that provokes a further raising of the sinker 5 and of the connected sinker 4 whose butt 4a is subject to the action of a cam 27, arranged substantially like an overturned "V" and located between the said cams 20, 120 of the band W1 (position Q3).

A fixed cam 42 is positioned over the top of the cam 27, detached therefrom. What has been just said causes the positioning of the butt 3a of the needle 3 in correspondence with a cam 28, also arranged like an overturned "V", situated in the band W2.

The butt 3a of the needle 3 is made to run along a path K (indicated with short dashed line in Fig. 2) whose upper level L2 is lower than the level L1 of the path H (position Q4).

In this way, the phases previously described with reference to Figs.4a,4b,4c occur again in reverse way, when the needle beds are considered.

In fact, in Fig. 5a, the numeral 150a indicates the loop held by the hook 70b of the needle 70, whose tang is indicated with 70e.

The needle 70 is brought to the upper level L1 along the relative path H, while the needle 3 is brought to the level L2 and then brought again in the rest position.

This allows the hook 3b to hook the loop 150a that in this way is moved to another needle bed 1 related to the needle 3. In this way the receiving of the fabric stitch from another needle bed has been completed.

The cam 28 brings the needle 3 back to the rest position, the internal track 120a of the cam 120 brings the sinker 4 back to the rest position, while the cam 26 brings the sinker 5 to the rest position.

As pointed out, the selection unit S_1 is used only with the carriage 13 translating according to F1, so as to activate the operating unit U_1, while

the selection unit S_2 is used to activate the operating unit U_2 only when the carriage translates towards F2.

The intermediate selection unit S works in the direction F1 to activate the operating unit U_2, and in the direction F2 to activate the operating unit U_1.

It is to be pointed out that each operating unit U_1, U_2, in correspondence with the band W2, is provided with a pivot cam 43 (Figs. 2, 3) that allows the relative unit U_1, U_2 to be operative in both directions F1 and F2 as far as e.g. the transferring of the fabric stitch from another needle bed is concerned.

Consequently, the number of the units S_1, S_2, S3 is bigger of one than the number of the operating units U_1, U_2 and the unit every time placed downstreams does not work.

In the present case when the carriage 13 moves in direction F1, F2, the units S_1,S_2 do not work respectively.

It is known that in order to increase the productivity and the versatility of the automatic flat knitting machines, two or more carriages are used according to the longitudinal extension of the machine; in the examples illustrated in Figs. 2 and 3 there are provided two carriages 13, 113 made in identical way.

The carriages 13, 113 are functionally independent from each other, because, as it has just been said, at the exit of a carriage the relative selection unit cannot select the sinkers 5, and this happens because of the following reasons:

- the cams 17a, 17b, 18a of the exit selection unit S_2 (i.e. the unit downstreams in the direction F1) are not enabled for completing the raising of the sinker 5 caused by the selection cam 6;
- the cams 7a, 7b, 8a provided in the selection unit S_1 of the carriage 113 are adapted to complete the raising of the sinker 5 already raised by the selection cam 6.

It is to be pointed out that making the sections 17, 18 of the selection unit S_2 identical and the sections 7, 8 of the selection unit S_1 relative to the carriage 113 in identical way as the intermediate selecting unit S, would not bring any useful effect.

In fact, the raising of the sinkers 4, 5 unit actuated by the selection unit S_2 would not bring to any operative phase for the relative needle 3. The raising of the sinker 4 actuated by the sinker 5, would not be completed by any cam, and therefore the same needle would remain inoperative.

On the contrary, the sinker 4 would be lowered by the first cams (considering the direction F1) of the unit U_1, of the carriage 113, moreover, in order to avoid improper interferences in the act of such lowering, between the sinker 4 and the sinker 5, the latter must be in advance brought back to the rest with a suitable cam.

The object of the present invention is to provide a machine in which a device placed between the two carriages sliding on the needle beds of the flat automatic knitting machine, increases the performance in respect to the ones obtainable by two carriages when considered separate.

Another object of the invention is to provide an improved machine that, besides satisfying the above, does not alter and/or affect the operative phases carried out by the two cited carriages when considered separate.

Yet a further object of the invention is to provide a machine in which the use of the cited device requires small adjustments of the selection units of both carriages.

A further object of the invention is to propose the above mentioned device shaped in a way similar to the operative units provided in the two carriages of the machine.

The above objects are achieved according to the technical teaching reported in the claims.

The characteristics of the invention are pointed out in the following, with particular reference to the accompanying drawings, in which:

- Fig. 1 shows a lateral view of an assembly made up of two sinkers and the associated needle, this assembly being inserted in the groove of a needle bed;
- Figs. 2, 3, 4a, 4b, 4c, 5a, 5b, 5c show, schematically, the known solution described in the introduction;
- Fig. 6 shows, in a plan view, the device mounted on the improved proposed machine;
- Fig. 7 shows the cited device placed and blocked between the two carriages of a knitting machine, and shows also, schematically, the ways in which the transfer of the fabric stitch to another needle bed is performed;
- Fig. 8 shows, with reference to the same view of the Fig. 7, the ways in which the receiving of the fabric stitch by another needle bed is performed.

With reference to the figure 6, the reference numeral 100 indicates a device constituted by a plate 101 to which there are secured a series of fixed cams forming the same combinations of profiles and/or paths determined by the fixed and mobile cams of each of the operating units U_1, U_2, more precisely, with all the mobile cams provided in the latter in the relative operative positions.

In fact, in the device 100 there is defined a band W1 with two cams 320, 320a laterally offset, and a separated cam 322 situated above the previous ones.

The cam 322, along with the upper track of the two cams 320 and 320a, forms a channel 323; all this is similar (or even identical) to what is made in

the operating units U_1 and U_2 (that is: cams 20, 20a corresponding to the cams 320, 320a, cam 22 corresponding to the cam 322, the whole forming a channel 23 corresponding to the channel 323).

In the device 100, between the cams 320,320a, there are provided, two cams 327, 342 shaped and placed, with respect to the other cams of the device, in similar way as for the cams 27, 42 in the units U_1, U_2.

In the band W2 of the device 100 there are provided cams 328, 337, and a pivot cam 343 shaped and mutually placed in a way similar (or even identical) to what provided for the cams 28, 37 and 43 of the units U_1, U_2.

Moreover, further cams 324, 325 of the device 100 have a shape similar (or even identical) to the shape of corresponding couples of cams 24-124, 25-125 provided in the units U_1, U_2.

The plate 101 of the device 100 can be secured to the carriages 13, 113, in a known way not shown, to be more precisely in such a way as to center the bands W1, W2 of the device 100 in respect to the bands W1, W2 of the units U_1, U_2 of the mentioned carriages.

The longitudinal extension of the device 100 allows for mating the opposing heads of the selection units S_1, S_2 adjacent to said heads.

It is to be pointed out that the optimal use of the device 100 requires some technical-constructive adjustemts made in the units S_2, S_1 respectively to the carriages 13,113, and in the parts turned outside of the couter-facing cams of the units U_2, U_1 of the carriages 13, 113 respectively.

In fact, the sections 17, 18 of the units S_2 - (carriage 13) and the sections 7, 8 of the selection unit S_1 (carriage 113) are shaped identically to the sections 117, 118 of the unit S; moreover the unit S_2, S_1 of the carriages 13, 113 are provided with the semicams 326a, 326b that, when they are side by side, define a cam 326 similar (or even identical) to the cited cams 26.

Lastly, the cams 45, 46 of the unit U_2 of the carriage 13, and the cams 145, 146 of the unit U_1 of the carriage 113 are shaped symmetrically with respect to relative vertical plans.

What has been said above, is illustrated in detail in figures 7, 8. The proposed device 100 can be actuated by the groups G2, G1 of the selection unit S_2 of the carriage 13, when the carriage 13-carriage 113 assebly moves in the direction F1, only to perform the transferring or receiving of the fabric stitch to and from another needle bed, and can be also activated for these operations by the selection units S_1 of the carriage 113-carriage 13 assembly, when it moves in the direction F2.

The mentioned figures 7 and 8 respectively show the transferring of the fabric stitch to another needle bed and the receiving of the fabric stitch from another needle bed, actuated when the cited assembly moves in the direction F1.

In Fig. 7 P1, P2, P3, P4, P5 indicate positions taken by the sinkers 4,5-needle 3 assembly during the transferring of the fabric stitch to another needle bed; the same technical-functional considerations already stated in the introduction with reference to the figures 3, 4a, 4b, 4c are applicable.

In Fig.8 Q1, Q2, Q3, Q4, Q5 indicate positions taken by the sinkers 4,5-needle 3 assembly during the receiving of the fabric stitch from another needle bed; the same technical-functional considerations already stated in the introduction with reference to the Figs. 2, 5a, 5b, 5c are applicable.

Consequently, the device 100 allows the use of the units S_2, S_1 relative to the carriages 13, 113, in the directions F1, F2 respectively; in this way, it is possible to operate, with the same device, the transferring and the receiving of the fabric stitch to and from another needle bed in both translation directions of the carriage 13-carriage 113 assembly.

As a result the productivity resulting from having joined the carriages 13, 113 is considerably increased by the fact that the device 100 has been placed between the same carriages.

It is to be pointed out that the realization of the device 100 does not involve particular costs, since the same device is shaped similarly (or even in the identical way) to the units U_1, U_2; moreover, the changes of the units S_2, S_1 of the carriages 13, 113 and of the cams 45, 46 require low cost, since they repropose the technical aspects already used in whole or partially in the subject carriages.

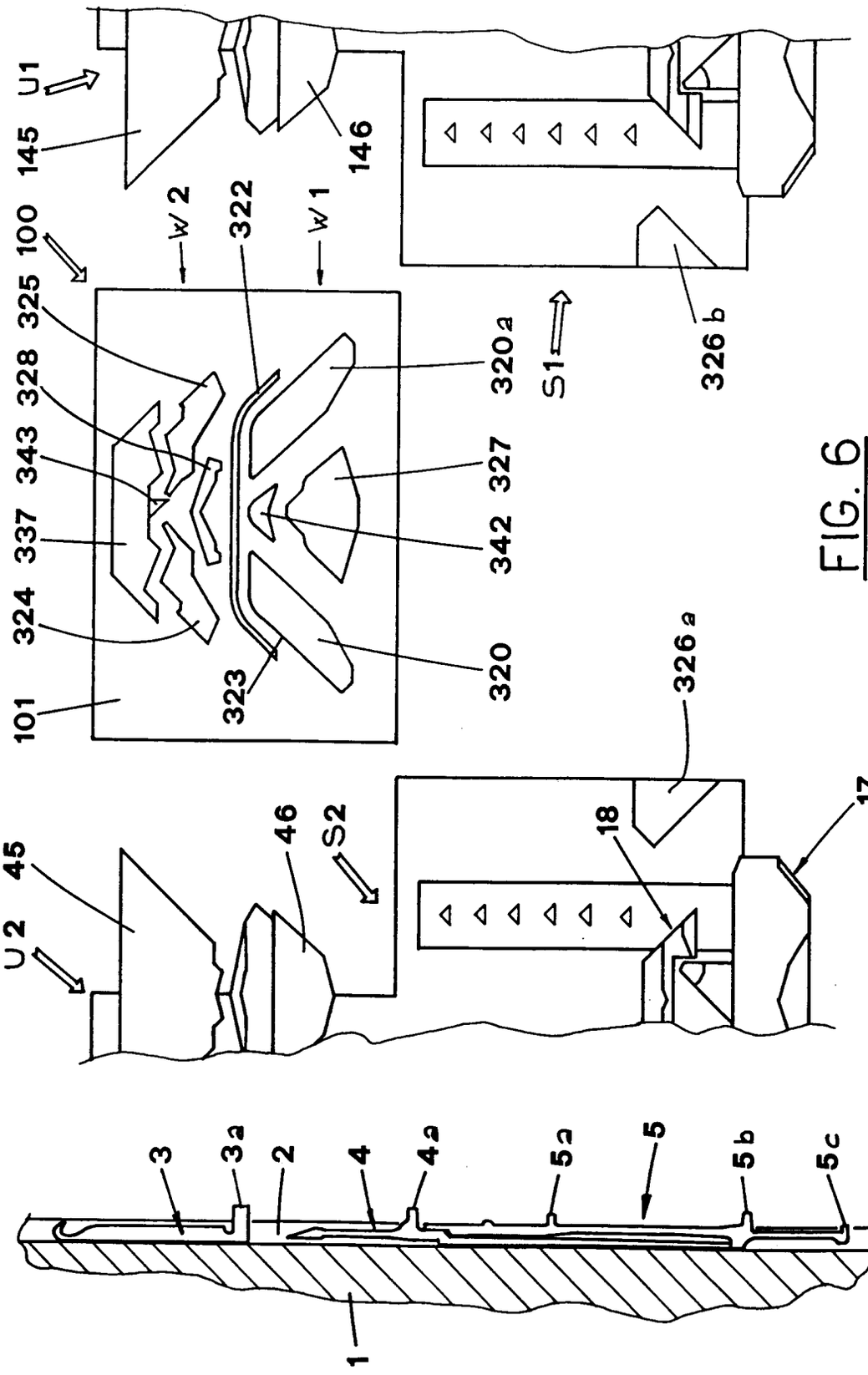
In the accompanying figures there are illustrated two separate sinkers 4, 5, interactive with each other; it is understood that the functions performed by said two sinkers can be performed either by a single sinker or by more than two sinkers; the technical teaching and the subsequent advantages of the described above solution are still applicable.

Claims

1. Improved flat automatic knitting machine, of the type including, amongst other things:
   two flat needle beds (1) inclined symmetrically in respect to a longitudinal vertical plan, and divergent from top to bottom, with each needle bed having equidistant transversal grooves (2), in each of which there are inserted, from top to bottom, a needle (3) provided with a butt (3a) protruding from the needle bed surface, an intermediate sinker (4) provided with at least one butt (4a) protruding from the needle bed surface, and a selection sinker (5), provided with at least three butts (5a, 5b, 5c), first,

second and third butt, all of them protruding from the needle bed surface;
at least two carriages (13, 113) sliding on the needle beds (1) according to a to-and-fro movement, each of which is provided with fixed and movable cams, turned toward the underlaying surface of the relative needle bed, shaped and mutually placed, in combination with the activation and/or deactivation of the movable cams, to define:
at least two selection units (S_1, S_2), spaced apart from each other, designed to select prefixed selection sinkers (5) respectively in one translation direction (F1) and in the other translation direction (F2) of the relative carriage (13, 113) by striking the first butt (5a) of the prefixed selection sinker with relative movable selected cam, with subsequent raising of said sinker to allow for further striking of at least one of the remaining butts (5b, 5c) of said selection sinker made by further cams of the related selection unit, with further raising of this latter sinker and of the associated intermediate sinker (4); at least one operative unit (U_1, U_2), situated over said selection units (S_1, S_2) in a position centred in respect of the vertical plane equidistant from the latters, said operative unit being formed by two longitudinal bands (W1, W2) of cams, with the cams of the first band (W1 designed to strike the butt (4a) of the intermediate sinker (4), only if the latter is already raised in respect to relative rest position, with subsequent shifting upwards of the associated needle (3), and subsequently to bring back to the rest position the same intermediate sinker, and with the cams of the second band (W2) designed to strike the butt (3a) of the needle (3), already raised in respect to the relative rest position by the relative intermediate sinker (4), with subsequent actuation of the same needle, to activate at least the transferring or receiving of the fabric stitch to and from another needle bed, and subsequent bringing the same needle back to the rest position with shifting downward of the associated intermediate sinker (4);
a resetting cam (26), placed between said units (S_1, S_2), adapted to strike, in both translation directions of the relative carriage (13, 113), the second or the third butt (5b, 5c) of the selection sinker (5) to bring the latter back to the rest position;
said machine being **characterized in that** the selection units (S_1, S_2) of said carriages (13, 113) adjacent to each other are fit to activate the selection of the selection sinkers (5) in both translation directions (F1, F2) of the relative carriages,
and **in that** it includes:
a device (100) removably fixed to said carriages in correspondence to said operative units (U_1, U_2) of the latters, said device having longitudinal extention such to allow the joining of the counter-facing heads of the selection units (S_1, S_2) of said carriages adjacent to said heads, and being provided with fixed cams shaped and mutually positioned in a way similar to the said operative units of the previously mentioned carriages (13,113) to allow, as a result of the selection of the said selection sinkers activated by one or the other adjacent selection units (S_1, S_2), correspondingly for one or the other translation direction of the two carriages-assembly, the transferring or the receiving of the fabric stitch to and from another needle bed;
two semicams (326a,326b) respectively situated in correspondence with the counter-facing heads of the said adjacent selection units, definig, as a result of the joining of said heads, a resetting cam (326) similar to the resetting cam provided in each carriage (13,113).

2. Machine according to claim 1, **characterized in that** the counter-facing cams of the operative units (U_1, U_2) of said carriages are shaped symmetrically with respect to relative vertical planes.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145
146
W 2
322
W 1
100
325
328
343
337
324
101
323
320a
S1
326b
327
342
320
326a
U2
45
46
S2
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17
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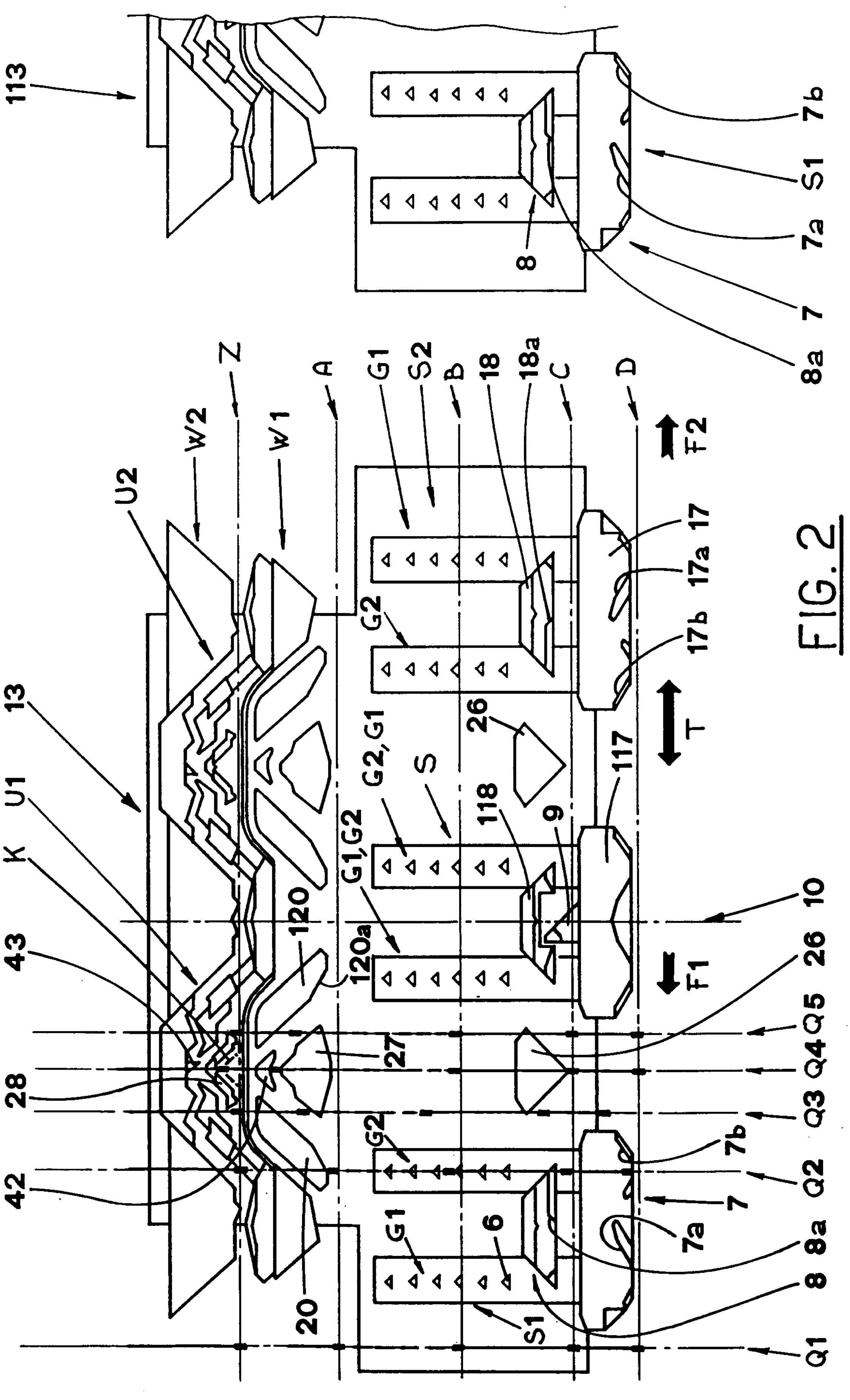
3a
2
4
4a
5a
5
5b
5c
1

FIG. 6

FIG. 1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8
8a
7
7a
S1
7b
Z
A
G1
S2
B
18
18a
C
D
F2
W2
W1
U2
17
17a
17b
G2
13
26
T
U1
K
43
28
42
G2,G1
S
118
9
117
10
G1,G2
120
120a
F1
26
Q5
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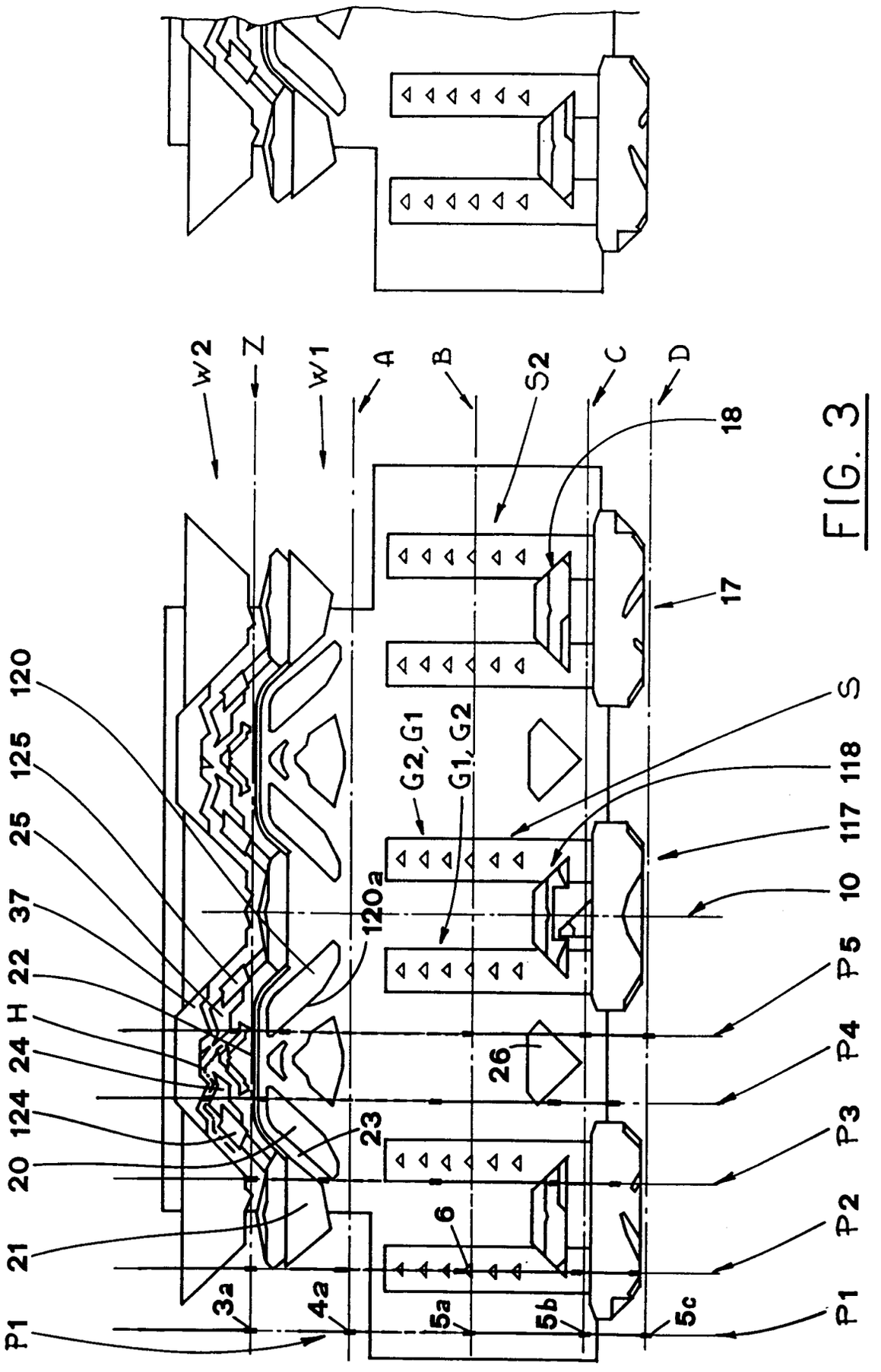
Q1

FIG. 2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B
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4a
5a
5b
5c
6
23
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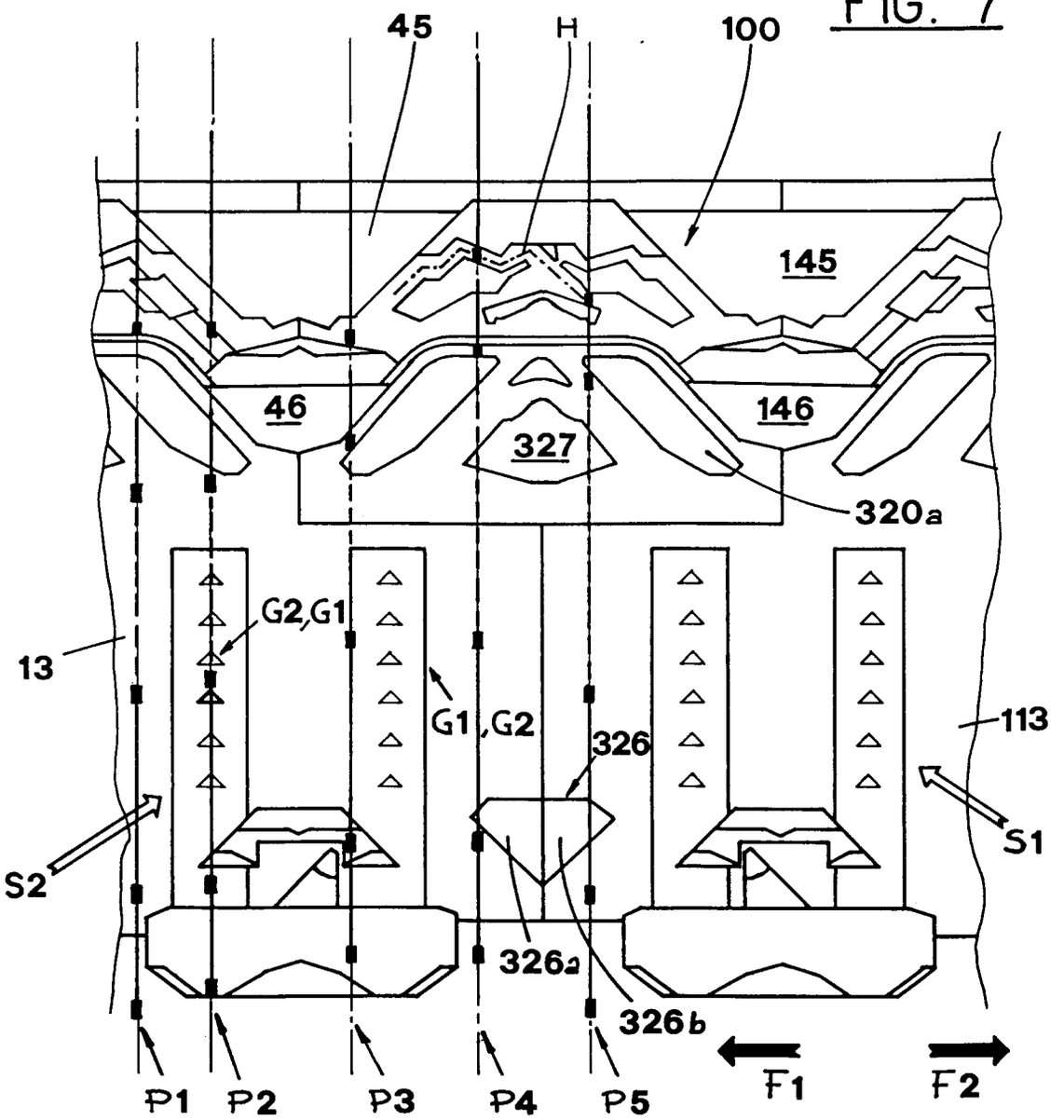
P5
P4
P3
P2
P1

FIG. 3

FIG. 7



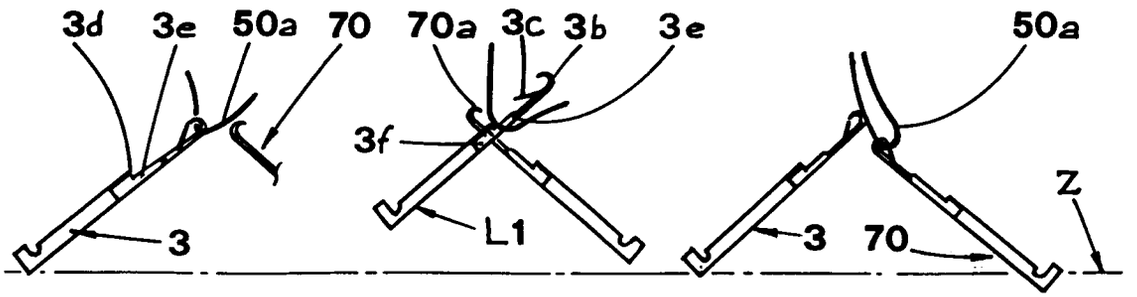
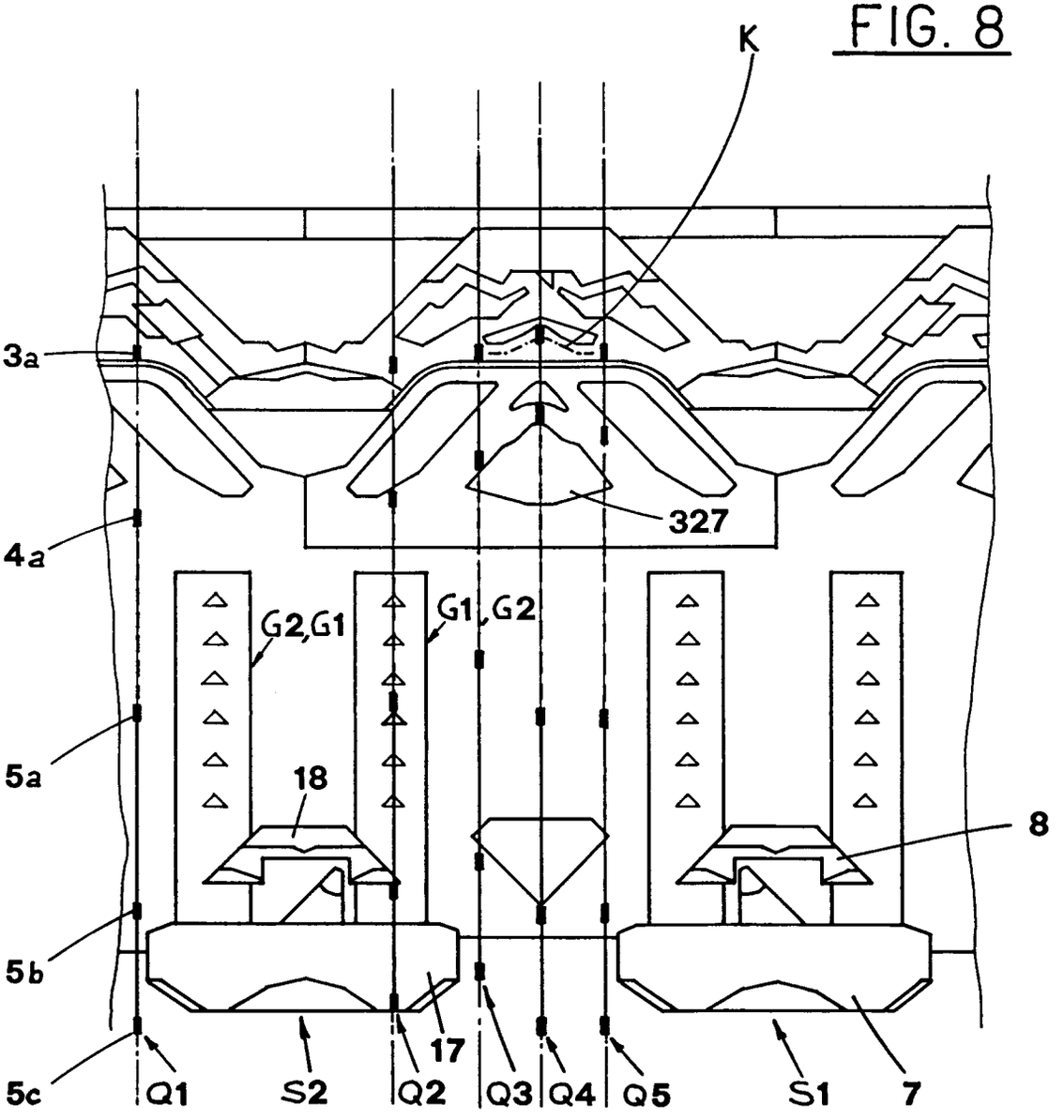


FIG. 4a FIG. 4b FIG. 4c

FIG. 8



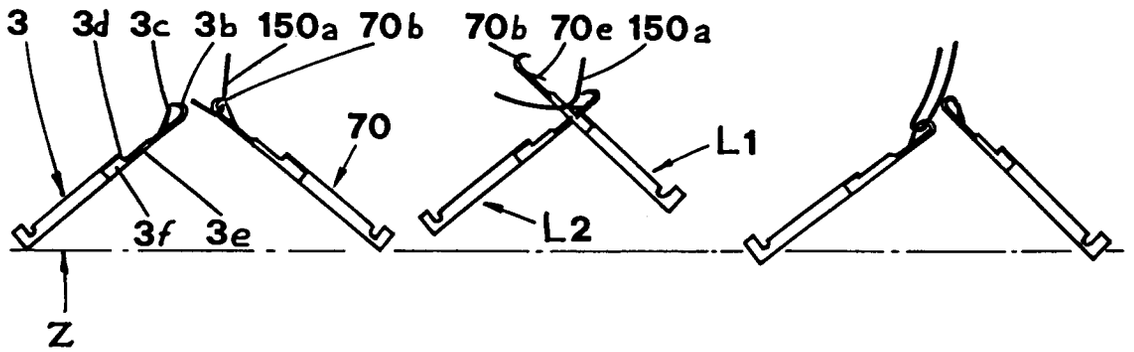


FIG. 5a FIG. 5b FIG. 5c

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Application Number
EP 93 83 0454

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)
D,A	EP-A-0 215 746 (E.M.M. EMILIANA MACCHINE MAGLIARIE S.R.L.) & US-A-4 667 488		D04B15/82
A	DE-U-84 24 135 (UNIVERSAL MASCHINENFABRIK DR. RUDOLF SCHIEBER GMBH & CO KG)		
A	EP-A-0 236 172 (ABRIL CULLELL)		
			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	17 February 1994	Van Gelder, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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