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(11) **EP 1 178 145 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
06.02.2002 Bulletin 2002/06

(51) Int Cl.7: **D06C 11/00**

(21) Application number: **01202482.4**

(22) Date of filing: **28.06.2001**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**
Designated Extension States:
AL LT LV MK RO SI

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(30) Priority: **01.08.2000 IT MI001781**

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(54) **Machine for softening the surface of a fabric**

(57) A machine for softening the surface of a continuous fabric (26; 126) comprises at least one row (4a; 4b; 104a) of rotating roller brushes (4; 104) in which each roller brush (4; 104) is operationally connected to a respective motor unit (12) capable of causing it to rotate at a predefined speed and in a predefined direction of rotation; at least one penetrating element (13; 113) for varying the winding angle of the fabric on a brush (4;

104); suction means (18-22, 130; 118-122, 230) capable of removing fine fibrous dust; an extension roller (27; 127) provided with load sensors able to detect the tension of said fabric (26; 126); and at least one additional rotating roller brush (4c) capable of exerting an additional brushing action on a second surface (26b) of said fabric; each roller brush (4; 104; 4c) being provided with bunches (10) of filaments (9).

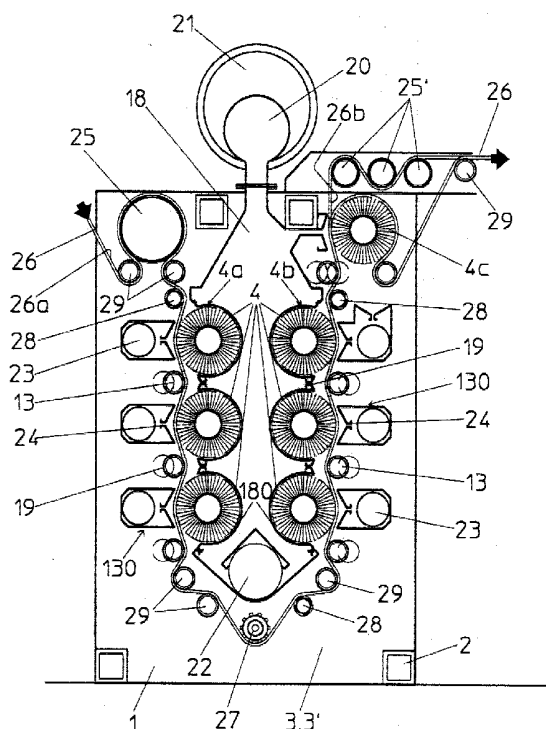


Fig.1

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Description

[0001] The present invention relates to a machine for softening the surface of a fabric.

[0002] More particularly, the present invention relates to a machine for softening the surface of a fabric having a high intrinsic elasticity, such as a knitted fabric, or in any case a fabric which yields to tensile stresses, such as a non-woven fabric.

[0003] During the course of the present description, the expression "knitted fabric" indicates circular knitted fabrics, the weave of which is of the type: single jersey, piqué, fleece and interlock, 1x1 and/or 2x2 rib and the like.

[0004] The yarns commonly used in the production of knitted fabrics are based on natural cellulose fibres, such as for example cotton or viscose, and/or synthetic fibres such as, for example, polyurethane fibres (for example Elastan™).

[0005] Typical examples of said yarns are cellulose yarns ranging from Ne 24/1 to Ne 50/1 (Ne = British cotton count) and mixed yarns comprising from 80 to 95% of cellulose fibres and from 20 to 5% of polyurethane fibres.

[0006] Typical examples of knitted fabrics are: 100% cotton interlock, 100% cotton fleece, 100% cotton 2x2 rib, 100% cotton single jersey, 100% cotton piqué, 100% cotton 1x1 rib, single jersey (88% viscose + 12% Lycra™ Du Pont).

[0007] The high degree of sensitivity to stresses of knitted fabrics and non-woven fabrics distinguishes them notably from other types of fabric such as, for example, woven fabrics, in particular during the finishing operations.

[0008] A typical finishing operation is softening. It may be achieved chemically or mechanically. Mechanical softening is generally achieved using processes which act on the surface of the fabrics so as to make them soft to touch and modify substantially also the appearance thereof.

[0009] Generally, the means used to produce these tactile and visual modifications in fabrics consist, for example, of metal needles, abrasive materials, and the like, which tear, raise and remove from the surface of the fabrics a considerable quantity of fibre, thus causing the formation of a surface hairiness which is more or less long and dense. In addition to the sought-after tactile effect (feel of the fabric) of softening, a considerable change is also produced, as a result, in the surface aspect of the fabrics, which is often not wanted and not popular on the market.

[0010] The machines which use these metal and/or abrasive means essentially consist of teaselling machines and/or sueding machines.

[0011] Teaselling machines comprise a certain number of teaselling rollers provided with metallic needles or lined with abrasive materials, rotating on the periphery of a drum which is also rotating. The continuous

fabric travels in contact with the teaselling rollers and is thus worked on its surface facing said rollers.

[0012] Sueding machines comprise a series of sueding rollers lined with abrasive materials, rotating and arranged in horizontal or vertical succession. The continuous fabric travels in contact with the sueding rollers and is thus worked on its surface facing said rollers. The extension of the contact zone is varied and adjusted by means of special penetrating devices.

[0013] Machines of another type, which are substantially used to cause artificial ageing of continuous fabrics, comprise a processing means consisting of a rotating roller brush essentially made of synthetic material. The brush is operationally associated with a belt conveying the fabric to be processed. The conveyor belt, in turn, is associated with a device able to vary and adjust the distance of the rotating brush from it. The continuous fabric advances on the conveyor belt and, coming into contact with the rotating brush, is worked on its surface facing the latter.

[0014] Machines of this type use brushes with filaments which are particularly flexible and which whip the fabric with force, resulting in wear of its surface and discolouring effects.

[0015] The Applicant has noted that this type of machine is not suitable for softening a fabric which yields to mechanical stresses.

[0016] Another type of known machine comprises a plurality of rotating brushes which are arranged on the surface of a drum, which is also rotating, and where the fabric, when passing through, undergoes a succession of processing operations.

[0017] The Applicant has noted that this type of machine also has drawbacks when it is used to soften a fabric which yields to mechanical stresses. In fact, each brush acts on too small a surface of fabric and the contact between brush and fabric is too brief. Therefore, a relatively large number of contact points is not sufficient to achieve a completely satisfactory softening effect for these fabrics.

[0018] The Applicant has now realised that the softening which can be achieved with teaselling and sueding machines of the known type is not satisfactory when a fabric has a high tendency to yield to mechanical stresses, as in the case of a knitted fabric and a non-woven fabric.

[0019] The object of the present invention is to improve the known machines, overcoming the limitations and drawbacks associated therewith when used to soften a yielding fabric.

[0020] According to a first aspect thereof, the invention relates to a machine for softening the surface of a continuous fabric being fed in a predefined direction, comprising:

- at least one row of rotating roller brushes, having substantially parallel axes and able to exert a respective brushing action on a first surface of said

fabric;

- each roller brush being operationally connected to a respective motor unit capable of causing it to rotate at a predefined speed and in a predefined direction of rotation, independent of the speed and direction of rotation of another brush;
- at least one penetrating element capable of varying the angle of winding of said fabric on one of said roller brushes;
- suction means capable of removing fine fibrous dust produced by the action of brushing said fabric;
- extension means provided with load sensors able to detect the tension of said fabric; and
- at least one additional rotating roller brush arranged downstream of said at least one row of roller brushes in the direction of feeding of said fabric and on the opposite side to said at least one row of brushes with respect to said fabric;
- said additional roller brush being operationally connected to a respective motor unit capable of causing it to rotate at a predefined speed and in a predefined direction of rotation independent of the speed and the direction of rotation of said brushes of said at least one row;
- said additional roller brush being capable of exerting an additional brushing action on a second surface of said fabric;
- at least one of said roller brushes being provided with bunches of filaments.

[0021] Preferably, said filaments are made of synthetic material incorporating granules of at least one abrasive material.

[0022] Advantageously, said synthetic material consists of nylon fibre.

[0023] Typically, said granules are chosen from the group comprising silicon carbide, aluminium oxide and synthetic diamond.

[0024] Preferably, the length of said filaments is between 50 and 150 mm.

[0025] Advantageously, said length is between 80 and 120 mm.

[0026] Preferably, the diameter of said filaments is between 0.4 and 0.8 mm.

[0027] Advantageously, said diameter is between 0.5 and 0.6 mm.

[0028] Preferably, the grade of said filaments is between 200 and 800.

[0029] Advantageously, said grade is between 240 and 320.

[0030] Preferably, the number of said filaments in each of said bunches is between 20 and 90.

[0031] Advantageously, said number is between 35 and 75.

[0032] Preferably, the density of said bunches in each brush is between 35/dm² and 75/dm².

[0033] Advantageously, said density is between 55/dm² and 65/dm².

[0034] Preferably, each brush has a diameter of the roller of between 100 and 150 mm.

[0035] Advantageously, said diameter of the roller is between 115 and 135 mm.

[0036] Preferably, said row is vertical.

[0037] Advantageously, said rotating roller brushes are arranged in two vertical and parallel rows.

[0038] According to a variant, said row is horizontal.

[0039] Preferably, said suction means comprise a shaped suction box having at least two semi-cylindrical casings each of which partially surrounds one of said roller brushes, each semi-cylindrical casing having lateral air intakes.

[0040] According to one embodiment, said suction box has two parallel rows of semi-cylindrical casings and is arranged between said two rows of brushes.

[0041] Preferably, said suction means comprise suction heads provided with air intakes facing said roller brushes.

[0042] Advantageously, said suction heads are located on the opposite side to said casings of said suction box.

[0043] Preferably, said suction means also comprise at least one header connected to said suction box, to said suction heads and to a suction device.

[0044] According to a second aspect, the invention relates to a method for softening the surface of a continuous fabric, comprising the steps of:

- a) feeding said fabric in a predefined direction;
- b) exerting at least one first and one second brushing action on a first surface of said fabric, said first and second brushing action being independent.

[0045] Preferably, said method also comprises the steps of:

- c) exerting an additional brushing action on a second surface of said fabric, opposite to said first surface, said additional brushing action being independent of said first and second brushing actions.

[0046] In the machine according to the invention, each rotating roller brush is motorised individually and therefore is able to operate at a speed different from that of the other brushes and rotate in either direction of rotation. This allows the brushing action exerted by the individual brushes to be differentiated and renders the machine highly efficient and flexible.

[0047] In addition there is the possibility of differentiating the grade of the filaments of the brushes so as to adapt it to the evolution in the modifications to the surface of the fabric during the course of the brushing treatment. In particular, the grade of the initial processing brushes may be different from that of the final processing brushes.

[0048] Moreover, the longitudinal tensile stresses of the fabric being processed may be controlled and ad-

justed depending on the type of fabric to be treated, by varying the speed of rotation of the individual roller brushes, their direction of rotation and the feed speed of the fabric.

[0049] The winding angle of the fabric on the brushes may also be adjusted within a fairly wide range by means of the penetrating elements.

[0050] Overall, the structure of the machine according to the invention allows combination of the various parameters, such as direction of rotation and speed of rotation of the brushes, breadth of the contact area and fineness of the abrasive filaments, thus producing a variety of adjustments such as to obtain an innumerable range of effects.

[0051] Particularly surprising and unexpected results were obtained with knitted fabrics of the type: 100% cotton, 100% cotton fleece, 100% cotton 2x2 rib, 100% cotton single jersey, 100% cotton piqué, 100% cotton 1x1 rib, single jersey (88% viscose + 12% Lycra™ Du Pont).

[0052] Further characteristic features and advantages of the invention will now be illustrated with reference to embodiments shown by way of a non-limiting example in the accompanying figures, in which:

Fig. 1 is a cross-sectional view of a machine for softening the surface of a continuous fabric, provided according to the invention;

Fig. 2 is a front view, on a larger scale, of a roller brush of the machine according to Fig. 1;

Fig. 2a shows details of the brush according to Fig. 2;

Fig. 3 shows a front view, on a larger scale, of a penetrating roller of the machine according to Fig. 1;

Fig. 4 shows a cross-sectional view of a variant of the machine according to Fig. 1.

[0053] Fig. 1 shows a machine for softening the surface of a continuous fabric, comprising a plurality of rotating roller brushes 4. The brushes 4 are arranged in series of three by three, with the axes substantially parallel, and form two vertical and parallel rows 4a and 4b. The brushes 4 are housed inside a support structure 1 reinforced by a frame 2 and comprising two end sidewalls 3 and 3'.

[0054] Each brush 4 is formed by a roller 5 (Fig. 2) which has a cylindrical lateral wall 7 lined with a layer 8 of synthetic material and in which bunches 10 (Fig. 2a) of filaments 9 made of synthetic material are embedded. The roller 5 is provided with hubs 6 and 6' which are rotatably supported in supports 11 and 11' mounted in the sidewalls 3 and 3' of the structure 1. Each roller brush 4 is operationally connected to a respective motor/drive unit (garmotor) 12. Each motor/drive unit 12 is capable of operating independently of those of the other roller brushes 4. Each unit 12 is fixed on the outside of the sidewall 3.

[0055] An additional rotating roller brush 4c is arranged downstream of the roller brushes 4 of the second

row 4b. The brush 4c has a structure similar to that of the brushes 4 and is actuated by its own respective motor/drive unit 12, also capable of operating independently from those of the brushes 4.

[0056] A motorised roller 25 for feeding a fabric 26 and motorised rollers 25' for extracting the fabric 26 are arranged inside the structure 1. An extension roller 27 provided with load sensors for controlling and adjusting the tension of the fabric 26, widening rollers 28 and drive rollers 29 are arranged between the feed roller 25 and extraction roller 25'.

[0057] The fabric 26 is fed inside the machine so that a surface (side) 26a thereof is in contact with the roller brushes 4 of the two rows 4a and 4b, being subject to a beating and abrasive action, and an opposite surface (side) 26b thereof is in contact with the roller brush 4c, being also subject to a beating and abrasive action.

[0058] Roller-type penetrating elements 13, able to adjust the winding angle of the fabric 20 on the brush, are associated with the roller brushes 4. The penetrating elements 13 are arranged upstream and downstream of each roller brush 4 and act on the surface 26b of the fabric 26 opposite to that which is in contact with the brushes 4.

[0059] Each roller penetrating element 13 is rotatably supported by a shaft 140 (Fig. 3). The shaft 140 has two end hubs 14 and 14' onto which toothed wheels 16 and 16' meshing with the racks 15 and 15' are keyed. The toothed wheels 16 and 16' are operationally connected, by means of the hub 14, to a telescopic actuator 17 which is capable of causing it to slide with respect to the racks 15 and 15'. The racks 15 and 15' have the function of maintaining the alignment of the penetrating element 13, namely they cause it to translate in a perpendicular direction with respect to the axis of its shaft 140.

[0060] The beating and abrasive action exerted by the brushes 4 on the surface 26a of the fabric causes the formation of a fine fibrous dust which is removed by a suction device 21 connected to a shaped suction box 18 arranged between the two rows of brushes 4a and 4b. The suction box 18 has two parallel rows of semi-cylindrical casings 180. Each casing 180 partially surrounds a brush 4 and has side slits (air intakes) 19 able to allow the through-flow of a stream of air. The stream of air and fine fibrous dust collected by the box 18 is conveyed outside by means of a header 20 arranged in the top of the box 18 and connected to the suction device 21. Another header 22 is arranged in the bottom of the box 18 and is connected to the header 20 so as to assist it with conveying air and fine fibrous dust to the suction device 21.

[0061] Suction heads 130 provided with slits (air intakes) 24 able to allow the through-flow of a stream of air and fine fibrous dust residue are located facing the roller brushes 4. The suction heads 130 are located on the opposite side to the casings 180 and are connected to suction channels 23 in turn connected to the header 20.

[0062] When the machine is in operation, the fabric 26 is fed continuously by means of the motorised roller 25 which causes it to engage first with the brushes 4 of the row 4a and then with the brushes 4 of the row 4b.

[0063] Each brush 4 is made to rotate by the respective motor/drive unit 12 at a predefined speed and with a predefined direction of rotation as to the direction of feeding of the fabric 26. Thus the fabric 26 travels in contact with the brushes 4 in a direction which is the same as or opposite to the direction of rotation of the brushes.

[0064] For example, the brushes 4 of the first row 4a rotate in the same direction as the direction of feeding of the fabric 26, while the brushes 4 in the second row 4b rotate in the opposite direction. Alternatively, the brushes of the two rows rotate in the direction opposite to that indicated above. It is also possible to cause the brushes of the two rows to rotate in the same direction.

[0065] The possibilities of combining the directions of rotation of the brushes 4 of the two rows 4a and 4b with respect to the direction of feeding of the fabric 26 are many. The two relative movements may be first in opposite directions and then in the same direction or else may be always in the same direction or always in the opposite direction.

[0066] In this way, the surface 26a of the fabric which is in contact with the brushes 4 may be subject to an action directed longitudinally and alternating in both directions. Depending on the requirements, it is possible to increase the action in one direction compared to that in the other direction or the actions may be balanced.

[0067] Moreover, each individual brush 4 of each row 4a and 4b may be actuated by the respective motor/drive unit 12 independently of the other brushes also as regards the speed of rotation. This allows the choice of the possible operating conditions of the machine to be increased considerably.

[0068] The brushes 4 perform a beating and abrasive action on the surface 26a of the fabric 26 which is more or less intense essentially depending on the direction of rotation and speed of rotation of the brushes 4 in relation to the fabric feed speed, the winding and contact arc of the surface 26a with the brushes, the longitudinal tension applied to the fabric and, finally, the overall form of the brushes 4.

[0069] This beating and abrasive action produces an undulating flexural stress on the entire textile structure of the fabric 23 and superficial wearing effect on its surface 26a, the combination of which produces the desired softening effect.

[0070] The inventor has found that the qualitative level of softening of the fabric depends on the constructional and dimensional characteristics of the brushes and that adequate balancing between the diameter of each roller (shaft 5 + lining 8), the length, the diameter and the grade of the filaments of synthetic material 9, the number of filaments 9 in the bunches 10, the density of the bunches 10 and the material from which these fila-

ments are made allows the qualitative level to be raised above that which can be achieved with conventional machines.

[0071] Preferably, the filaments of synthetic material 9 of the brushes 4 are made of nylon fibre incorporating granules chosen from the group comprising silicon carbide, aluminium oxide and synthetic diamond.

[0072] The length of the filaments 9 varies from 50 to 150 mm and is preferably between 80 and 120 mm.

[0073] The diameter of the filaments 9 varies from 0.4 to 0.8 mm and is preferably between 0.5 and 0.6 mm.

[0074] The grade of the filaments 9 varies from 200 to 800 and is preferably between 240 and 320.

[0075] The density (or number) of filaments 9 in each bunch 10 varies from 20 to 90 and is preferably between 35 and 75.

[0076] The density (or number) of bunches 10 in each brush varies from 35/dm² to 75/dm² and is preferably between 55/dm² and 65/dm².

[0077] The diameter of the roller (shaft 5 + lining 8) varies from 100 to 150 mm, and is preferably between 115 and 135 mm.

[0078] The brush 4c which is in contact with the surface 26b of the fabric 26 has the possibility of varying the direction of rotation and the speed of rotation, in the same manner as the brushes 4. Thus, on the surface 26b of the fabric opposite to the surface 26a, it is also possible to produce a softening effect which is harmonised as far as possible with that provided by the brushes 4 of the rows 4a and 4b.

[0079] After the brushing treatment, the fabric 26 is continuously extracted by means of the motorised rollers 25'. The longitudinal tension of feeding of the fabric 26 is controlled and adjusted by the roller 27 which is provided with electronic load sensors capable of varying the speed of rotation of the motorised roller 25.

[0080] In the machine it is possible to vary and adjust the brushing action, increasing or diminishing it, by also varying other parameters.

[0081] One of these parameters consists of the grade of the abrasive filaments 9 of the brushes 4. It is also possible to use filaments with a varying grade depending on the position which each brush occupies in the contact sequence with the passing fabric: for example, coarser grades for the initial brushes and finer grades for the final brushes.

[0082] Another parameter consists of the area of contact between the surface 26a of the fabric 26 and each brush 4. This area of contact may be varied by displacing the penetrating element 13 by means of the actuator 17 in a direction substantially perpendicular to the fabric. The degree of penetration of the fabric 26 into the space immediately upstream and downstream of each brush 4 causes a variation in the angle of winding of the fabric onto the brush, increasing or decreasing the area of the surface of the fabric in contact with each brush 4, thereby intensifying or diminishing the action thereof.

[0083] A further parameter consists of the longitudinal

tension of feeding of the fabric 26. This may be controlled and regulated by means of the roller 27 provided with electronic load sensors capable of varying the speed of rotation of the feed roller 25. The pre-set tension value of the fabric 26 is continuously controlled and maintained by the roller 27 by means of the continuous variation of the speed of rotation of the feed roller 25 with respect to the speed of the extraction rollers 25', thus compensating also the influence of the longitudinal stresses exerted on the fabric 26 by the direction and by the speed of rotation of the brushes 4.

[0084] The fine fibrous dust formed as a result of the mechanical beating and abrasive action of the brushes 4 on the fabric 26 is removed and conveyed away by means of local suction of air flows. This is performed by means of the slits 19 of the suction box 18 and the slits 24 of the suction heads 130. In this way, removal and conveying away of the fine fibrous dust occurs in the formation zones, namely in the zones where brushes and fabric come into contact, thereby avoiding, or at least minimising, both local accumulation of fine dust and dispersion inside the structure 1. The suction device 21, by means of the headers 20 and 22 and the channels 23, sucks the air flows from inside the box 18 and from the channels 23 and conveys the fine dust towards collection and filtration units which are known and not shown.

[0085] Fig. 4 shows a machine for softening the surface of a continuous fabric, which forms a variant of that shown in Fig. 1. The machine comprises a plurality of rotating roller brushes 104 housed inside a support structure 101. The structure 101 is reinforced by a frame 102 and comprises two end sidewalls 103 and 103'. The brushes 104 are arranged in a horizontal row 104a, with the axes substantially parallel, and are rotatably supported in the sidewalls 103 and 103'. The brushes 104 have a form similar to that of brushes 4 and each of them is operationally connected to a respective motor/drive unit similar to the unit 12 (Fig. 2). An additional rotating roller brush, not shown, similar to the brush 4c and also operationally connected to a respective motor/drive unit may be arranged downstream of the brushes 104.

[0086] A motorised roller 125 for feeding a fabric 126 and a motorised roller 125' for extracting the fabric 126 are arranged inside the structure 101. An extension roller 127 provided with load cells for controlling and adjusting the tension of the fabric, a widening roller 128 and drive rollers 129 are arranged between the feed roller 125 and the extraction roller 125'.

[0087] The brushes 104 are in contact with a surface 126a of the fabric, while an optional brush, similar to the brush 4c, is in contact with the opposite surface.

[0088] The roller brushes 104 have, associated with them, roller penetrating elements 113 able to adjust the winding angle of the fabric 126 on the brush. Each roller penetrating element 113 has a form and operating mode similar to those of the penetrating element 13 (Fig. 3).

[0089] A shaped suction box 118 is housed inside the

support structure 101 and is arranged underneath the row of brushes 104. The box 118 has a series of semi-cylindrical casings 280, each of which partially surrounds a brush 104 and has side slits (air intakes) 119 able to allow the through-flow of a stream of air and fine fibrous dust. The stream of air and fine fibrous dust collected by the box 118 is conveyed outside by means of a header 120 arranged in the side wall of the box 118 and connected to a suction device 121. Another header 122 is arranged in the bottom of the box 118 and is connected to the header 120 so as to assist it with conveying air and fine fibrous dust to the suction device 121.

[0090] Suction heads 230 provided with slits (air intakes) 124 able to allow the through-flow of a stream of air and fine fibrous dust residue are located facing the roller brushes 104. The suction heads 230 are located on the opposite side to the casings 280 and are connected to suction channels 123 in turn connected to the header 120.

[0091] Operation of the machine shown in Fig. 4 is similar to that of the machine according to Fig. 1.

[0092] In the machine according to Fig. 4, a single row of brushes 104 exerts a beating and abrasive action on the surface 126a of the fabric 126.

[0093] In this case also, the speed and the direction of rotation of each brush 104 may be adjusted by combining them in various ways. For example, all the brushes 104 may rotate in the same direction or in the opposite direction to the direction of feeding of the fabric, or some of the brushes 104a rotate in the same direction and some in the opposite direction to the direction of feeding of the fabric, or else the brushes 104a rotate alternately in the same direction and in the opposite direction to the direction of feeding of the fabric. In this way, the surface 126a of the fabric which is in contact with the brushes 104 may be subject to a brushing action directed longitudinally and alternating in both directions and, depending on the requirements, it is possible to increase the action in one direction compared to that in the other direction or the actions may be balanced.

Claims

1. Machine for softening the surface of a continuous fabric (26; 126) being fed in a predefined direction, comprising:
 - at least one row (4a; 4b; 104a) of rotating roller brushes (4; 104), having substantially parallel axes and able to exert a respective brushing action on a first surface (26a; 126a) of said fabric (26; 126);
 - each roller brush (4; 104) being operationally connected to a respective motor unit (12) capable of causing it to rotate at a predefined speed and in a predefined direction of rotation, independent of the speed and sense of rotation of

- another brush (4; 104);
 - at least one penetrating element (13; 113) capable of varying the winding angle of direction fabric (26; 126) on one of said roller brushes (4; 104);
 - suction means (18-22, 130; 118-122, 230) capable of removing fine fibrous dust produced by the action of brushing said fabric (26; 126);
 - extension means (27; 127) provided with load sensors able to detect the tension of said fabric (26; 126); and
 - at least one additional rotating roller brush (4c) arranged downstream of said at least one row (4a; 4b; 104a) of roller brushes (4) in the direction of feeding of said fabric (26) and on the opposite side to said at least one row (4a; 4b; 104a) of brushes with respect to said fabric (26);
 - said additional roller brush (4c) being operationally connected to a respective motor unit (12) capable of causing it to rotate at a predefined speed and in a predefined direction independent of the speed and the direction of rotation of said brushes (4) of said at least one row (4a; 4b; 104a);
 - said additional roller brush (4c) being capable of exerting an additional brushing action on a second surface (26b) of said fabric;
 - at least one of said roller brushes (4; 104; 4c) being provided with bunches (10) of filaments (9).
2. Machine according to Claim 1, **characterized in that** said filaments (9) are made of synthetic material incorporating granules of at least one abrasive material.
3. Machine according to Claim 2, **characterized in that** said synthetic material consists of nylon fibre.
4. Machine according to Claim 2, **characterized in that** said granules are chosen from the group comprising silicon carbide, aluminium oxide and synthetic diamond.
5. Machine according to Claim 1, **characterized in that** the length of said filaments (9) is between 50 and 150 mm.
6. Machine according to Claim 5, **characterized in that** said length is between 80 and 120 mm.
7. Machine according to Claim 1, **characterized in that** the diameter of said filaments (9) is between 0.4 and 0.8 mm.
8. Machine according to Claim 7, **characterized in that** said diameter is between 0.5 and 0.6 mm.
9. Machine according to Claim 1, **characterized in that** the grade of said filaments (9) is between 200 and 800.
10. Machine according to Claim 9, **characterized in that** said grade is between 240 and 320.
11. Machine according to Claim 1, **characterized in that** the number of said filaments (9) in each of said bunches (10) is between 20 and 90.
12. Machine according to Claim 11, **characterized in that** said number is between 35 and 75.
13. Machine according to Claim 1, **characterized in that** the density of said bunches (10) in each brush (4; 104; 4c) is between 35/dm² and 75/dm².
14. Machine according to Claim 13, **characterized in that** said density is between 55/dm² and 65/dm².
15. Machine according to Claim 1, **characterized in that** each brush (4; 104, 4c) has a diameter of the roller of between 100 and 150 mm.
16. Machine according to Claim 15, **characterized in that** said diameter of the roller is between 115 and 135 mm.
17. Machine according to Claim 1, **characterized in that** said row (4a; 4b) is vertical.
18. Machine according to Claim 1, **characterized in that** said rotating roller brushes are arranged in two vertical and parallel rows (4a, 4b).
19. Machine according to Claim 1, **characterized in that** said row (104a) is horizontal.
20. Machine according to Claim 1, **characterized in that** said suction means (18-22, 130; 118-122, 230) comprise a shaped suction box (18; 118) having at least two semi-cylindrical casings (180; 280) each of which partially surrounds one of said roller brushes (1; 101), each semi-cylindrical casing (180; 280) having lateral air intakes (19; 119).
21. Machine according to Claims 18 and 20, **characterized in that** said suction box (18) has two parallel rows of semi-cylindrical casings (180) and is arranged between said two rows of brushes (4a, 4b).
22. Machine according to Claim 1, **characterized in that** said suction means (18-22, 130; 118-122, 230) comprise suction heads (130; 230) provided with air intakes (24; 124) facing said roller brushes (4; 104).
23. Machine according to Claims 20 and 22, **charac-**

terized in that said suction heads (130; 230) are located on the opposite side to said casings (180; 280) of said suction box (18; 118).

24. Machine according to Claims 1, 20 and 22, **characterized in that** said suction means (18-22, 130; 118-122, 230) also comprise at least one header (20; 22; 120; 122) connected to said suction box (18; 118), to said suction heads (130; 230) and to a suction device (21; 121). 5
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25. A machine according to any one of the preceding claims, **characterized in that** said continuous fabric is a knitted fabric. 15

26. A machine according to Claim 25, **characterized in that** said continuous fabric is a circular knitted fabric.

27. A machine according to any one of the preceding Claims 1 to 24, **characterized in that** said continuous fabric is a non-woven fabric. 20

28. Method for softening the surface of a continuous fabric (26; 126), comprising the steps of: 25

- a) feeding said fabric (26; 126) in a predefined direction;
- b) exerting at least one first and one second brushing action on a first surface (26a; 126a) of said fabric (26; 126), said first and second brushing action being independent. 30

29. Method according to Claim 28, **characterized in that** it also comprises the steps of: 35

- c) exerting an additional brushing action on a second surface (26b) of said fabric (26), opposite to said first surface (26a), said additional brushing action being independent of said first and second brushing actions. 40

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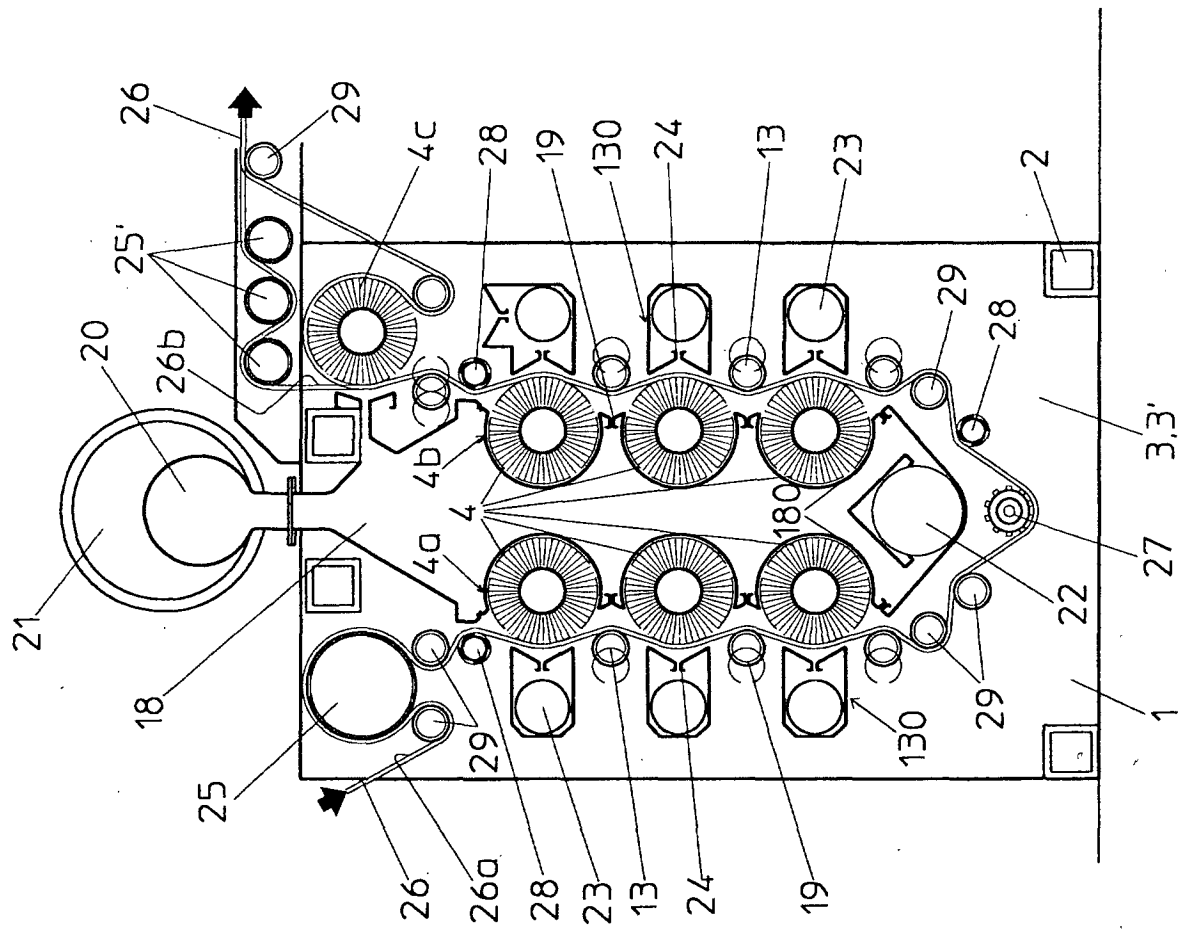
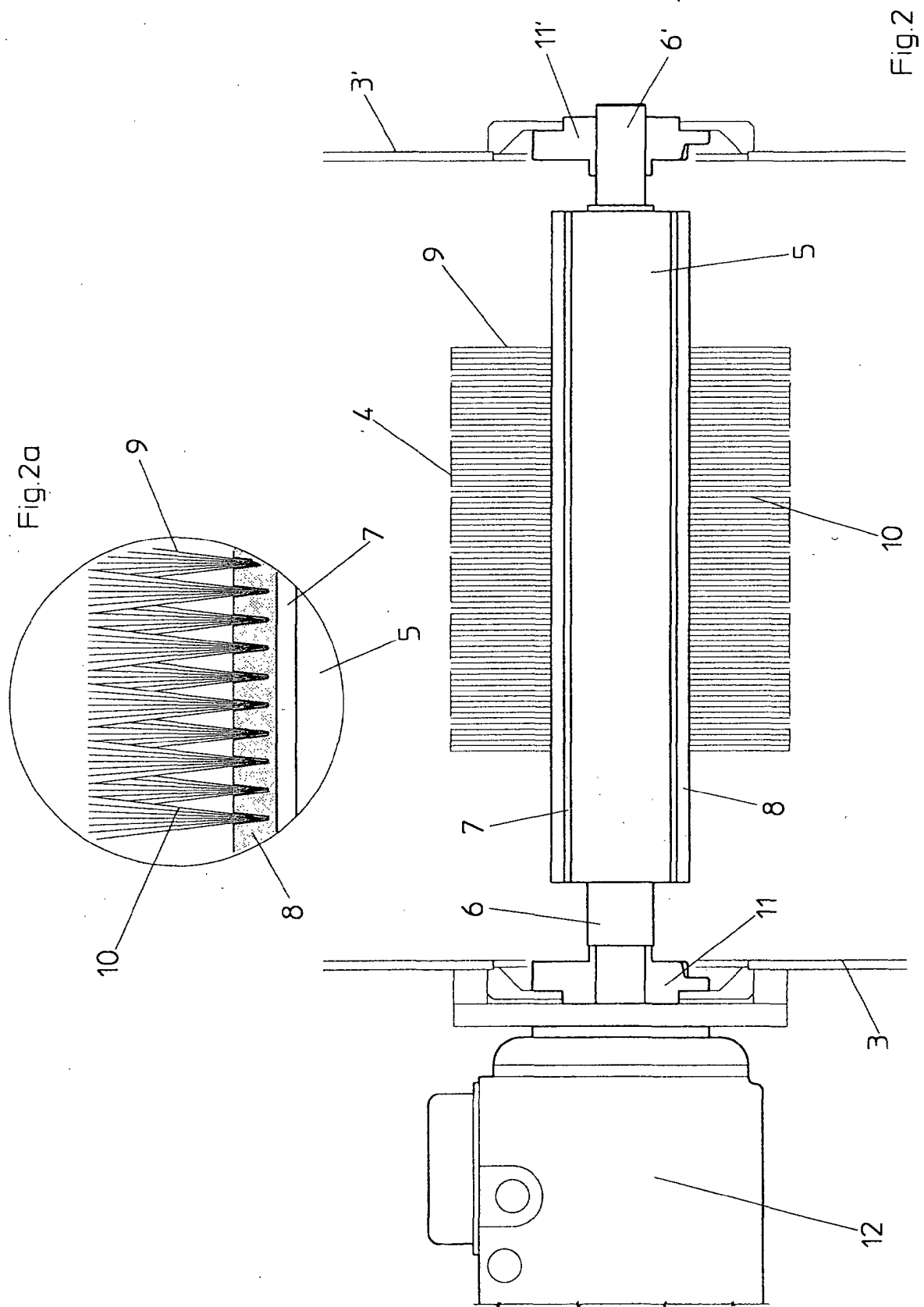
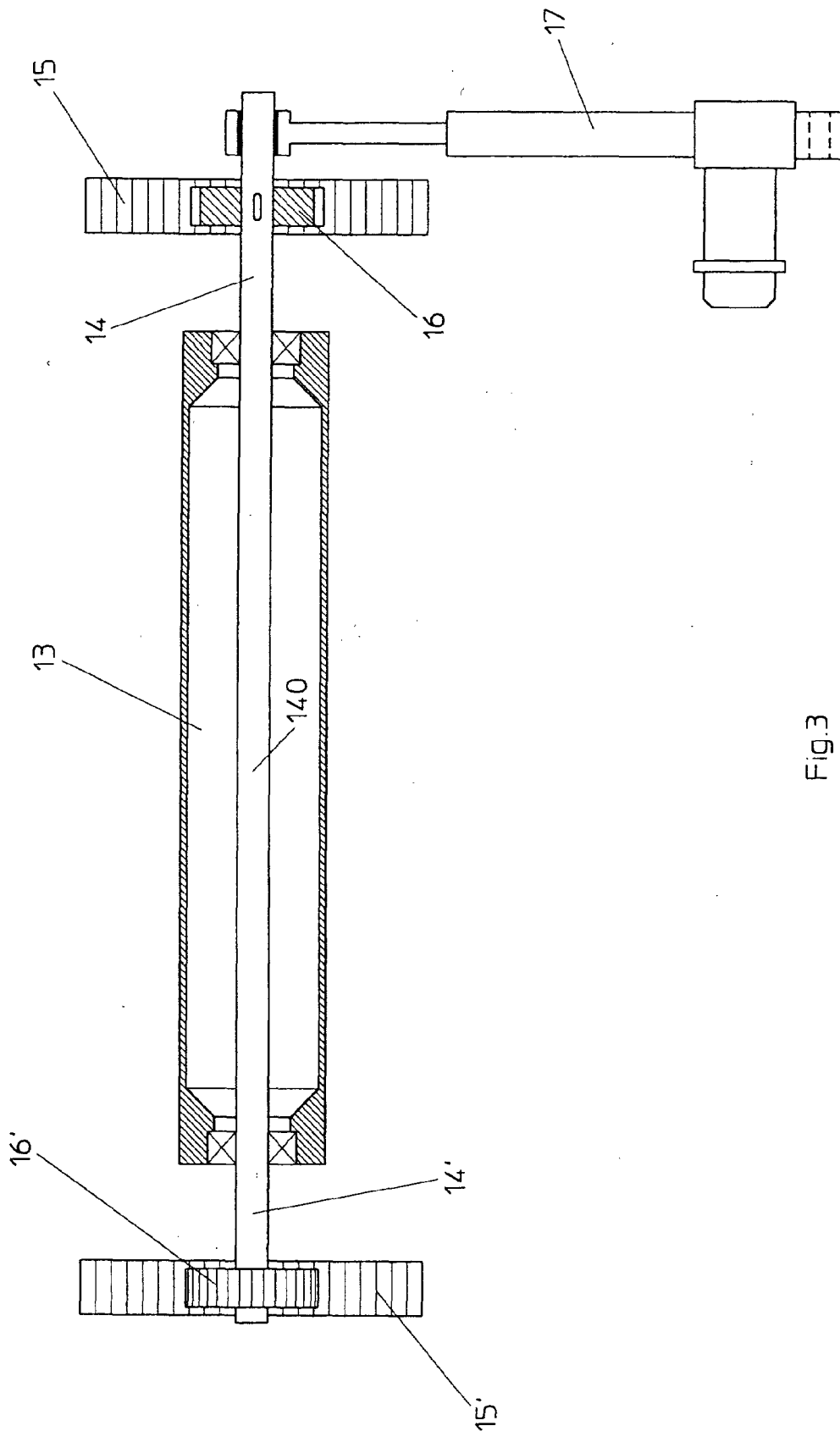


Fig. 1





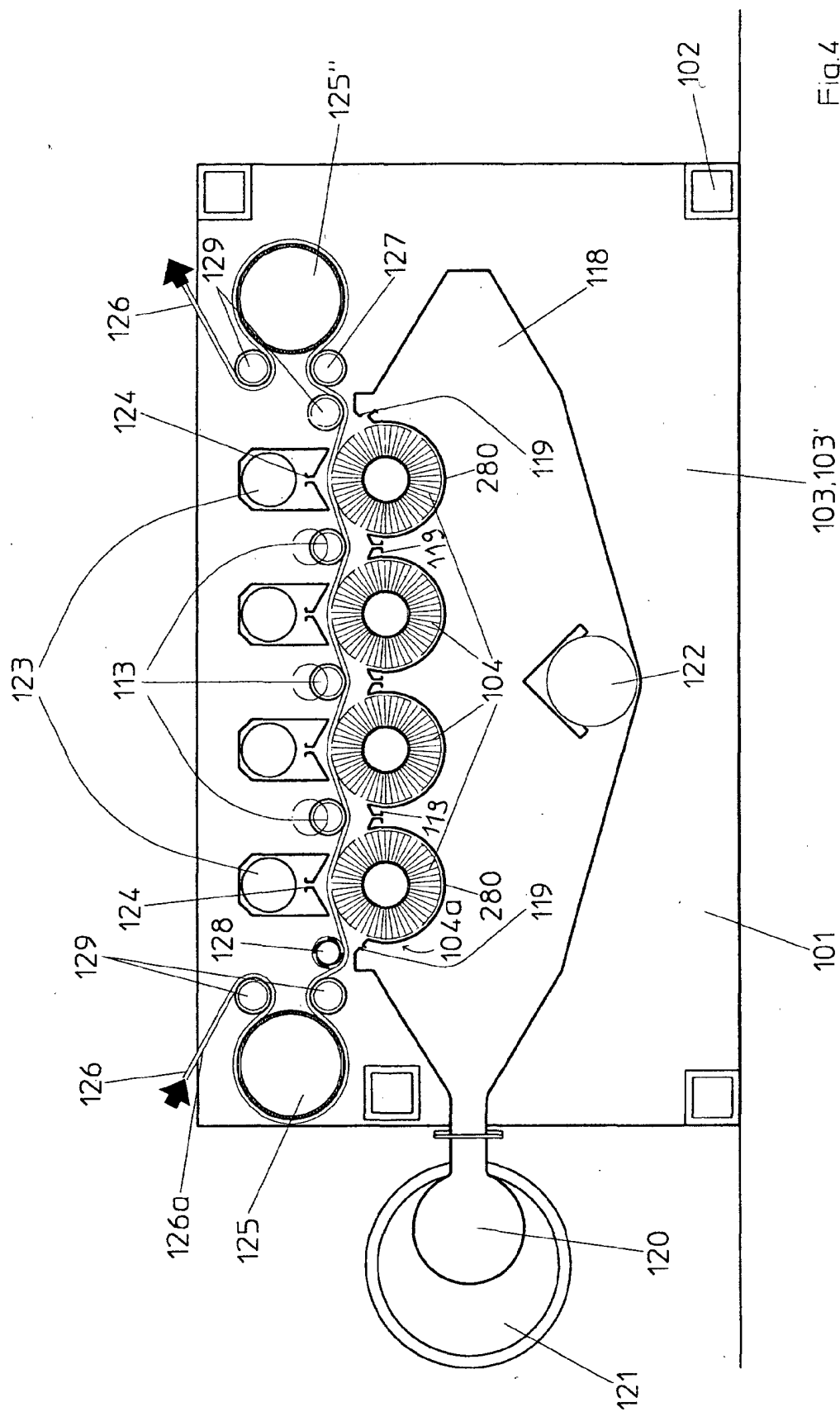


Fig. 4