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(54) **Machine for softening surfaces of a continuous circular knitted fabric**

Maschine zum Flauschen von Oberflächen eines endlosen Rundgestricks

Dispositif d'assouplissement de surfaces pour un tricot circulaire continu

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Description

[0001] The present invention relates to a machine for softening surfaces of a continuous circular knitted fabri.

[0002] Circular knitted fabrics are produced using looms - called in fact circular knitting machines - which interweave the yarn by means of needles suitably arranged along the top circumference of a rotating cylindrical element. Consequently, the fabric is formed in a closed circular shape and therefore is similar to a continuous tube. For this reason, circular knitted fabric is also called - using the current textile jargon - tubular knitted fabric, or even more simply, tubular fabric. Circular knitted fabrics have to undergo, depending on the circumstances, a succession of processing operations involving preparation, dyeing and finishing such as to make them aesthetically suitable for tailoring. A typical finishing step consists in softening. It is performed in order to make fabrics soft to the touch and also modify substantially their appearance. The softening operation may be performed chemically or mechanically.

[0003] The mechanical softening process may be performed both on fabrics which have a tubular form, as they descend from the circular knitting machine, and on fabrics which have an open form, obtained by means of cutting of the tubular product along one of the two side edges.

[0004] At present, there is an increasingly widespread requirement in certain sectors to process knitted fabrics in tubular form for technical reasons, for cost effectiveness or for market requirements. In this connection, there is a growing tendency to cut and manufacture so-called "body size" knitwear articles with increasingly less wastage of material and reduced equipment and labour.

[0005] However, the conventional machines are unable to process the entire external surface of tubular fabrics.

[0006] Italian patent application MI 2000A 001781, filed on 1 August 2000 in the name of the same Applicant, relates to a machine for softening the surface of a continuous fabric, comprising at least one row of rotating roller brushes able to perform a brushing action over a first surface of the fabric; each roller brush is operationally connected to a respective motor unit capable of causing it to rotate at a prechosen speed and in a prechosen direction of rotation; at least one penetrating member for varying the angle of winding of the fabric onto a brush; suction members capable of removing fine fibrous dust; an extension roller equipped with load sensors able to detect the tension of the fabric and at least one additional rotating roller brush capable of performing an additional brushing action over a second surface of said fabric; each rotating roller brush is equipped with bunches of filaments.

[0007] This machine is particularly suitable for processing open-form fabrics.

[0008] In order to process tubular-form fabrics, the machine must perform a double pass over the fabric. This results in a lengthening of the finishing cycle.

[0009] In the machine described above, the tubular fabric has a flattened form and the side edges of the tubular fabric and the surface portions adjacent to them are subject to a treatment different from that of central surface portions. This results in a marked lack of tactile and, in particular, visual uniformity between the central portions of the flattened tubular fabric and the edges (so-called "centre-selvage" defect), such that the finished product is unacceptable for the tailor and/or end user.

[0010] US 3 553 801 A, briefly referred to as D1, describes an apparatus for treating a running fabric web. In particular, the apparatus according to D1 comprises driving means for advancing said fabric web; first and second rotating roller brushes having axes of rotation substantially parallel to each other and to said fabric web; and motor units, each roller brush being operationally connected to a respective motor unit rotating it at a prechosen speed and in a prechosen direction of rotation which are independent of the speed and the direction of rotation of another brush. D1 clearly relates only to fabric webs and fails to describe additional rollers for threating the edges of the fabric, namely no mention is made to additional roller brushes having axis of rotation substantially perpendicular to the external surfaces of the fabric for carrying out a brushing action on the edges.

[0011] US 2 190 860 A, briefly referred to as D2, describes a system for feeding a tubular knitted fabric to tolls or other handling means. Fundamentally, D2 describes a mechanism for guiding and feeding the material in such a way as to permit the center portions of a flattened fabric to be drawn ahead at a faster rate while the friction at the edges retards the side portions and to apply a special corrective adjustment of the edges of the fabric just before it is received between the rolls. D2 describes brush rolls (designated as 44 in D2) having bristles for engaging the fabric with little deflection so that there is an intimate resilient surface gripping of the fabric by the tips of the bristles to positively push or slide it along rods at a rate corresponding to the speed of the rollers. This action may be likened to the teeth of a gear engaging a rack but does not provide any brushing action on the edges of the tubular flattened fabric.

[0012] The object of the present invention is to improve the surface softening machine described above, while ensuring that it retains its constructional simplicity. This object is fully achieved with a machine according to independent claim 1. Preferred embodiments are the subject of dependent claims 2 to 11.

[0013] Preferably, said machine comprises at least one device for guiding said fabric in tubular and flattened form, said guiding device being able to be engaged with said fabric and disengaged therefrom and carrying said additional brushes.

[0014] Advantageously, said guiding device is provided with expanders for transverse extension of said fabric

in tubular form, said expanders having end portions carrying support members for said side edges of said fabric, said support members being located opposite said additional brushes.

[0015] Typically, said additional brushes are mounted on arms connected to said guiding device by means of pins and means for adjusting the distance of said additional brushes with respect to said side edges of said fabric.

[0016] Preferably, said additional brushes are operationally connected to respective motor means and to mechanisms able to cause the displacement of said additional brushes along the respective axes of rotation.

[0017] Preferably, said guiding device is arranged upstream of said first row of first brushes, said guiding device carrying two of said additional brushes.

[0018] According to one embodiment, said machine comprises another guiding device arranged upstream of said second row of second brushes, said other guiding device carrying another two of said additional brushes.

[0019] According to another embodiment, said machine comprises a further guiding device arranged downstream of said second row of second brushes, said further guiding device carrying another two of said additional brushes.

[0020] Advantageously, said guiding device can be engaged with and disengaged from said fabric by means of an operating mechanism comprising a threaded shaft operationally connected to a motor.

[0021] Typically, said fabric is wound onto said first row of first brushes forming two branches which bring into contact with said first brushes opposite sectors of said first surface portion.

[0022] Advantageously, said fabric is wound onto said second row of second brushes forming two branches which bring into contact with said second brushes opposite sectors of said second surface portion.

[0023] The machine according to the present invention performs in a single pass the simultaneous processing of two surface portions of a circular knitted fabric both in tubular form and in open form and also performs the processing of the side edges of the fabric when it is in tubular form. it is thus able to achieve a finished fabric having a uniform appearance over two surface portions and also along its side edges, when it is in tubular form.

[0024] This allows the processing cycle times to be minimised and the productivity to be increased.

[0025] 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 drawings in which:

Fig. 1 is a cross-sectional view of a machine for softening surfaces of a continuous circular knitted fabric, provided in accordance with the invention;

Fig. 2 is cross-sectional view along the plane indicated by II-II in Fig. 1;

Fig. 3 is a cross-sectional view along the plane indicated by III-III in Fig. 1;

Fig. 4 is a top plan view, on a larger scale, of a device for guiding the fabric of the machine according to Fig. 1;

Fig. 5 is a cross-sectional view along the plane indicated by V-V in Fig. 4;

Fig. 6 shows a variant of the machine according to Fig. 1;

Fig. 7 shows another variant of the machine according to Fig. 1.

[0026] Fig. 1 shows a machine 1 for softening surfaces of a circular knitted fabric 2 in tubular form. The tubular fabric 2 enters into the machine 1 in a flattened form and has a first external surface portion 2a, a second external surface portion 2b, opposite to the surface portion 2a, and two side edges 21 and 21' (Fig. 4).

[0027] The tubular fabric 2 moves inside the machine 1, proceeding in the feeding direction indicated by the arrow A.

[0028] The machine 1 comprises a group 3 for extending and widening the tubular fabric 2, a first unit 4 for processing the surface portion 2a of the tubular fabric 2, a second unit 5 for processing the surface portion 2b of the tubular fabric 2, arranged following the first processing unit, and a group 6 for collecting the processed tubular fabric 2. The exit point of the fabric 2 from the machine 1 is indicated by the arrow B.

[0029] The group 3 for extending and widening the tubular fabric 2 in turn comprises a widening device 32, for example, of the idle ring type, which extends the tubular fabric 2, a motorised roller 33 for feeding the tubular fabric, an electrically, pneumatically or hydraulically operated tensioning roller 34 and a device 35 for guiding the tubular fabric. The devices 32 and 35 and the rollers 33 and 34 are supported by two side shoulders, one of which, indicated by 30, is shown in Fig. 1.

[0030] As shown in Figs. 4 and 5, the guiding device 35 comprises two expanders 37 and 37' for extending the tubular fabric 2, which are inserted inside the latter and are engaged with its edges 21 and 21'. The expanders 37 and 37' are associated magnetically with two C-shaped support plates 36 and 36'. The expanders 37 and 37' and the plates 36 and 36' are equipped with permanent magnets, or electromagnets, which, by means of attraction, join the expanders 37 and 37' rigidly to the plates 36 and 36' and, by means of a repelling action, keep the expanders aligned with the plates, as described in European patent application EP-0,900,872 in the name of the same Applicant. The plates 36 and 36' may be moved towards each other or away from each other by means of an operating mechanism comprising a threaded shaft 31 with a right-hand and left-hand thread and a motor 310, as described in the abovementioned European patent application EP-0,900,872.

[0031] The movement of the plates 36 and 36', and therefore the expanders 37 and 37', towards or away

from each other, produces in the tubular fabric 2 a transverse widening tension which is adjustable.

[0032] Each plate 36 or 36' has, mounted on it, a pair of motorised wheels 316, 317 and 316', 317', respectively, each of which causes the movement of a belt 336, 337, 336', 337' associated with pairs of idle roller wheels 326, 327, 326' and 327' mounted on the expanders 37 and 37'.

[0033] The tubular fabric 2 is fitted over the expanders 37 and 37' and inserted into the gap between the wheels 316, 317 and 316', 317' and the respective belts 336, 337 and 336', 337'. Thus the fabric 2 is gripped between the outer wheels and the inner belts and advances by means of the pushing action resulting from adherence to the latter.

[0034] The plates 36 and 36' have, mounted on them in a projecting manner, rotating roller brushes 38 and 38' which have the function of brushing and softening the side edges 21 and 21' of the fabric 2. The brushes 38 and 38' are situated at the exit end of the guiding device 35 and are rotatably supported by respective arms 330 and 330' connected to the plates 36 and 36' by means of pins 318 and 318' and adjusting means 331, 331', 332, 332' which allow the distance of the brushes 38 and 38' from the side edges 21 and 21' of the fabric 2 to be varied.

[0035] The roller brushes 38 and 38' are driven rotatably by respective motors 39 and 39' via shafts 319 and 319' having axes of rotation substantially perpendicular to the surface portions 2a and 2b of the fabric 2. The roller brushes 38 and 38' are also operationally connected to mechanisms 333 and 333' able to cause displacement thereof along the respective axes of rotation.

[0036] The expanders 37 and 37' have end portions 37a and 37'a which are provided with two frame assemblies 320 and 320' located opposite the roller brushes 38 and 38'. The frame assemblies 320 and 320' support the side edges 21 and 21' of the tubular fabric 2 on the inside and keep them tensioned. The frame assemblies 320 and 320' act as a support surface for the side surfaces and as opposition means for the roller brushes 38 and 38'. The extension and the depth of the contact zone may be adjusted by varying the distance of the brushes from the side edges of the tubular fabric.

[0037] The roller brushes 38 and 38' make contact with the external surface of the side edges 21 and 21' and, when they are operating, rotate and may also perform guided translatory movements along the respective axes of rotation, performing a guided brushing action over the external surface of the side edges 21 and 21' of the tubular fabric 2.

[0038] The roller brushes 38 and 38' may be disengaged from the fabric 2 when the fabric being processed in the machine 1 is in the open form and not tubular form. This is performed by displacing the support plates 36 and 36' of the guiding device 35 by means of the operating mechanism comprising the threaded shaft 31 and the motor 310 and by removing the expanders 37 and 37'. In this way a gap of suitable width for allowing the fabric in open form to pass through upstream of the unit 4 is left free.

[0039] The processing unit 4 comprises a motorised roller 41 for feeding the fabric and a row 42 of three rotating roller brushes which are arranged in vertical succession and with their axes of rotation parallel to each other and (Fig. 2) to the surface portion 2a of the fabric 2. The unit 4 also comprises idle rollers 49 for driving the tubular fabric 2, penetrating rollers 44 and 44' which are operationally connected to respective electrically, pneumatically or hydraulically operated actuators 45 and 45', a widening cylinder 46 connected to load sensors, not shown, a motorised roller 47 for extraction of the tubular fabric 2, and a synchronisation jockey cylinder 48. The unit 4 is housed inside structure 40 having two sidewalls 401 and 402 (Fig. 2).

[0040] The roller brushes 43 are rotatably supported in the two sidewalls of the structure 40 and are operationally connected to respective gearmotors 430 (Fig. 2). Each gearmotor 430 of each roller brush 43 is capable of operating independently of those of the other brushes 43. The rollers 41 and 47 are operationally connected to gearmotors, not shown. The rollers 41, 47, 49, 44 and 44' and the cylinders 46 and 48 are also rotatably supported and the actuators 45 and 45' mounted in the sidewalls of the structure 40.

[0041] The motorised roller 41 causes the tubular fabric 2 to advance, turning over the surface portion 2a outwards with respect to the roller 41.

[0042] The fabric 2 is wound onto the row 42 of roller brushes 43 so that opposite sectors of the surface portion 2a of its branches 201 and 202 come into contact simultaneously with the roller brushes 43. The penetrating rollers 44 and 44' are arranged upstream and downstream of each brush 43 in the direction of feeding of the fabric 2 and keep in contact with opposite sectors 431 and 432 of the roller brushes 43 opposite sectors of the surface portion 2a of the descending section 201 and ascending section 202, respectively, of the tubular fabric 2.

[0043] The penetrating rollers 44 and 44' are actuated so to move at right angles with respect to the fabric 2 by the respective actuators 45 and 45' and move towards or away from each other so as to increase or reduce the angle of winding of the fabric 2 onto each roller brush 43. Four pairs of opposite penetrating rollers 44 and 44' are present in the processing unit 4.

[0044] Suction ducts 411 provided with shaped slits 412 are associated with the roller brushes 43 (Fig. 2). The ducts 411 are connected to headers 421 and 422 by means of openings 441 (Fig. 1) formed in the sidewall 401 and to suction means and to collection and filtering groups, not shown, arranged outside the structure 40.

[0045] The processing unit 5 comprises a motorised roller 51 for feeding the fabric and a row 52 of three rotating roller brushes 53 arranged in vertical succession and with their axes of rotation parallel to each other (Fig.

3) and to the surface portion 2b of the fabric 2. The unit 5 also comprises idle rollers 59 for transmission of the tubular fabric, penetrating rollers 54 and 54' operationally connected to respective electrically, pneumatically or hydraulically operated actuators 55 and 55', a widening cylinder 55 connected to load sensors, not shown, a motorised roller 57 for extraction of the tubular fabric 2 and a synchronisation jockey cylinder 58. The unit 5 is housed in a structure 50 with two sidewalls 501 and 502 (Fig. 3).

[0046] The roller brushes 53 are rotatably supported in the two sidewalls of the structure 50 and are operationally connected to respective gearmotors 530 (Fig. 3). Each gearmotor 530 of each roller brush 53 is capable of functioning independently of those of the other brushes 53. The rollers 51 and 57 are operationally connected to gearmotors 510 and 570. The rollers 51, 57, 59, 54 and 54' and the cylinders 56 and 58 are also rotatably supported and the actuators 55 and 55' mounted in the sidewalls of the structure 50.

[0047] The motorised roller 51 causes the tubular fabric 2 to advance, turning over the surface portion 2a outwards with respect to the roller 51.

[0048] The fabric 2 is wound onto the row 52 of roller brushes 53 so that opposite sectors of the surface portion 2b of its branches 203 and 204 come into contact simultaneously with the roller brushes 53. The penetrating rollers 54 and 54' are arranged upstream and downstream of each brush 53 in the direction of feeding of the fabric 2 and keep, in contact with opposite sectors 531 and 532 of the roller brushes 53, opposite sectors of the surface portion 2b of the ascending section 203 and descending section 204, respectively, of the tubular fabric 2.

[0049] The penetrating rollers 54 and 54' are actuated so to move at right angles with respect to the fabric 2 by the respective actuators 55 and 55' so as to increase or reduce the angle of winding of the fabric 2 onto each roller brush 53. Four pairs of opposite penetrating rollers 54 and 54' are present in the processing unit 5.

[0050] Suction ducts 511 provided with shaped slits 512 are associated with the roller brushes 53 (Fig. 3). The ducts 511 are connected to headers 521 and 522 by means of openings 541 (Fig. 1) formed in the sidewall 501 and to suction means and collection and filtering groups arranged outside the structure 50.

[0051] The group 6 for collecting the processed tubular fabric 2 essentially comprises a motorised roller 62 for discharging the fabric 2 and two rollers 65 and 66 for collecting the fabric 2. The roller 62 is operationally connected to a respective motor, not shown, and the rollers 65 and 66 are driven rotationally by the roller 62 via movement transmission means, not shown. The roller 62 is rotationally supported in shoulders 60, 61. The rollers 65 and 66 are rotatably supported in pivoting arms 63, 64.

[0052] When the machine 1 is functioning, the tubular fabric 2, which is fed by the motorised roller 33 and pretensioned by the tensioning roller 34, is made to advance in the longitudinal direction by means of the guiding device 35, being pushed by the engagement between the motorised wheels 316, 317 and 316', 317' and the respective idle belts 336, 337 and 336', 337' (Fig. 4).

[0053] In the guiding device 35, the tubular fabric 2 is widened transversely and overfed longitudinally. The action of transverse widening of the tubular fabric 2 has the function of flattening folds and wrinkles in order to tension the two surface portions 2a and 2b and ensure that they are properly smoothed for the subsequent softening process. Since the transverse widening produces a certain longitudinal shortening due to the intrinsic elasticity of the circular stitch, the overfeeding of the tubular fabric 2 offsets and compensates for the undesirable effects of excessive contraction.

[0054] Upon leaving the guiding device 35, the side edges 21, 21' of the tubular fabric 2 are brushed by the roller brushes 38 and 38' which rotate and may move along their axes of rotation. The roller brushes 38 and 38' act both on the side edges 21, 21' of the fabric and on the surface portions 2a and 2b which are adjacent to the edges and are supported and kept tensioned by the frame assemblies 320 and 320'. Therefore, the frame assemblies 320 and 320' assist and render more effective the action of the roller brushes 38 and 38' on the side edges of the fabric.

[0055] As a result of the guided brushing action of the roller brushes 38 and 38' on the side edges 21 and 21', it is possible to follow the side edges 21 and 21' during their displacement caused by the screw effect which is typical of tubular fabric. In fact, circular knitted fabrics, during weaving, follow the rotation of the circular machine such that, when they descend from the loom, they retain their screw-like state. Therefore the side edges of the tubular fabric do not remain parallel, but follow a mutual screw-like path, continuously modifying their position from the sides towards the centre. The guided vertical movement of the roller brushes 38 and 38' is intended precisely to keep the action of said brushes concentrated on the side edges of the tubular fabric and on the surface portions adjacent thereto.

[0056] The guiding device 35 feeds the tubular fabric 2 inside the first processing unit 4 where it is wound around the motorised roller 41. The motorised roller 41 causes the tubular fabric 2 to advance, turning over the surface portion 2a outwards. As the section 201 of the fabric 2 moves along a descending path, the surface portion 2a comes into contact with the sectors 431 of the rotating roller brushes 43 and undergoes a first brushing and softening operation.

[0057] The motorised extraction roller 47 causes the tubular fabric 2 to advance outside of the processing unit 4. As the section 202 of the fabric moves along an ascending path, the surface portion 2a comes into contact with the sectors 432 of the rotating roller brushes 43 and undergoes a second brushing and softening operation.

[0058] The zones of contact between the roller brush-

es 43 and the surface portion 2a are varied and regulated by the movement, towards or away from each other, of the penetrating rollers 44 and 44' which are actuated by the respective actuators 45 and 45'.

[0059] The widening cylinder 46 with load sensors controls the longitudinal tension of the fabric 2 inside the unit 4 by varying its feed speed. The synchronisation jockey roller 48 synchronises the speed of movement of the tubular fabric 2 as it passes from the first processing unit 4 to the second processing unit 5.

[0060] The motorised roller 51 causes overturning of the surface portion of the tubular fabric 2 undergoing processing in the processing unit 5, causing the tubular fabric 2 to advance with the surface portion 2b directed outwards. As the section 203 of the fabric 2 moves along an ascending path, the surface portion 2b comes into contact with the sectors 531 of the rotating roller brushes 53 and undergoes a first brushing and softening operation.

[0061] The motorised extraction roller 57 causes the tubular fabric 2 to advance outside of the processing unit 5. As the section 204 of the fabric moves along a descending path, the surface portion 2b comes into contact with the sectors 532 of the rotating roller brushes 53 and undergoes a second brushing and softening operation.

[0062] The zones of contact between the roller brushes 53 and the surface portion 2b are varied and regulated by the movement, towards or away from each other, of the penetrating rollers 54 and 54' which are actuated by the respective actuators 55 and 55'.

[0063] The widening cylinder 56 with load sensors controls the longitudinal tension of the fabric 2 inside the unit 5 by varying its feed speed. The synchronisation jockey roller 58 synchronises the speed of movement of the tubular fabric 2 as it passes from the second processing unit 5 to the group 6 for collecting the processed tubular fabric 2.

[0064] The tubular fabric 2 emerges from the unit 5 with both its surface portions 2a and 2b processed.

[0065] The processed tubular fabric 2 engages with the motorised discharge roller 62 and with the rotating rollers 65 and 66 which facilitate the collection thereof in pleated form as a result of the pivoting oscillating movement of the arms 63, 64.

[0066] During the processing of the fabric 2 in the first and second processing units 4 and 5, the fine fibrous dust which is produced following the mechanical beating and abrasive action of the brushes 43 and 53 is removed and conveyed away by means of the suction ducts 411, 511 and the associated shaped slits 412, 512. The slits 412 and 512 face the surface portions 2a and 2b of the tubular fabric and are arranged in zones where brushes and fabric make contact, namely in the zones where the dust itself is formed. In this way, both localised accumulation of dust and dispersion inside the structures 40, 50 are minimised. Moreover, the suction openings 441, 541 formed in the sidewalls 401, 501 specifically have the function of capturing the residual portion of dust which has eluded the action of the suction ducts.

[0067] Fig. 6. shows a machine 101 which is a variant of that shown in Fig. 1. In the machine 101, a second device 80 for guiding the tubular fabric 2, which is of the same type as the device 35, is arranged downstream of the first processing unit 4 and upstream of the second processing unit 5. In particular, the device 80 is supported in the structure 50 of the processing unit 5 between the redirecting rollers 59. The device 80 is equipped with expanders 82, 82', which are the same as the expanders 37, 37', and with roller brushes 81, 81', which are the same as the brushes 38, 38'. The guiding device 80 receives the tubular fabric 2 from the roller 47 for extraction from the unit 4 and directs it towards the feed roller 51 of the unit 5.

[0068] In the machine 101, the operation of brushing and softening of the side edges 21, 21' of the tubular fabric 2 is performed a first time by means of the brushes 38 and 38' of the guiding device 35, as a treatment preceding that of the surface portion 2a, and is repeated a second time by means of the guiding device 80, as a treatment preceding that of the surface portion 2b, opposite to the surface portion 2a.

[0069] Since the guiding device 80 is located respectively downstream and upstream of the motorised rollers 47 and 51 and between them there is located the synchronisation jockey device 48 which synchronises the speed of movement of the tubular fabric 2 as it passes from the first processing unit 4 to the second processing unit 5, the presence of a tensioning roller, such as the roller 34 of the group 3 (Fig. 1), is superfluous.

[0070] Fig. 7 shows a machine 201 which is a variant of that shown in Fig. 1. In the machine 201, a further device 70 for guiding the tubular fabric 2, which is of the same type as the device 35, is arranged in the collection group 6, downstream of the second processing unit 5, which in this case also comprises a drive roller 69. The guiding device 70 is provided with expanders 72, 72', which are the same as the expanders 37, 37', and roller brushes 71, 71', which are the same as the brushes 38, 38'. The expanders 72, 72' have end portions 72a, 72'a which direct the tubular fabric 2 towards a tensioning roller 67 and a roller 68 for driving the processed tubular fabric 2.

[0071] In the machine 201, the operation of brushing and softening the side edges 21, 21' of the tubular fabric 2 is performed as a treatment following that of the two surface portions 2a, 2b.

[0072] In this case, upstream of the row of roller brushes 42, it is possible to use a guiding device 350 of the type described in European patent application EP-0,900,872, able to perform only the operations of transverse widening and longitudinal overfeeding of the tubular fabric 2.

[0073] The machines 1, 101 and 201 are able to process in a single pass the two surface portions, both of a tubular knitted fabric and of a knitted fabric in open form

or, more generally, of a woven fabric or a nonwoven fabric. In this latter case, the guiding devices 35, 80, 70 are disengaged from the fabric.

[0074] The brushes 43, 53, 38, 38', 71, 71', 81 and 81' are provided with bunches of filaments made of synthetic material. Preferably, the filaments consist of nylon fibres incorporating granules chosen from the group comprising silicon carbide, aluminium oxide and synthetic diamond.

[0075] The length of the filaments varies from 50 to 150 mm and preferably is between 80 and 120 mm.

[0076] The diameter of the filaments varies from 0.4 to 0.8 mm and preferably is between 0.5 and 0.6 mm.

[0077] The grain (fineness) of the filaments varies from 200 and 800 and preferably is between 240 and 320.

[0078] The density (or population) of the filaments in each bunch varies from 20 to 90 and preferably is between 35 and 75.

[0079] The density (or population) of the bunches in each brush varies from 35/dm^2 to 75/dm^2 and preferably is between 55/dm^2 and 65/dm^2.

[0080] The diameter of the roller of the brushes varies from 100 to 150 mm and preferably is between 115 and 135 mm.

Claims

1. Machine (1; 101; 201) for softening a continuous circular knitted fabric (2), the circular fabric (2) entering the machine in a flattened form and having a first external surface portion (2a), a second opposite external surface portion (2b) and two side edges (21 and 21'), the circular fabric (2) advancing in a prechosen direction, the machine (1; 101; 201) comprising:

   - feeding driving means (41; 51) for advancing said fabric (2),
   - first and second rotating roller brushes (43; 53) having axes of rotation substantially parallel to each other and to said fabric (2),
   - motor units (430; 530), each roller brush (43; 53) being operationally connected to a respective motor unit (430; 530) rotating it at a prechosen speed and in a prechosen direction of rotation which are independent of the speed and the direction of rotation of another brush (43; 53),

   characterized in that it also comprises:

   - additional rotating roller brushes (38, 38'; 71, 71'; 81, 81') having axes of rotation substantially perpendicular to said first and second external surface portions (2a, 2b) of said fabric (2), said additional brushes (38, 38'; 71, 71'; 81, 81') engaging with the side edges (21, 21') of said fabric (2) and performing a brushing action on said edges.

2. Machine (1; 101; 201) according to claim 1, **characterized in that** it further comprises:

   - first and second penetrating members (44, 44'; 54, 54') varying the angle of winding of said fabric (2) onto one of said rotating roller brushes (43, 53),
   - first and second extending means (46; 56), the extending means being equipped with load sensors and detecting the tension of said fabric (2) engaging with said rotating roller brushes (43, 53), and
   - first and second suction means (411, 511) removing fine fibrous dust produced by the brushing action of said rotating roller brushes (43, 53) on said first first and second external surface portions (2a, 2b).

3. Machine (1; 101; 201) according to Claim 1 or 2, **characterized in that** it comprises at least one guiding device (35; 70; 80) for guiding said fabric (2) in tubular and flattened form, said guiding device (35; 70; 80) being engaged with said fabric (2) and disengaged therefrom and carrying said additional brushes (38, 38'; 71, 71'; 81, 81').

4. Machine (1; 101; 201) according to Claim 3, **characterized in that** said guiding device (35; 70; 80) is provided with expanders (37, 37'; 72, 72'; 82, 82') for transverse extension of said fabric (2) in tubular form, said expanders (37, 37'; 72, 72'; 82, 82') having end portions (37a, 37'a; 72a, 72'a; 82a, 82'a) carrying support members (320, 320') for said side edges (21, 21') of said fabric (2), said support members (320; 320') being located opposite said additional brushes (38, 38'; 71, 71'; 81, 81').

5. Machine (1; 101; 201) according to Claim 2, **characterized in that** it further comprises arms (330; 330') and distance adjusting means (331, 331'; 332, 332'), said additional brushes (38, 38'; 71, 71'; 81, 81') being mounted on the arms (330; 330') connected to said guiding device (35; 70; 80) by means of pins (318, 318') and by the means (331, 331'; 332, 332') for adjusting the distance of said additional brushes (38, 38'; 71, 71'; 81, 81') with respect to said side edges (21, 21') of said fabric (2).

6. Machine (1; 101; 201) according to Claim 1, **characterized in that** it further comprises motor means (39; 39'), and displacement mechanisms (333; 333'), said additional brushes (38, 38'; 71, 71'; 81, 81') being operationally connected to the respective motor means (39; 39') and to the mechanisms (333,

333') displacing said additional brushes (38, 38'; 71, 71'; 81, 81') along the respective axes of rotation.

7. Machine (1; 101; 201) according to Claim 3, **characterized in that** said guiding device (35) is arranged upstream of said first rotating roller brushes (43), said guiding device (35) carrying two of said additional rotating roller brushes (38, 38').

8. Machine (1; 101; 201) according to Claim 7, **characterized in that** it comprises another guiding device (80) arranged upstream of said second rotating roller brushes (53), said other guiding device (80) carrying another two of said additional brushes (81, 81').

9. Machine (1; 101; 201) according to Claim 7, **characterized in that** it comprises a further guiding device (70) arranged downstream of said second rotating roller brushes (53), said further guiding device (70) carrying another two of said additional brushes (71, 71').

10. Machine (1; 101; 201) according to Claim 3, **characterized in that** it further comprises an operating mechanism comprising a threaded shaft (31) operationally connected to a motor (310), said guiding device (35; 70; 80) being engaged with and disengaged from said fabric (2) by means of the operating mechanism.

11. Machine (1; 101; 201) according to Claim 1, **characterized in that** it further comprises extraction driving means (47, 57) cooperating with the feeding driving means (41, 51) so that said fabric (2) is wound onto said rotating roller brushes (43, 53) forming two branches (201, 202; 203, 204) which bring into contact with said rotating roller brushes (43, 53) opposite sectors of said surface portions (2a; 2b).

Patentansprüche

1. Vorrichtung (1; 101; 201) zum Weichmachen einer endlosen, kreisförmiger Maschenware (2), welche kreisförmige Maschenware (2) in einer abgeflachten Form in die Vorrichtung eintritt und einen ersten externen Oberflächenabschnitt (2a), einen zweiten entgegengesetzten externen Oberflächenabschnitt (2b) und zwei Seitenkanten (21 und 21') aufweist, wobei die kreisförmige Maschenware (2) in einer vorgewählten Richtung befördert wird, welche Vorrichtung (1; 101; 201) umfasst:

eine Zuführantriebseinrichtung (41; 51) zum Fördern der Maschenware (2),

eine erste und eine zweite sich drehende Bürstenwalze (43; 53), die im wesentlichen zueinander und zu der Maschenware (2) parallele Rotationsachsen aufweisen,

Motoreinheiten (430; 530), wobei jede Bürstenwalze (43; 53) funktionell mit einer entsprechenden Motoreinheit (430; 530) verbunden ist, die sie in einer vorgewählten Geschwindigkeit und einer vorgewählten Rotationsrichtung dreht, wobei diese von der Geschwindigkeit und der Rotationsrichtung einer anderen Bürste (43; 53) unabhängig sind,

dadurch gekennzeichnet, dass sie ferner umfasst:

zusätzliche sich drehende Bürstenwalzen (38, 38'; 71, 71'; 81, 81'), welche Rotationsachsen aufweisen, die im wesentlichen senkrecht zu dem ersten und zweiten externen Oberflächenabschnitt (2a, 2b) der Maschenware (2) sind, welche zusätzlichen Bürsten (38, 38'; 71, 71'; 81, 81') mit den Kanten (21, 21') der Maschenware (2) in Eingriff kommen und ein Bürsten der Kanten durchführen.

2. Vorrichtung (1; 101; 201) nach Anspruch 1, **dadurch gekennzeichnet, dass** sie ferner umfasst:

ein erstes und zweites Vordrängelement (44, 44'; 54, 54'), welches den Aufwickelwinkel der Maschenware (2) auf eine der sich drehenden Bürstenwalzen (43, 53) variiert,

eine erste und zweite Längungseinrichtung (46; 56), welche Längungseinrichtung mit Lastsensoren ausgestattet ist und die Zugspannung der Maschenware (2) aufnimmt, die mit den sich drehenden Bürstenwalzen (43, 53) in Eingriff steht, und

eine erste und zweite Saugeinrichtung (411, 511), die den durch das Bürsten der ersten und zweiten externen Oberflächenabschnitte (2a, 2b) mit den sich drehenden Bürstenwalzen (43, 53) erzeugten feinen Faserstaub entfernen.

3. Vorrichtung (1; 101; 201) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** sie zumindest eine Führungseinrichtung (35; 70; 80) zum Führen der Maschenware (2) in einer röhrenförmigen und abgeflachten Form umfasst, welche Führungseinrichtungen (35; 70; 80) mit der Maschenware (2) in Eingriff und damit außer Eingriff kommt und die zusätzlichen Bürsten (38, 38'; 71, 71'; 81, 81') trägt.

4. Vorrichtung (1; 101; 201) nach Anspruch 3, **da-**

durch gekennzeichnet, dass die Führungseinrichtung (35; 70; 80) mit Expandern (37, 37'; 72, 72'; 82, 82') zum querlaufenden Strecken der Maschenware (2) in röhrenförmiger Form versehen ist, welche Expander (37, 37'; 72, 72'; 82, 82') Endabschnitte (37a, 37'a; 72a, 72'a; 82a, 82'a) aufweisen, die Stützelemente (320, 320') für die Seitenkanten (21, 21') der Maschenware (2) tragen, welche Stützelemente (320; 320') gegenüber der zusätzlichen Bürsten (38, 38'; 71, 71'; 81, 81') angeordnet sind.

5. Vorrichtung (1; 101; 201) nach Anspruch 2, **dadurch gekennzeichnet, dass** sie ferner Arme (330; 330') und Abstandeinstelleinrichtungen (331, 331'; 332, 332') umfasst, wobei die zusätzlichen Bürsten (38, 38'; 71, 71'; 81, 81') an den Armen (330; 330') angebracht sind, welche mittels Stiften (318, 318') und mittels der Einrichtungen (331, 331'; 332, 332') zum Einstellen des Abstands der zusätzlichen Bürsten (38, 38'; 71, 71'; 81, 81') in bezug auf die Seitenkanten (21, 21') der Maschenware (2) mit der Führungseinrichtung (35; 70; 80) verbunden sind.

6. Vorrichtung (1; 101; 201) nach Anspruch 1, **dadurch gekennzeichnet, dass** sie ferner eine Motoreinrichtung (39; 39'), und Versatzmechanismen (333; 333') umfasst, wobei die zusätzlichen Bürsten (38, 38'; 71, 71'; 81, 81') funktionell mit der entsprechenden Motoreinrichtung (39, 39') und mit den Mechanismen (333, 333'), die die zusätzlichen Bürsten (38, 38'; 71, 71'; 81, 81') entlang der entsprechenden Rotationsachsen versetzen, verbunden sind.

7. Vorrichtung (1; 101; 201) nach Anspruch 3, **dadurch gekennzeichnet, dass** die Führungseinrichtung (35) den ersten sich drehenden Bürstenwalzen (43) vorgeschaltet angeordnet ist, welche Führungseinrichtung (35) zwei der zusätzlichen sich drehenden Bürstenwalzen (38, 38') trägt.

8. Vorrichtung (1; 101; 201) nach Anspruch 7, **dadurch gekennzeichnet, dass** sie eine andere Führungseinrichtung (80) umfasst, die den zweiten sich drehenden Bürstenwalzen (53) vorgeschaltet angeordnet ist, welche andere Führungseinrichtungen (80) zwei andere der zusätzlichen Bürsten (81, 81') trägt.

9. Vorrichtung (1; 101; 201) nach Anspruch 7, **dadurch gekennzeichnet, dass** sie eine weitere Führungseinrichtung (70) umfasst, die den zweiten sich drehenden Bürstenwalzen (53) nachgeschaltet angeordnet ist, welche weitere Führungseinrichtung (70) zwei andere der zusätzlichen Bürsten (71, 71') trägt.

10. Vorrichtung (1; 101; 201) nach Anspruch 3, **dadurch gekennzeichnet, dass** sie ferner einen Betriebsmechanismus umfasst, der einen mit Gewinde versehenen Schaft (31) umfasst, der funktionell mit einem Motor (310) verbunden ist, wobei die Führungseinrichtung (35; 70; 80) mittels des Betriebsmechanismus mit der Maschenware (2) in Eingriff und außer Eingriff gebracht wird.

11. Vorrichtung (1; 101; 201) nach Anspruch 1, **dadurch gekennzeichnet, dass** sie ferner eine Ausgabeantriebseinrichtung (47, 57) umfasst, die mit der Zuführantriebseinrichtung (41, 51) zusammenwirkt, so dass die Maschenware (2) um die sich drehenden Bürstenwalzen (43, 53) gewickelt wird, die zwei Äste (201, 202; 203, 204) bilden, welche entgegengesetzte Sektoren der Oberflächenabschnitte (2a; 2b) mit den sich drehenden Walzenbürsten (43; 53) in Kontakt bringen.

Revendications

1. Machine (1 ; 101 ; 201) pour assouplir un article tricoté circulaire continu (2), l'article circulaire (2) pénétrant dans la machine sous une forme aplatie et comportant une première partie de surface externe (2a), une deuxième partie de surface externe opposée (2b) et deux bords latéraux (21 et 21'), l'article circulaire (2) avançant dans une direction choisie au préalable, la machine (1 ; 101 ; 201) comprenant :

- des moyens de commande d'avance (41 ; 51) pour avancer ledit article (2),
- des premiers et deuxièmes rouleaux-brosses rotatifs (43, 53) ayant des axes de rotation sensiblement parallèles les uns aux autres et audit article (2),
- des unités de moteur (430 ; 530), chaque rouleau-brosse (43, 53) étant relié de manière opérationnelle à une unité de moteur (430 ; 530) respective le faisant tourner à une vitesse choisie au préalable et dans une direction de rotation choisie au préalable qui sont indépendantes de la vitesse et de la direction de rotation d'une autre brosse (43, 53),

caractérisée en ce qu'elle comprend également :

- des rouleaux-brosses rotatifs supplémentaires (38, 38' ; 71, 71' ; 81, 81') ayant des axes de rotation sensiblement perpendiculaires auxdites première et deuxième parties de surface externe (2a, 2b) dudit article (2), lesdites brosses supplémentaires (38, 38' ; 71, 71' ; 81, 81') se mettant en prise avec les bords latéraux (21, 21') dudit article (2) et effectuant une action de

brossage sur lesdits bords.

2. Machine (1 ; 101 ; 201) selon la revendication 1, **caractérisée en ce qu'**elle comprend en outre :

- des premier et deuxième éléments pénétrants (44, 44' ; 54, 54') modifiant l'angle d'enroulement dudit article (2) sur l'un desdits rouleaux-brosses rotatifs (43, 53),
- des premiers et deuxièmes moyens extensibles (46, 56), les moyens extensibles étant équipés de détecteurs de charge et détectant la tension dudit article (2) se mettant en prise avec lesdits rouleaux-brosses rotatifs (43, 53), et
- des premiers et deuxièmes moyens d'aspiration (411, 511) retirant une fine poussière fibreuse produite par l'action de brossage desdits rouleaux-brosses rotatifs (43, 53) sur lesdites première et deuxième parties de surface externe (2a, 2b).

3. Machine (1 ; 101 ; 201) selon la revendication 1 ou 2, **caractérisée en ce qu'**elle comprend au moins un dispositif de guidage (35 ; 70 ; 80) pour guider ledit article (2) sous une forme tubulaire et aplatie, ledit dispositif de guidage (35 ; 70 ; 80) mis en prise avec ledit article (2) et séparé de celui-ci et supportant lesdites brosses supplémentaires (38, 38' ; 71, 71' ; 81, 81').

4. Machine (1 ; 101 ; 201) selon la revendication 3, **caractérisée en ce que** ledit dispositif de guidage (35 , 70 ; 80) est pourvu d'élargisseurs (37, 37' ; 72, 72' ; 82, 82') pour l'extension transversale dudit article (2) sous forme tubulaire, lesdits élargisseurs (37, 37' ; 72, 72' ; 82, 82') comportant des parties d'extrémité (37a, 37a' ; 72a, 72a' ; 82a, 82a') supportant des éléments de support (320, 320') pour lesdits bords latéraux (21, 21') dudit article (2), lesdits éléments de support (320, 320') étant situés face auxdites brosses supplémentaires (38, 38' ; 71, 71' ; 81, 81').

5. Machine (1 ; 101 ; 201) selon la revendication 2, **caractérisée en ce qu'**elle comprend, en outre, des bras (330, 330') et des moyens d'ajustement de distance (331, 331' ; 332, 332'), lesdites brosses supplémentaires (38, 38' ; 71, 71' ; 81, 81') étant montées sur les bras (330, 330') reliés audit dispositif de guidage (35 ; 70 ; 80) à l'aide de broches (318, 318') et par les moyens (331, 331' ; 332, 332') pour ajuster la distance desdites brosses supplémentaires (38, 38' ; 71, 71' ; 81, 81') par rapport auxdits bords latéraux (21, 21') dudit article (2).

6. Machine (1 ; 101 ; 201) selon la revendication 1, **caractérisée en ce qu'**elle comprend, en outre, des moyens formant moteur (39, 39') et des mécanismes de déplacement (333, 333'), lesdites brosses supplémentaires (38, 38' ; 71, 71' ; 81, 81') étant reliées de manière opérationnelle aux moyens formant moteur (39, 39') respectifs et aux mécanismes (333, 333') déplaçant lesdites brosses supplémentaires (38, 38' ; 71, 71' ; 81, 81') le long des axes de rotation respectifs.

7. Machine (1 ; 101 ; 201) selon la revendication 3, **caractérisée en ce que** ledit dispositif de guidage (35) est agencé en amont desdits premiers rouleaux-brosses rotatifs (43), ledit dispositif de guidage (35) supportant deux desdits rouleaux-brosses rotatifs supplémentaires (38, 38').

8. Machine (1 ; 101 ; 201) selon la revendication 7, **caractérisée en ce qu'**elle comprend un autre dispositif de guidage (80) agencé en amont desdits deuxièmes rouleaux-brosses rotatifs (53), ledit autre dispositif de guidage (80) supportant deux autres desdites brosses supplémentaires (81, 81').

9. Machine (1 ; 101 ; 201) selon la revendication 7, **caractérisée en ce qu'**elle comprend un dispositif de guidage supplémentaire (70) agencé en aval desdits deuxièmes rouleaux-brosses rotatifs (53), ledit dispositif de guidage supplémentaire (70) supportant deux autres desdites brosses supplémentaires (71, 71').

10. Machine (1 ; 101 ; 201) selon la revendication 3, **caractérisée en ce qu'**elle comprend, en outre, un mécanisme d'actionnement, comprenant un arbre fileté (31) relié de manière opérationnelle à un moteur (310), ledit dispositif de guidage (35 ; 70 ; 80) étant mis en prise avec ledit article (2) et séparé de celui-ci au moyen du mécanisme d'actionnement.

11. Machine (1 ; 101 ; 201) selon la revendication 1, **caractérisée en ce qu'**elle comprend, en outre, des moyens de commande d'extraction (47, 57) coopérant avec les moyens de commande d'avance (41, 51) de sorte que ledit article (2) soit enroulé sur lesdits rouleaux-brosses rotatifs (43, 53) formant deux branches (201, 202 ; 203, 204) qui amènent en contact avec lesdits rouleaux-brosses rotatifs (43, 53) des secteurs opposés desdites parties de surface (2a, 2b).

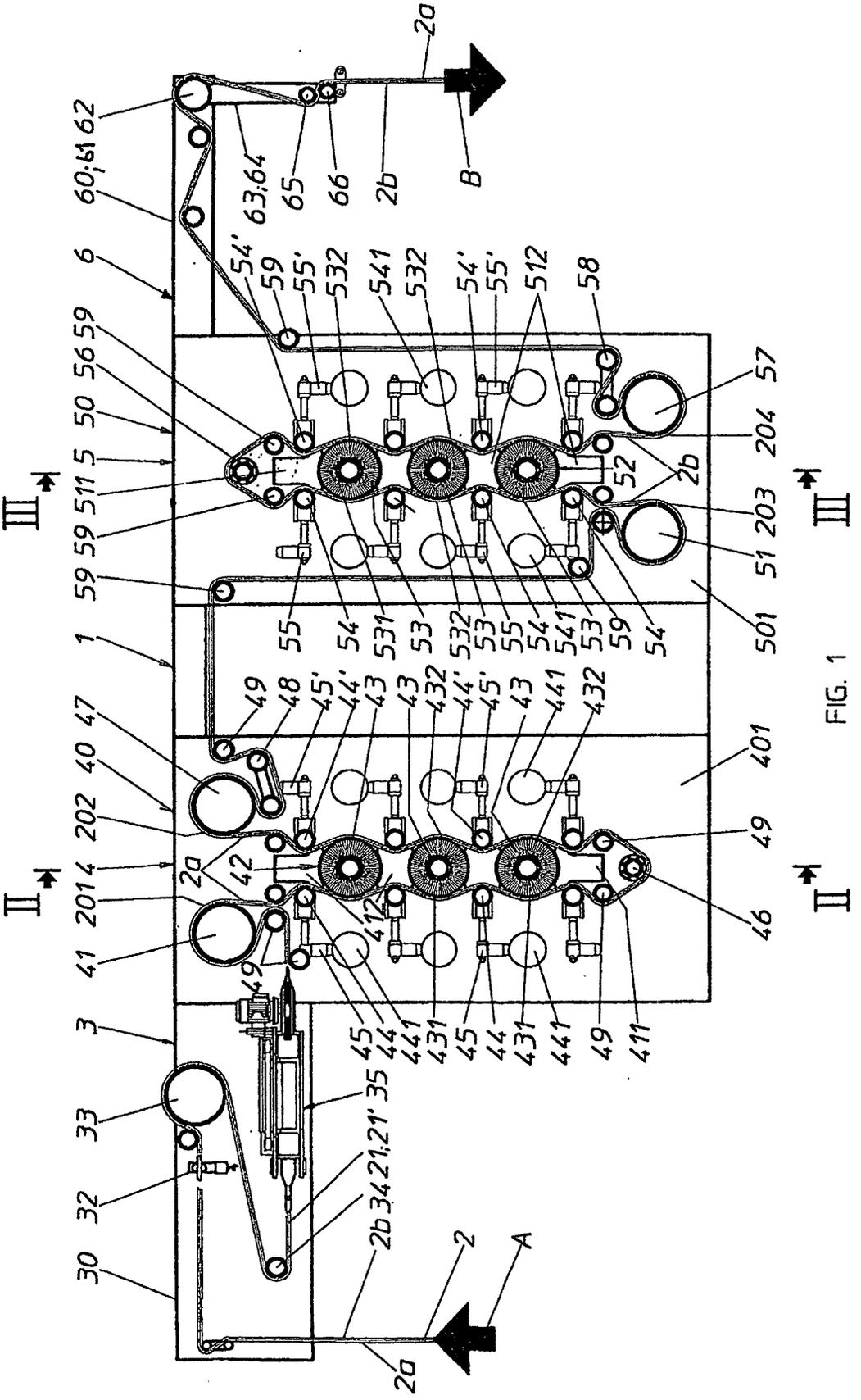

2a
62
60;61
63;64
65
66
2b
B
6
54'
59
55'
532
541
532
54'
55'
512
58
59
56
50
5
511
59
59
1
47
40
202
4
201
41
3
33
32
30
2b
34
21;21'
35
2
A
2a
III
III
II
II
57
204
52
2b
203
51
501
401
49
46
55
54
531
53
532
53
55
54
541
53
59
54'
49
48
45'
44'
43
43
432
44'
45'
43
441
432
42
412
49
45
44
441
431
45
44
431
441
49
411

FIG. 1

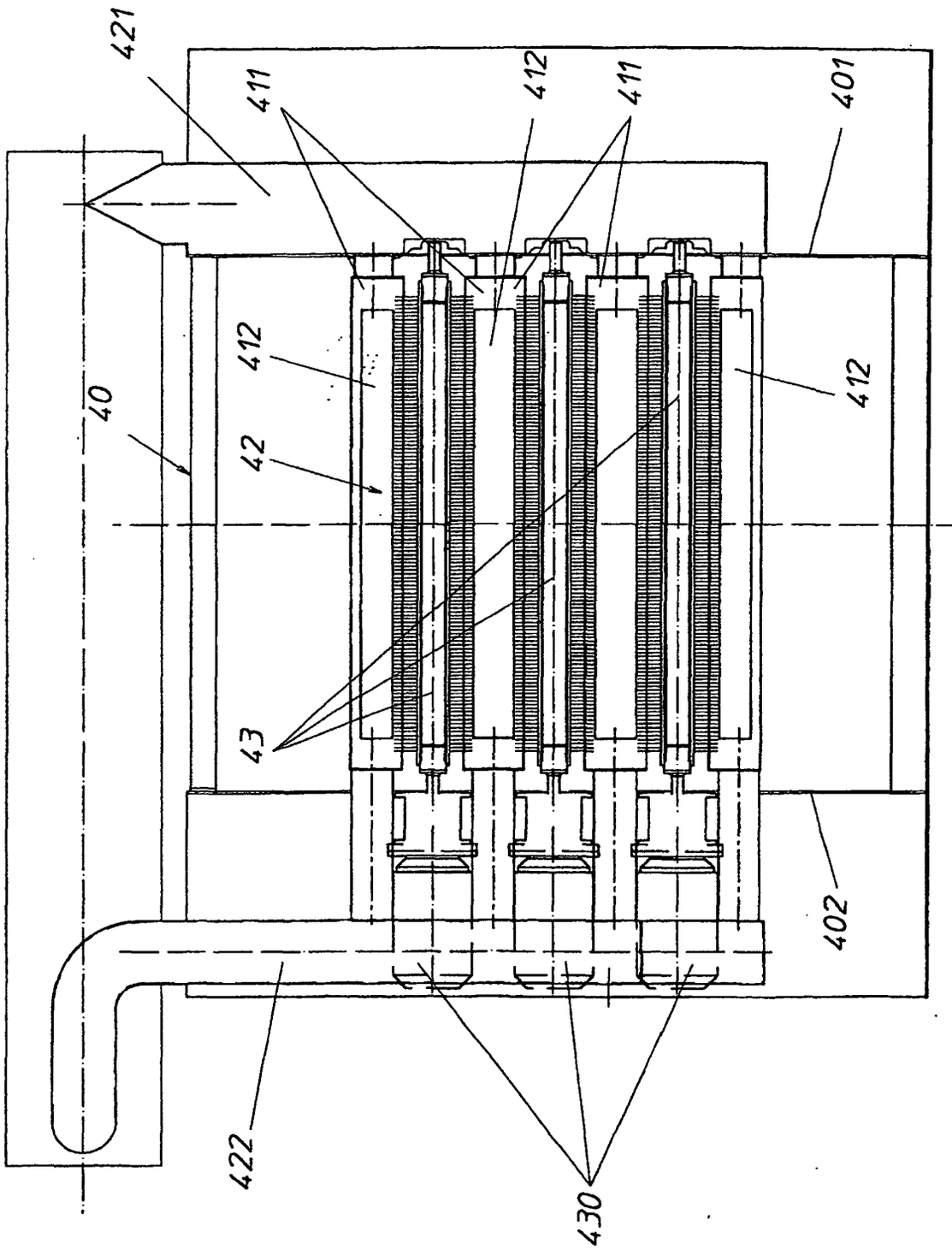


FIG. 2

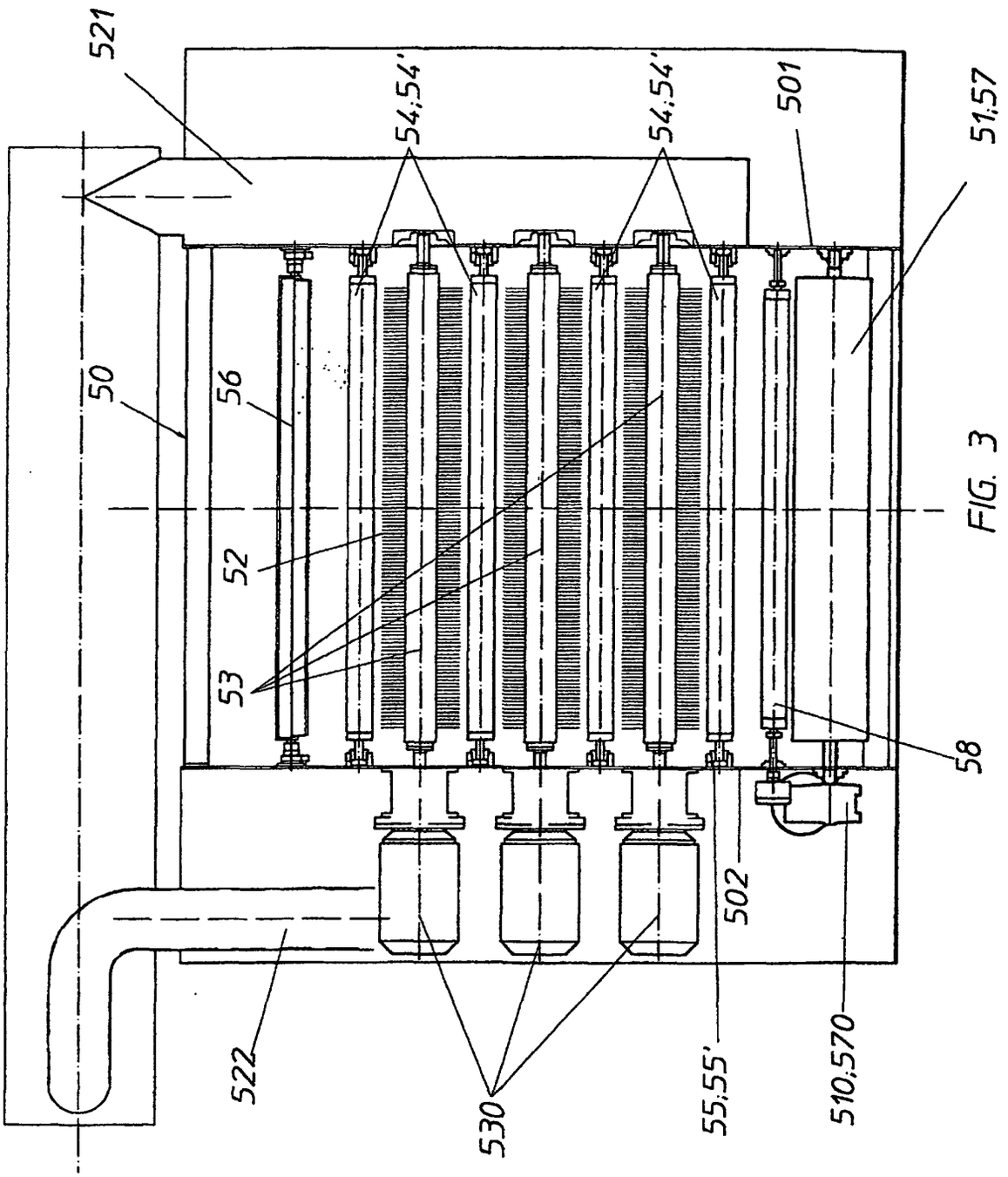


FIG. 3

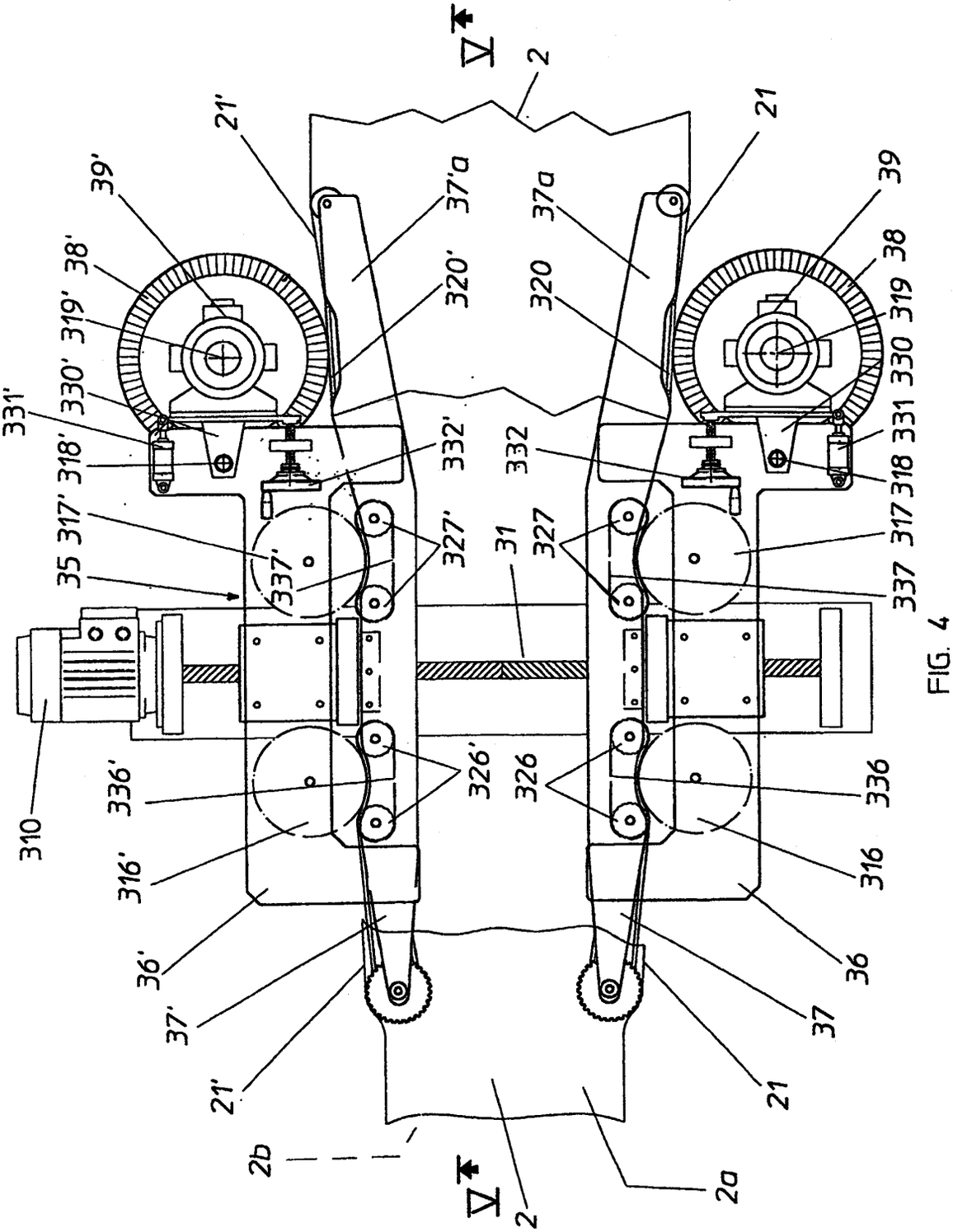

V
2
21'
21
39'
39
37'a
37a
38'
38
320'
320
319'
319
330'
330
331'
331
318'
318
332'
332
317'
317
35
337'
337
327'
327
31
326'
326
336'
336
310
316'
316
36'
36
37'
37
21'
21
2b
2a
2
V

FIG. 4

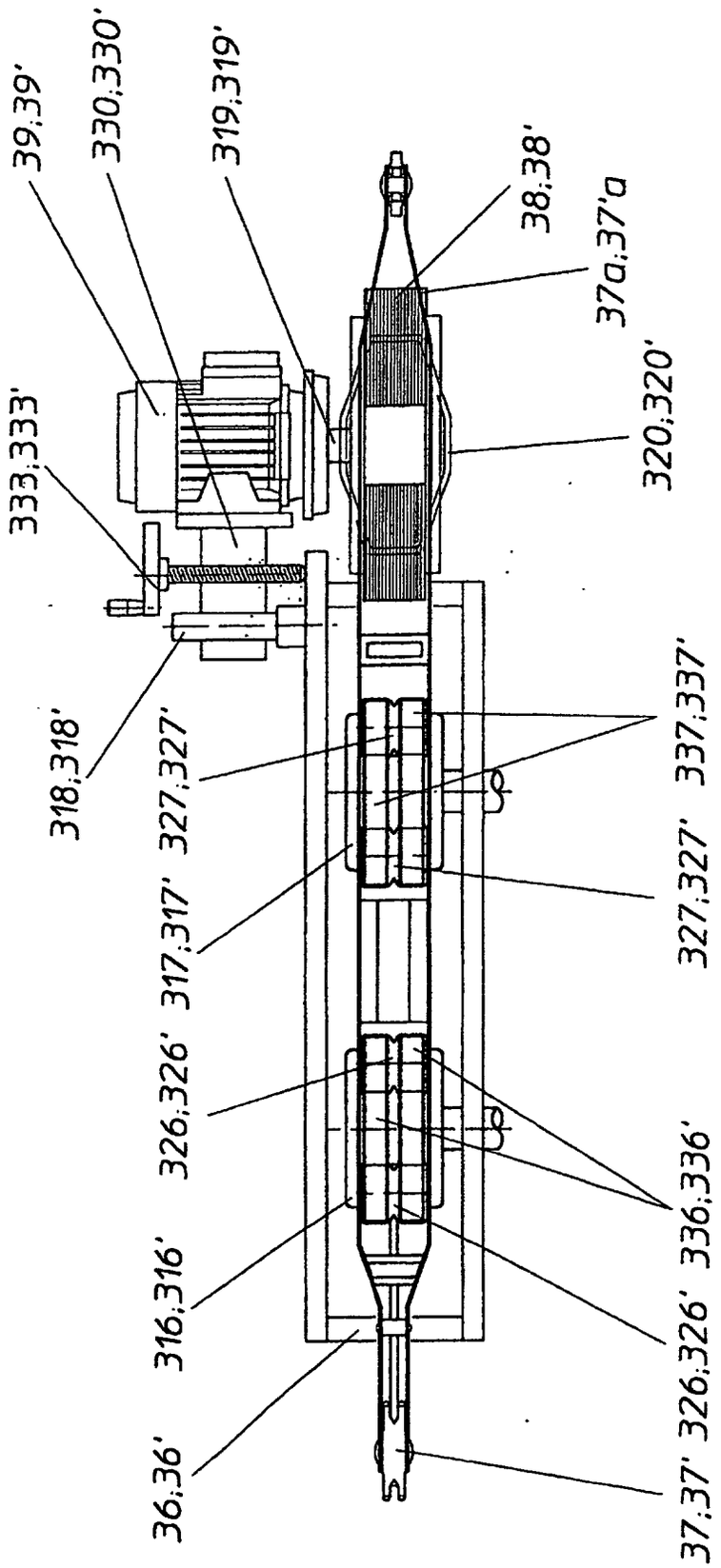

39;39'
330;330'
319;319'
38;38'
37a;37'a
320;320'
333;333'
318;318'
327;327'
337;337'
317;317'
327;327'
326;326'
316;316'
336;336'
326;326'
36;36'
37;37'

FIG. 5

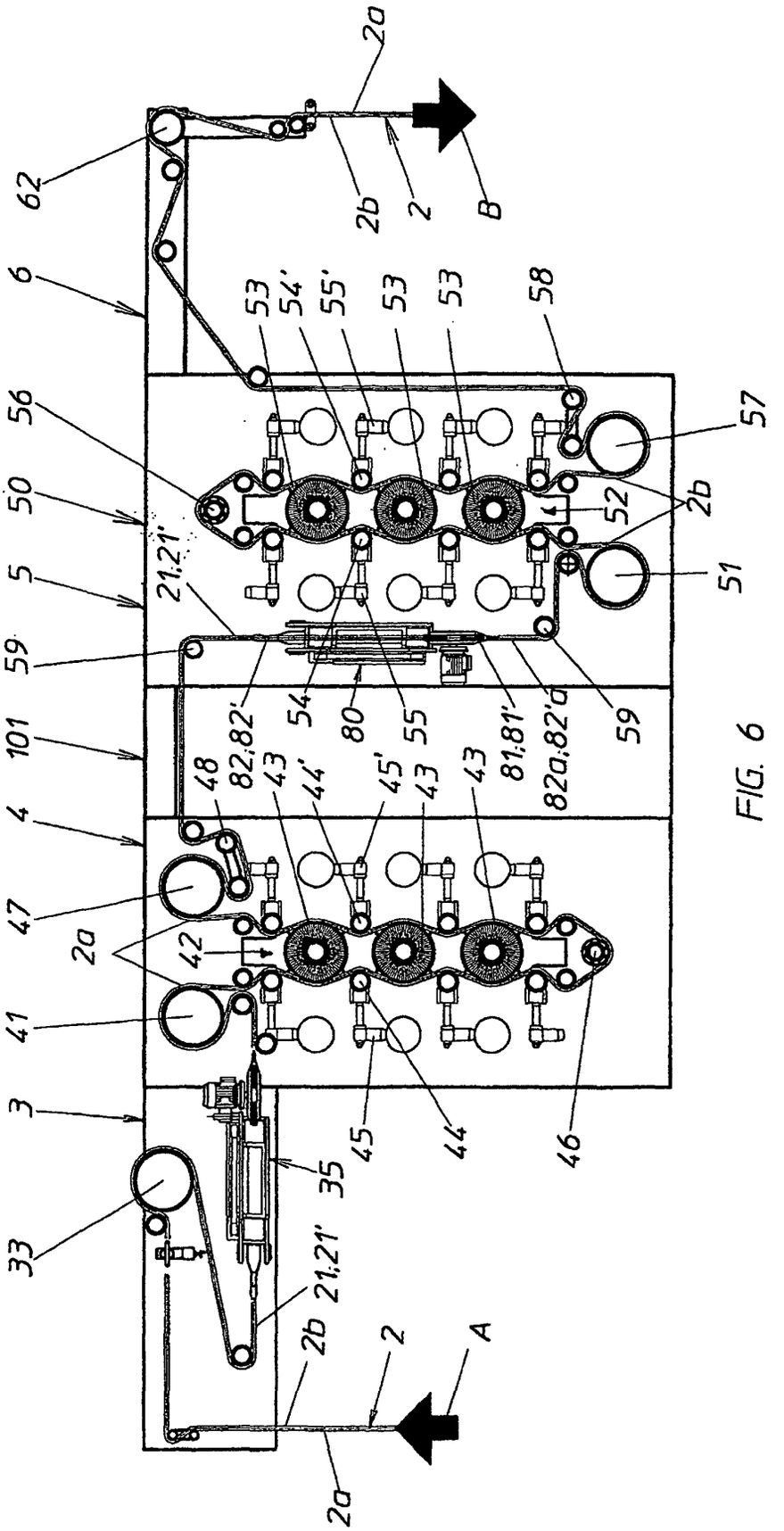

2a
62
2b
2
B
6
53
54'
55'
53
53
58
56
57
50
52
2b
5
21,21'
51
59
54
80
55
81,81'
82a,82'a
59
101
82,82'
48
43
44'
45'
43
43
4
47
2a
42
41
3
45
44
46
35
33
21,21'
2b
2
A
2a

FIG. 6

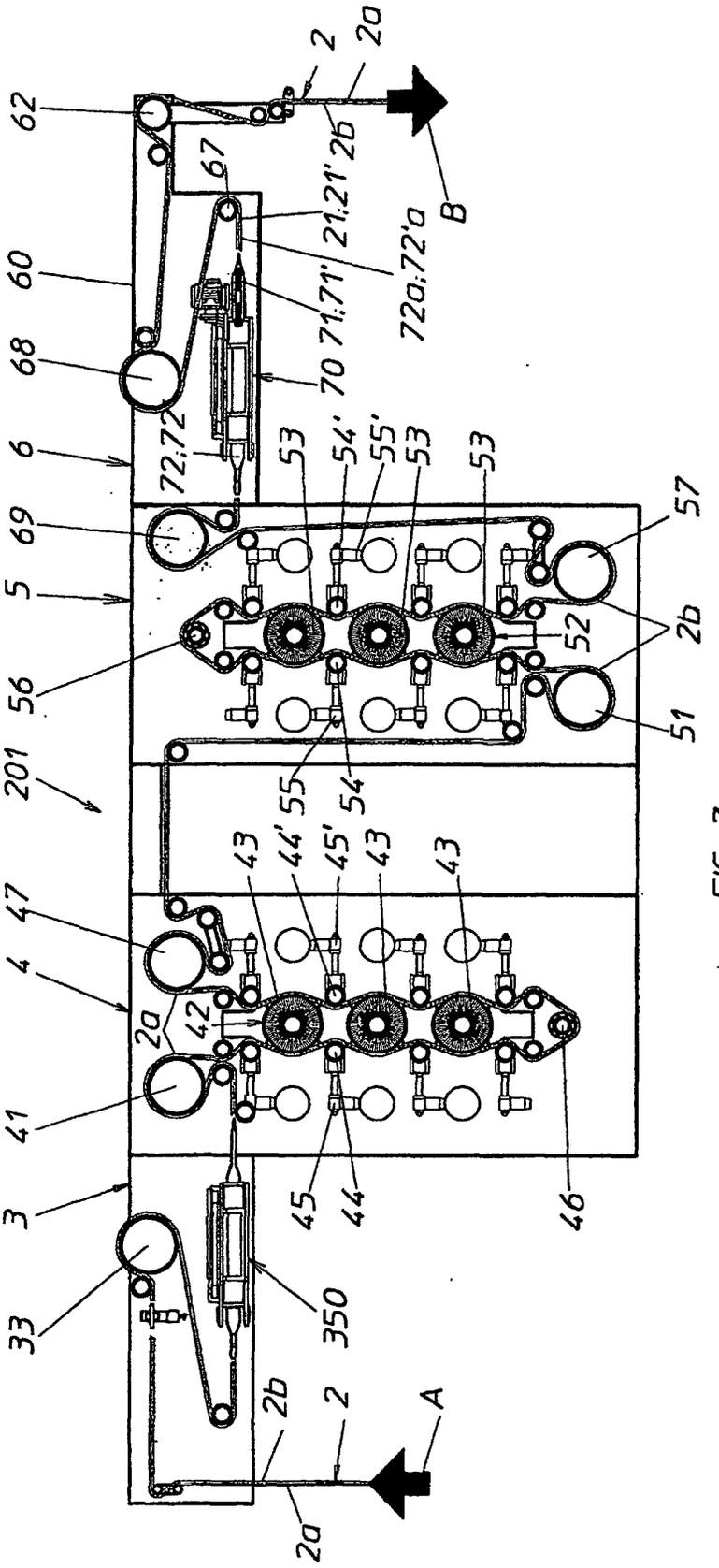

62
67
60
68
6
69
5
56
201
47
4
41
3
33
2
2a
2b
A
B
21,21'
72a,72'a
71,71'
70
72,72'
53
54'
55'
54
55
43
44'
45'
44
45
46
42
52
57
51
350

FIG. 7