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(71) Applicant: **LAFIN Srl**
**36015 Schio (VI) (IT)**

(72) Inventor:
**De Marchi, Maria Teresa**
**36015 Schio (VI) (IT)**

(74) Representative:
**Petraz, Gilberto Luigi et al**
**GLP S.r.l.**
**Piazzale Cavedalis 6/2**
**33100 Udine (IT)**

## (54) Grinding device for textile material and relative method

(57) Grinding device for textile material (15) and relative method, said device comprising a rotary drum (11) on the circumference of which a plurality of brushes (12) made of abrasive material are mounted and able to be made to rotate by means of at least a drive assembly (17, 117, 217) and in contact with which said textile material (15) is suitable to pass in order to achieve the grinding process, each of said brushes (12) comprising a central shaft (13) on which a lining (14) made of filaments of abrasive material is applied.

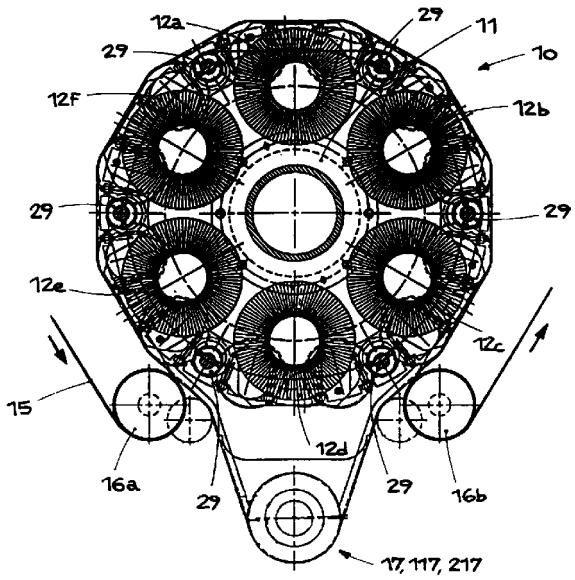


Fig. 1

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## Description

### FIELD OF THE INVENTION

**[0001]** This invention concerns a grinding device for textile material and the grinding method which uses said device.

**[0002]** The invention is applied in finishing processes for textiles and woollens to give the feel of the fabric particular aesthetic effects, for example, ageing, prewashing or the so-called peach-skin effect.

**[0003]** The invention can be applied substantially to any type of textile material, in the field of cotton, synthetic fibers, wool and in knitwear, and is particularly indicated for application on at least partly elastic or elasticized fabrics.

### BACKGROUND OF THE INVENTION

**[0004]** The process of grinding, which is well-known in finishing processes, substantially consists of drawing the textile material into contact with rollers or cylinders lined with abrasive or diamond paper or other material with abrasive properties. The action of the abrasive material produces a partial breakage and a possible slight removal of fibrous material, causing the formation of a surface down which can be more or less accentuated according to the final result desired or the characteristics of the feel to be obtained.

**[0005]** In the state of the art, grinding can be used either on dry or wet textile material or material which has at least been dampened before it is sent to the grinding rollers.

**[0006]** In the second case, the fabric is normally immersed in an impregnation bath, or subjected to wetting or damping by spraying, in a position upstream of the grinding zone.

**[0007]** Wet grinding, as opposed to dry grinding, causes a less accentuated and therefore more superficial abrasive action, it raises the pile less, and thus obtains a short, thick pile.

**[0008]** Conventional grinding machines, in general, are low performance in terms of productivity and efficiency, they are difficult to maintain and difficult for the operator to control, and they occupy a large horizontal space. Moreover, conventional machines in general have a problem connected with the shrinkage of the fabric, due to the tension which the grinding rollers or cylinders transmit to the fabric: the more elastic the fabric, the more accentuated the problem.

**[0009]** A further disadvantage of conventional machines is that longitudinal creases are formed in the fabric and that the edges of the fabric curl up.

**[0010]** These phenomena give a non-uniform grinding, or in any case poor quality grinding, since the grinding rollers or cylinders do not act on the whole surface of the fabric.

**[0011]** Conventional grinding machines, moreover, consist of purpose-built machines, which are able to perform only those functions for which they have been designed and constructed; they cannot be re-configured for other types of processing.

**[0012]** EP-A-784.114 describes a grinding machine comprising a grinding cylinder provided with strips equipped on the outside with bristles covered with abrasive material. The grinding machine performs its action by means of successive percussions on a brief segment of fabric which is made to pass in contact with the lower part of the cylinder.

**[0013]** The result of these percussions is however an extremely unhomogeneous and dis-uniform abrasion, wherein the fabric, moreover, can pucker and curl as it passes in contact with the cylinder.

**[0014]** WO-A-9906624 describes a device, applied onto raising cylinders, to widen a fabric while it is winding on a raising drum.

**[0015]** The present Applicant has devised, tested and embodied this invention to solve all these shortcomings, but above all to achieve an innovative, practical, economical and extremely functional solution, which can be adapted on every type of fabric and is able to guarantee very high quality results.

### SUMMARY OF THE INVENTION

**[0016]** The invention is set forth and characterized in the respective main claims, while the dependent claims describe other characteristics of the main embodiment.

**[0017]** The purpose of the invention is to achieve a grinding device and method for textile material suitable to guarantee high quality and uniform processing substantially on every type of textile material, also and particularly in the case of knitwear, elasticized fabrics and light and fine fabrics.

**[0018]** Another purpose of the invention is to prevent shrinkage of the fabric, particularly in the case of elasticized fabric or knitwear, and to prevent longitudinal creases forming or the edges of the fabric curling up while the material is being processed on the grinding device.

**[0019]** Another purpose is to achieve a grinding device wherein the fabric is correctly supported between one brush and the other, so that it does not penetrate too much into the bristles of the brushes.

**[0020]** A further purpose is to achieve a versatile and flexible device which can easily be re-configured to perform processing and/or treatments of a different type.

**[0021]** Another purpose is to obtain a device which is compact, functional, adaptable to different types of fabric and suitable to be integrated upstream or downstream with auxiliary drying, rinsing, humidity-regulation devices or otherwise.

**[0022]** According to the invention, the grinding device comprises a rotary drum, substantially of the

type used as ordinary raising drums, on the circumference of which a plurality of brushes are mounted, which are also rotating, consisting of a central shaft and a lining made of abrasive material.

**[0023]** In a preferential form of embodiment, the abrasive material consists of nylon filaments or other similar plastic material.

**[0024]** According to a variant, the abrasive material consists of horsehair material or similar.

**[0025]** According to a further variant, the abrasive material consists of natural or artificial stiff bristle.

**[0026]** In one embodiment of the invention, the abrasive material of the brushes is arranged in a substantially helical configuration or similar, so as to encourage the discharge and fall of the hairs and dust removed from the fabric during the grinding operation.

**[0027]** The brushes are distributed symmetrically on the circumference of the rotary drum and can vary in number according to their size and to the size of the drum itself.

**[0028]** According to the invention, it is preferable to have between 2 and 16 brushes, advantageously between 6 and 8.

**[0029]** In the preferential embodiment, the brushes are made to rotate by drive means with a tangential belt, for example of the toothed type.

**[0030]** According to a variant, the brushes are made to rotate by chain-type drive means.

**[0031]** In a first embodiment, all the brushes are moved in the same direction of rotation.

**[0032]** According to a variant, the brushes are made to rotate in groups, in opposite directions: for example a first group of brushes rotates clockwise and another group of brushes rotates anti-clockwise.

**[0033]** In this case, in a preferential embodiment, a first group of brushes receives motion from drive means arranged on one side of the drum and a second group of brushes from drive means arranged on the opposite side of the drum.

**[0034]** According to one characteristic of the invention, in an intermediate position between each of the brushes there are means suitable to cause a width-maintenance/transverse tensioning of the fabric to prevent it from shrinking and to eliminate or prevent the formation of creases or curls at the edges, which may form due to the tension transmitted by the abrasive action of the brushes.

**[0035]** Moreover, said means are able to support the fabric so that it does not penetrate too much between the brushes.

**[0036]** In one embodiment of the invention, the width-maintenance/tensioning means consist of little shafts with spiral threads, associated with means suitable to make them rotate, on which the fabric is brought into contact in the intermediate segment between one brush and the other.

**[0037]** According to a variant, the width-maintenance means consist of rollers on which a coil is wound, made of steel wire or with profiles of a different shape, substantially of a conventional type.

**[0038]** According to another variant, the width-maintenance means consist of fixed staves, bars, rollers or cylinders rotating solid with the drum, including a thread or coil made of steel wire on the surface. In this case the width of the fabric is maintained thanks to the difference between the speed of the fabric kept under tension between the means located at inlet to and outlet from the drum, and the speed of rotation of the drum itself.

**[0039]** In a further variant, said width-maintenance/tensioning means consist of fixed staves or bars with a plane surface which have the purpose of supporting the fabric and keeping it steady in a direction transverse to the direction of feed so that no rolls are formed at the edges.

**[0040]** The width-maintenance means allow to keep the fabric always perfectly taut and therefore in substantially optimal conditions to be subjected to the action of each individual brush; this allows to obtain an optimum quality grinding, substantially uniform over the whole width of the fabric.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0041]** These and other characteristics of the invention will become clear from the following description of some preferred forms of embodiment, given as a non-restrictive example, with reference to the attached drawings wherein:

| | |
|---|---|
| Fig. 1 | is a schematic view of the grinding device according to the invention; |
| Figs. 2 and 3 | are schematic views from the two sides of the grinding device in Fig. 1; |
| Fig. 4 | is a schematic view of the system to move the brushes of the grinding device in Fig. 1; |
| Fig. 5 | shows a variant of Fig. 4; |
| Fig. 6 | shows a variant of Fig. 1. |

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

**[0042]** With reference to the attached drawings, a grinding device 10 for fabrics 15 according to the invention comprises a rotary drum 11, of the type substantially equivalent to raising drums, on the circumference of which a plurality of rotary brushes 12 are mounted in a removable fashion.

**[0043]** In this case, the grinding device 10 comprises six brushes 12a, 12b, 12c, 12d, 12e, 12f, arranged symmetrical on the circumference of the drum 11, but obviously the number of brushes 12 may be different and advantageously is between two and sixteen.

**[0044]** Upstream and downstream of the drum 11, the grinding device 10 comprises two drawing rollers,

respectively inlet 16a and outlet 16b, by means of which the fabric 15 is made to advance around a substantial part of the drum 11 in contact with the brushes 12.

**[0045]** The drawing rollers 16a and 16b are driven by means of conventional systems and are associated with means to regulate the drawing action, which are not shown here, by means of which it is possible to vary as necessary the winding tension of the fabric 15 around the brushes 12.

**[0046]** Each brush 12 comprises a central shaft 13 on the outer surface of which a lining 14 made of abrasive material is applied, in this case in the form of filaments, by means of which the grinding process is achieved.

**[0047]** In a preferential embodiment, the lining 14 consists of a plurality of filaments made of nylon or similar synthetic material.

**[0048]** According to another variant, the lining 14 is made of filaments made of synthetic material distributed uniformly along the central shaft 13.

**[0049]** According to another variant, the lining 14 is made of a bristle material, natural or artificial, appropriately treated so as to make it sufficiently stiff.

**[0050]** According to a further variant, the lining 14 is made using horsehair material.

**[0051]** In a first embodiment of the invention, shown schematically in Fig. 5, all the brushes 12 are made to rotate in the same direction by means of a single drive assembly 17 arranged on one side of the drum 11.

**[0052]** In this case, the drive assembly comprises a motor 18; on the shaft 19 of the motor 18 a primary pulley 20 is keyed, and connected by means of toothed or trapezoid belts 21 to six pulleys 22 keyed onto respective shaftlets 23 mounted on the drum 11 in a position mating with that of the brushes 12.

**[0053]** On each shaftlet 23 a command pulley 24 is also mounted, and connected by means of a toothed belt 25 to a mating pulley 26 keyed onto one end of the shaft 13 of a brush 12.

**[0054]** The rotation movement of the brushes 12 is then transmitted, through the toothed belts 21 and 25, from the shaft 19 of the motor 18 to every individual pulley 26 keyed onto the shafts 13 of the brushes 12 which are thus made to rotate uniformly in the same direction.

**[0055]** According to a variant, the motor 18 is of the reversible type and allows the brushes 12 to rotate either in a clockwise or in an anti-clockwise direction.

**[0056]** In the embodiment shown in Figs. 2-4, three brushes 12, in this case 12a, 12c and 12e, are suitable to be made to rotate in one direction by means of a first drive assembly 117 and the other three brushes 12b, 12d and 12f in the opposite direction by means of a second drive assembly 217.

**[0057]** The drive assemblies 117 and 217 are arranged on opposite sides of the drum 11 and comprise respective motors 118 and 218, rotating in opposite directions; on the shafts 119 and 219 of the respective motors 118 and 218, respective primary pulleys 120 and 220 are keyed.

**[0058]** Each of the primary pulleys 120 and 220 is connected, by means of relative toothed or trapezoid belts 121 and 221, to three mating pulleys respectively 22a, 22c, 22e and 22b, 22d 22f mounted on shaftlets 23 arranged in a position mating with that of the brushes 12.

**[0059]** The toothed or trapezoid belts 121 and 221 are also associated with return pulleys 27 mounted on the drum 11.

**[0060]** With each of the pulleys 22a, 22b, 22c, 22d, 22e, 22f a mating drive pulley 24a, 24b, 24c, 24d, 24e, 24f is axially associated, mounted on the same shaftlet 23.

**[0061]** The drive pulleys 24a, 24b, 24c, 24d, 24e, 24f are connected by means of relative toothed belts 25a, 25b, 25c, 25d, 25e, 25f to corresponding pulleys 26a, 26b, 26c, 26d, 26e, 26f keyed onto the shafts 13 respectively of the brushes 12a, 12b, 12c, 12d, 12e, 12f.

**[0062]** The movement of rotation produced by the motor 118 is then transmitted through the toothed belts 121 and 25a, 25c, 25e from the shaft 119 to each pulley 26a, 26c, 26e, causing the brushes 12a, 12c, 12e to move in a desired direction of rotation, for example, clockwise.

**[0063]** In the same way, the movement of rotation produced by the motor 218 is transmitted through the toothed belts 221 and 25b, 25d, 25f from the shaft 219 to each pulley 26b, 26d, 26f, causing the brushes 12b, 12d, 12f to move in a direction of rotation opposite that of the brushes 12a, 12c, 12e, for example, anti-clockwise.

**[0064]** In this embodiment the fabric 15 therefore transits in contact alternately with brushes 12 acting in a clockwise direction and with brushes 12 acting in an anti-clockwise direction, thus allowing to obtain an extremely efficacious grinding process.

**[0065]** In this embodiment too, the motors 118 and 218 can be of the reversible type, so as to allow the brushes 12 to rotate in the same direction, or to allow the brushes 12 to rotate in differentiated groups in one direction or another.

**[0066]** Uniformly distributed on the circumference of the drum 11 and in an intermediate position between the brushes 12, there are six width-maintenance/tensioning elements, which in the case of Fig. 1 consist of rotating rollers 29 in contact with which the fabric 15 is made to pass.

**[0067]** The rotary movement is individually transmitted to each width-maintenance roller 29 by means of a toothed belt 31 connecting a pulley 28, mounted at the outer end of the shaftlet 23 located upstream or downstream, with a pulley 32 associated with the width-maintenance roller 29 itself (Figs. 4 and 5).

**[0068]** As they rotate, the width-maintenance rollers 29 are suitable to tauten the fabric 15 transversely, contrasting the shrinking action produced thereon by the brushes 12 and preventing the formation of longitudinal

creases or curled edges; this allows to keep the fabric 15 at its normal width from the inlet to the outlet of the grinding device 10.

**[0069]** To be more exact, the width-maintenance rollers 29 have spiral threads or ridges 30 on their outer surface which, due to the effect of the rotation of the width-maintenance rollers 29 themselves, are displaced transversely and tauten the fabric 15 as it passes through.

**[0070]** In the embodiment shown in Figs. 4 and 5, the width-maintenance rollers 29 are divided lengthwise into two parts, 29a, 29b with respective opposite spiral threads or ridges 30.

**[0071]** This embodiment causes the fabric 15 to be stretched in two directions, and therefore allows it to be kept in a central position with respect to the brushes 12.

**[0072]** With the device 10 according to the invention, the grinding of the fabric 15 is achieved by making it advance by means of the drawing rollers 16a and 16b, while the drum 11 is rotating and with the brushes 12 and the width-maintenance rollers 29 mounted thereon rotating around their own axis according to the direction established.

**[0073]** Before and after each abrasive treatment by each individual brush 12, the fabric 15 is always subjected to a transverse tension by the width-maintenance roller 29 located upstream and downstream of the brushes 12, and is kept sufficiently taut in its travel around the drum 11.

**[0074]** According to the invention, the grinding device 10 may easily be re-configured to perform processes of a different type on the fabric 15, by removing the brushes 12 from the drum 11 and replacing them with other fabric treating means.

**[0075]** For example, instead of the brushes 12, it is possible to mount raising cylinders to perform raising processes on the fabric 15; if necessary, the working parameters of the device 10 are adapted.

**[0076]** It is obvious, however, that modifications and additions can be made to the grinding device 10 as described heretofore and to the relative method, but these shall remain within the field and scope of the invention.

**[0077]** For example, the drive assemblies 17, 117, 217 may be of a different configuration and have different means to transmit the motion to the brushes 12, such as for example chains instead of the toothed or trapezoid belts 21, 121, 221, 25.

**[0078]** Or there may be two or more width-maintenance rollers 29 between the brushes 12 and they may also be mounted idle on the drum 11, and be made to rotate by the fabric 15 as it passes through.

**[0079]** The width-maintenance rollers 29 may also be stationary and the width-maintenance effect is obtained thanks to the relative speed between the fabric 15 under tension between the drawing rollers 16a and 16b and the rotating drum 11.

**[0080]** Instead of the width-maintenance rollers 29 there may be other means suitable for the purpose, such as for example staves or plates 129, acting in contact with the fabric 15, mounted on sliders or little trolleys movable from the center towards the outer part of the fabric 15.

**[0081]** The staves or plates 129 can also be fixed, as in the embodiment shown in Fig. 6, and have the function of keeping the fabric 15 axially steady, so that it remains perfectly taut and so that it does not curl up at the edges; moreover, the staves or plates 129 have the function of supporting the fabric 15 so that it does not penetrate too much into the abrasive lining 14 of the brushes 12.

**[0082]** Furthermore, the brushes 12 may be divided into groups with a differentiated drive.

**[0083]** It is also obvious that, although the invention has been described with reference to specific examples, a skilled person in the field will certainly be able to achieve many other equivalent forms of the grinding device, all of which come within the field and scope of the invention.

## Claims

1. Grinding device for textile material (15) comprising at least drawing means (16a, 16b) suitable to make said textile material (15) advance to take it into contact with abrasive means suitable to achieve the grinding process, the device being characterized in that it comprises a rotary drum (11) on the circumference of which a plurality of brushes (12) made of abrasive material are mounted and suitable to be made to rotate by means of at least a drive assembly (17, 117, 217) and in contact with which said textile material (15) is suitable to pass in order to achieve the grinding process, each of said brushes (12) comprising a central shaft (13) on which a lining (14) made of filaments of abrasive material is applied.

2. Device as in Claim 1, characterized in that it comprises width-maintenance/tensioning means (29, 129) mounted on said drum (11) and able to keep the fabric (15) transversely taut to prevent it from curling up at the edges.

3. Device as in Claim 2, characterized in that said width-maintenance/tensioning means (29, 129) are mounted in an intermediate position between at least some of the pairs of adjacent brushes (12).

4. Device as in Claim 1, characterized in that said brushes (12) are symmetrically distributed on the circumference of said rotary drum (11).

5. Device as in Claim 1, characterized in that there are between 2 and 16 of said brushes (12).

**6.** Device as in Claim 1, characterized in that there are between 6 and 8 of said brushes (12).

**7.** Device as in Claim 1, characterized in that said lining (14) comprises filaments made of nylon or similar synthetic material.

**8.** Device as in Claim 1, characterized in that said lining (14) is made with stiff bristles of a natural and/or synthetic type.

**9.** Device as in Claim 1, characterized in that said lining (14) is made of horsehair material or similar.

**10.** Device as in any claim hereinbefore, characterized in that said lining (14) is arranged in a substantially helical configuration to encourage the discharge and fall of the hairs and dust removed from the textile material (15) during the grinding operation.

**11.** Device as in Claim 1, characterized in that said brushes (12) are all made to rotate by the same drive assembly (17).

**12.** Device as in Claim 1, characterized in that said brushes (12) are divided into at least two distinct groups which can be activated selectively, a first group (12a, 12c, 12e) being suitable to be made to rotate in one direction by a first drive assembly (117) and a second group (12b, 12d, 12f) being suitable to be made to rotate in the opposite direction by a second drive assembly (217).

**13.** Device as in Claim 1, characterized in that said drive assemblies (17, 117, 217) are of the reversible type.

**14.** Device as in Claim 1, characterized in that said drive assemblies (17, 117, 217) comprise means to transmit the motion with a tangential belt or chain (21, 121, 221, 25) cooperating with mating pulley means (20, 120, 220, 22, 24, 26) connected to said brushes (12).

**15.** Device as in Claim 2 or 3, characterized in that said width-maintenance/tensioning means consist of rotary shaftlets or rollers (29) provided with spiral threads or ridges (30) on their outer surface.

**16.** Device as in Claim 2 or 3, characterized in that said width-maintenance/tensioning means consist of stationary shaftlets or rollers provided with spiral threads or ridges (30) on their outer surface.

**17.** Device as in Claim 15 or 16, characterized in that each of said shaftlets or rollers (29) is divided into two parts (29a, 29b) with spiral threads or ridges (30) opposite each other.

**18.** Device as in Claim 15, characterized in that said rotary shaftlets or rollers (29) are suitable to be made to rotate by means of motion transmitting means (28, 31, 32) associated with said drive assembly (17, 117, 217).

**19.** Device as in Claim 15, characterized in that said rotary shaftlets or rollers (29) are mounted idle on said drum (11) and are suitable to be made to rotate by the textile material (15) in transit.

**20.** Device as in Claim 2 or 3, characterized in that said width-maintenance/tensioning means consist of stave elements or similar acting in contact with the textile material (15) in transit and suitable to move from the center towards the edges thereof.

**21.** Device as in Claim 2 or 3, characterized in that said width-maintenance/tensioning means consist of fixed stave or plate elements (129) able to support the fabric (15) at least between two adjacent brushes (12) and to keep it transversely taut.

**22.** Device as in Claim 1, characterized in that said brushes (12) are of the removable type and are suitable to be replaced by means to process the textile material (15) of a different type such as raising cylinders or similar.

**23.** Grinding method for textile material (15) comprising at least a step wherein said textile material (15) is made to pass in contact with abrasive means and kept under tension by means of drawing means (16a, 16b), the method being characterized in that in said step, said textile material (15) is made to pass in contact with brush-type rotary abrasive means (12) distributed on the circumference of a rotary drum (11) and suitable to achieve the grinding process, each of said brush-type abrasive means (12) comprising a central shaft (13) on which a lining (14) made of filaments of abrasive material is applied.

**24.** Method as in Claim 23, characterized in that said brush-type abrasive means (12) are made to rotate all in the same direction.

**25.** Method as in Claim 23, characterized in that some of said brush-type abrasive means (12) are made to rotate in one direction and the others are made to rotate in the opposite direction.

**26.** Method as in Claim 23, characterized in that in said step, said textile material (15) is subjected to a treatment of transverse width maintenance to contrast the shrinking effect of said grinding process.

**27.** Method as in Claim 26, characterized in that said

width maintenance treatment is made on said textile material (15) at least downstream or upstream of each of said brush-type abrasive means (12).

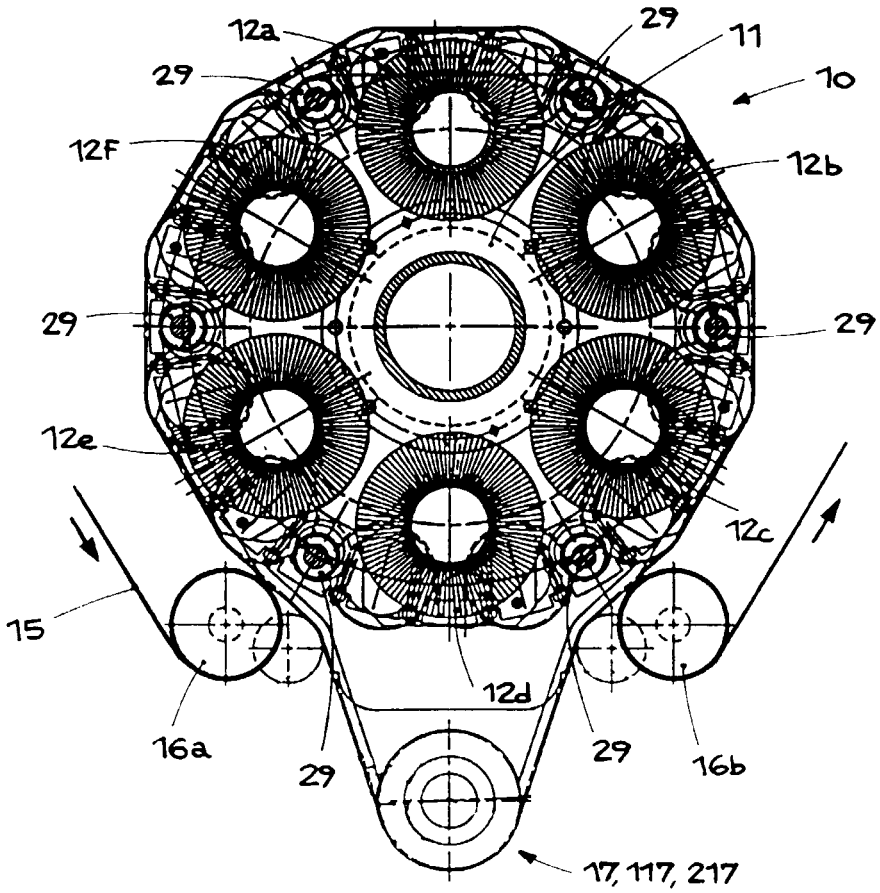


Fig. 1

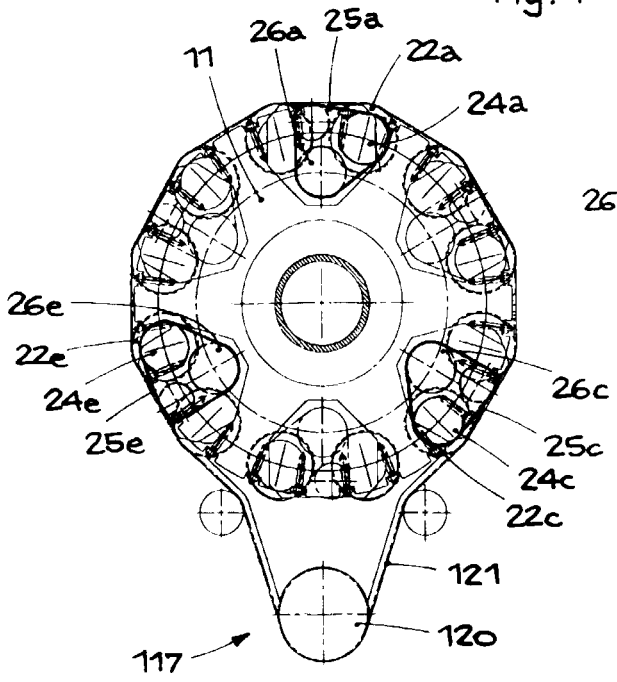


Fig. 2

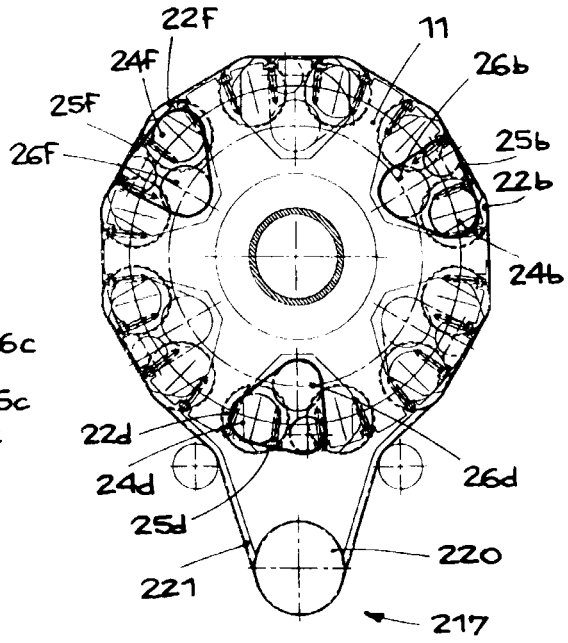


Fig. 3

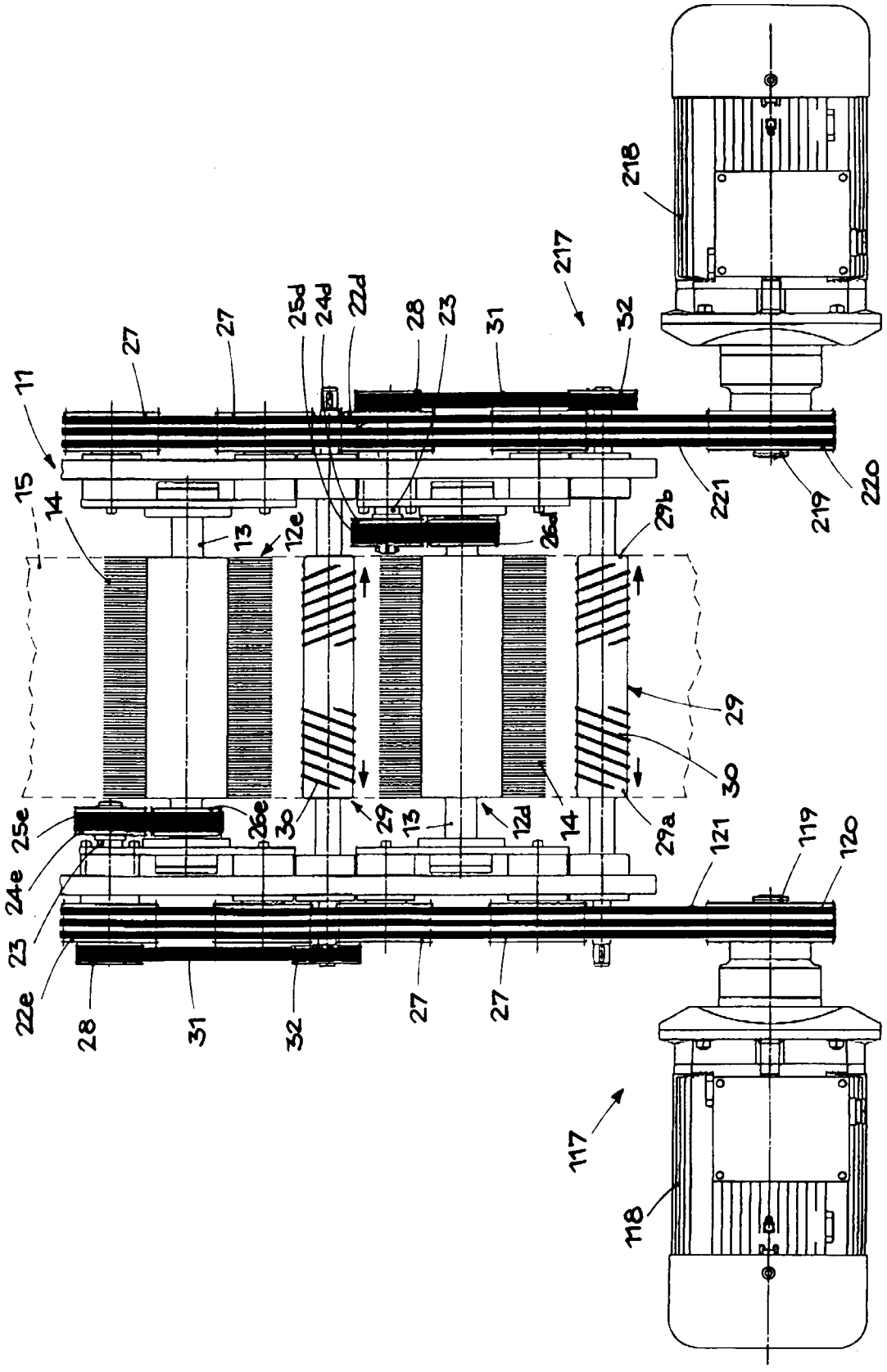
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fig. 4

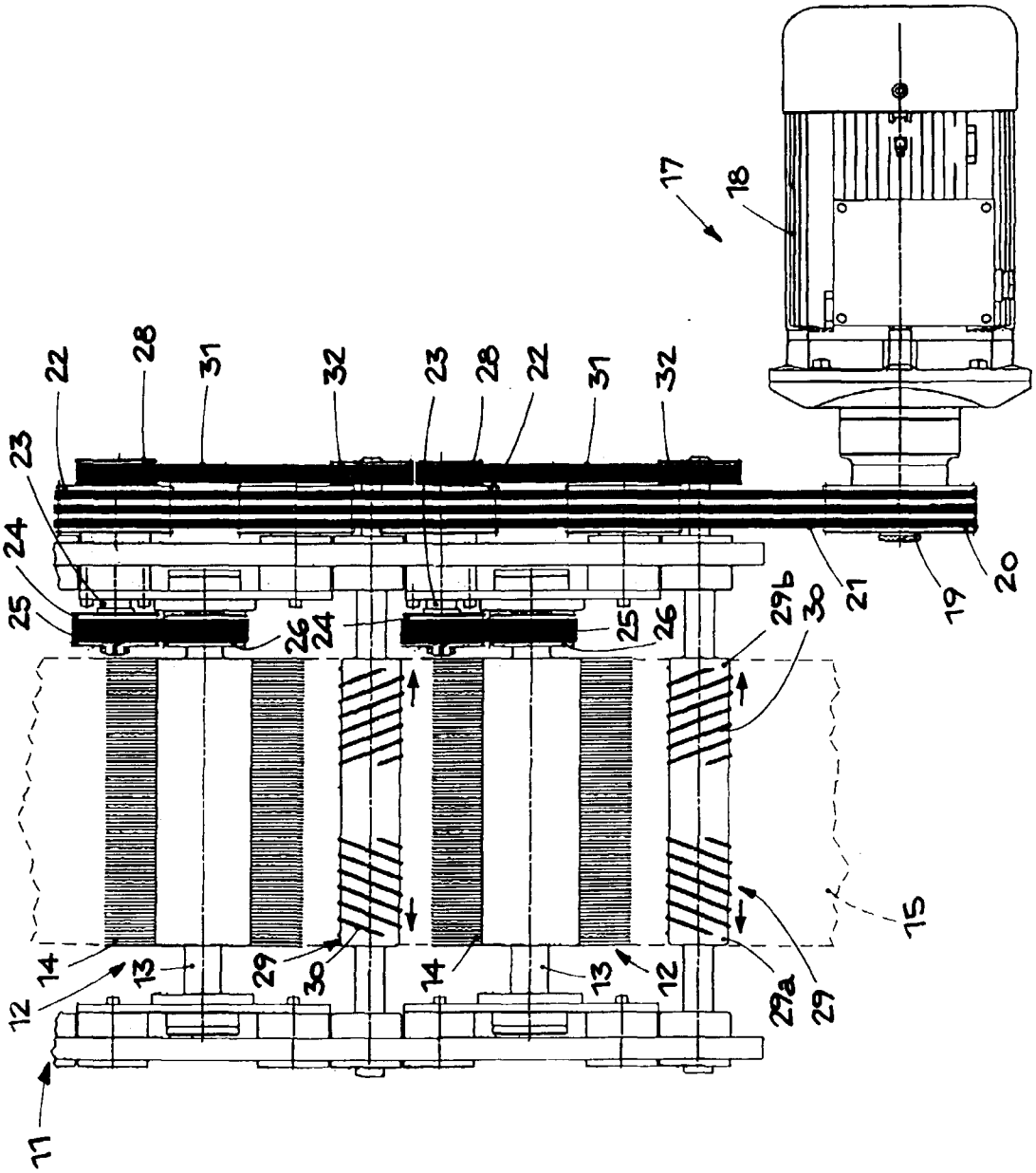
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fig.5

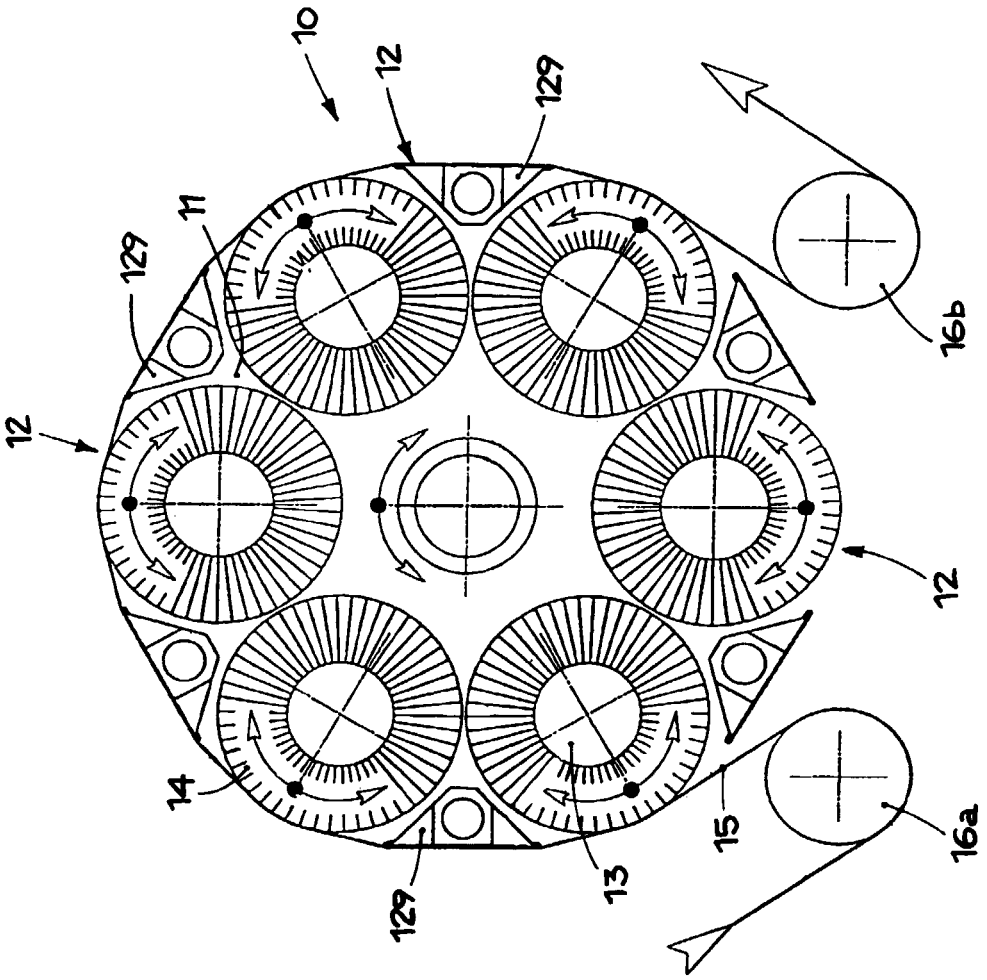


fig.6