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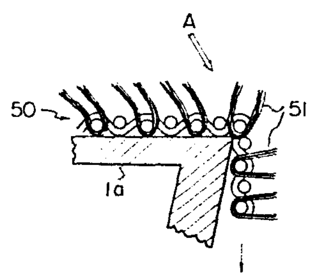
(54) **Process and apparatus for finishing velvet-like fabrics.**

(57) A process for finishing a velvet-like fabric, cut piles (51) of which are composed of thermoplastic fiber filaments. The back surface of the fabric is brought closely into face to face contact with a heater until foot portions (55) of the cut piles (51) are plasticized and thereafter a fluid at a lower temperature than that of the heater is ejected onto the cut piles (51), along the direction shown by the arrow (A), so that the tilted cut piles are straightened upright and are set as they are. The process may be repeated. An apparatus utilized for the process has at least a heater (1a) provided with a curvex contact surface and at least a nozzle (3a) facing a path of the fabric.

Fig. 2 A



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PROCESS AND APPARATUS FOR FINISHING VELVET-LIKE FABRICS

This invention relates to the finishing of velvet-like fabrics, especially velvet-like fabrics composed of cut piles of thermoplastic fiber filaments standing upright over the entire ground surface.

Velvet is a type of warp pile fabric comprised of numerous cut piles, originally of silk or rayon filaments, on a ground surface. Recently, warp pile fabrics utilizing thermoplastic fiber filaments for pile components have become widely available.

One problem inherent in velvet-like fabrics utilizing thermoplastic fiber filaments is dishevellment or tilt of the cut piles during wet processes utilizing wet-heat, such as dyeing. Dishevellment or tilt of the cut piles degrades the appearance of the fabric and reduces the yield of high grade product in total production.

To eliminate the above-mentioned problem, various methods have been proposed. For example, Japanese Patent Publication No. 49-20265 discloses a method in which all cut piles in a fabric to be finished are first forced to tilt in one direction, then, are mechanically straightened with a doctor knife and heated and cooled with air jets to be set upright.

However, in the known method in which a doctor knife is utilized, the cut piles in the resulting product tend to show rib lines on the pile side surface due to different contact conditions of the doctor knife with the pile side surface across the width.

Japanese Patent Publication No. 40-3638 and No. 50-26676 disclose, methods in which tilted piles on the surface of dyed fabrics are straightened up by ejecting hot air or steam directly to the piles through nozzles disposed against the back surface of the fabric to be finished, the hot air or steam passing through the fabric from the back surface to the pile side surface. Since high temperature air or steam is applied directly to the piles in these cases, however, the piles are softened and, thereafter, are deformed by the forces exerted during the process. Moreover, in certain circumstances, they curl due to their own latent crimps. Therefore, a high grade product having strict evenness in appearance cannot be obtained.

The present inventors analyzed the cut pile fabrics resulting from the wet-heat process, for example, dip dyeing and jet dyeing. They found that piles of a relatively short length of not more than 5 mm are straight at their free end portions but are deformed at their foot portions. Based on this information, the present inventors researched how to straighten the deformation, i.e., how to bend the foot portion of the pile, and finally completed the invention.

It is an object of the present invention to provide a process for producing a velvet-like fabric comprising a plurality of cut piles, especially cut piles made from thermoplastic fiber filaments, on the entire ground surface.

Another object of the invention is to provide an apparatus suitable for carrying out the above-mentioned process.

In one aspect this invention provides a process for finishing a velvet-like fabric provided with a plurality of cut piles composed of thermoplastic fiber filaments, said cut piles being tilted randomly on a surface of said fabric in which the back surface of said fabric is brought closely into face to face contact with a heater until foot portions of said cut piles are plasticized and in that immediately thereafter, a fluid having a temperature lower than that of said heater is ejected onto said cut piles along a direction to make said cut piles stand upright.

In a second aspect the invention provides an apparatus for carrying out the process comprising a heater provided with a convexed contact surface, a nozzle for ejecting said fluid disposed just behind a rear end of said heater, both said heater and said nozzle being arranged along a path of said fabric, and means for introducing said fabric into said path.

The invention and preferred features will be explained further, and embodiments of the invention will be described in detail with reference to the drawings, in which:

Figure 1 shows an enlarged sectional side view of the cut piles before finishing;

Fig. 2 shows a schematic side view of a device according to the invention provided with an arcuate heater and a nozzle disposed above the fabric;

Fig. 2A is an enlarged section side view of a rear end of the arcuate heater shown in Fig. 2, in which positions of the cut piles are illustrated;

Fig. 3 shows a schematic side view of another device according to the invention provided with a roll heater and a nozzle disposed above the fabric;

Fig. 4 is a schematic side view of still another device according to the invention provided with an arcuate heater and a nozzle disposed beneath the fabric;

Fig. 5 is a schematic side view of a further device according to the invention provided with a roll heater and a nozzle disposed beneath the fabric;

Fig. 6 is a schematic side view of an arrangement according to the invention in which the devices shown in Figs. 2 and 4 are combined; and

Figs. 7 and 8 show enlarged sectional views of the cut piles finished with the process according to the invention and finished with conventional processes, respectively.

Fabrics to be finished in the process and the apparatus according to the invention are pile fabrics such as double raschel knit, woven seal, and velvet; one surface of each fabric being covered with a plurality of short cut piles made from thermoplastic fiber such as polyester, polyamide, polyacrylic, and triacetate fibers in the form of filaments.

Figure 1 shows a state of cut piles after having been dyed. The cut piles (51) projecting from a ground (54) are tilted over randomly and filaments (53) composing the cut piles are crossing each other. Deformation of each cut pile (51) occurs mainly in foot portions (55), while free portion (52) thereof being kept straight.

According to the invention, the pile fabric to be finished is brought into contact with a heater such that the back surface of the fabric, namely the side opposite to the pile side faces the heated surface of the heater. This enables heating of mainly the foot portions of the cut piles to place the foot portions in a plastic condition. With the foot portions in a plastic condition, application of a foreign force thereto would be sufficient to change the posture of the cut pile.

Next, fluid having a temperature not higher than that of the heater is ejected from a nozzle to the surface of the fabric in the desired direction of standing of the cut piles. This fluid separates individually filaments comprising the cut piles as well as straightening and setting upright the cut piles.

Air, especially normal temperature air, is preferably utilized as the fluid to be ejected. Various types of ejection are available, depending upon conditions of the pile fabric such as structure, density, pile length, and specific weight. Among them, two are preferable: a first type wherein the fluid is ejected directly to the pile side surface, immediately after heating the foot portion of the cut piles, from a nozzle disposed above a path of the fabric, and a second type wherein the fluid is ejected to the back surface and passes through it to the pile side surface, immediately after heating.

The first type is preferably utilized for finishing pile fabrics provided with rather shorter cut piles, while the second type is suitable for longer cut piles.

Figures 2 and 3 show the devices utilized for the first type of ejection. In Fig. 2, an arcuate heater (1a) having a little wider width than that of the fabric and having built therein heating wires (2) is disposed along a path of the pile fabric (50) with its convex heated surface in face to face contact with the back surface of the fabric.

A nozzle (3a) for ejecting a cooling fluid also has a little wider width than that of the fabric and is disposed just above the rear end (4) of the heater (1a) to face the pile side surface of the fabric (50). An outlet (5a) of the nozzle (3a) is inclined to the running direction of the fabric so as to make the cut piles stand upright.

In Fig. 3, a roll heater (1b) which may be rotatable, is provided instead of the arcuate heater (1a), and a nozzle (3b) is disposed instead of the nozzle (3a) just above a guide bar (6) located behind the heater (1b). An outlet (5b) of the nozzle (3b) is also inclined to the running direction of the fabric (50) as in Fig. 2.

In both cases, it is preferable that the running direction of the fabric be turned acutely just behind the heater (1a), (1b). The reasons why the above-mentioned turning of the direction is desirable will be apparent later.

The pile fabric (50) requiring finishing after dyeing is supplied to the heater (1a) or (1b). The back surface of the fabric comes into face to face contact with the heated surface of the heater (1a) or (1b). The heat from the back surface raises the temperature of the foot portion of the cut pile (51) (Fig. 1) to the degree necessary to plasticize the material composing the cut pile. The free end portion of the cut pile is hardly heated at all because of the material's poor heat conductivity. Since the fabric (50), as stated before, turns acutely in its running direction just behind the heater (1a) or (1b), the individual cut piles (51) tend to stand upright at the turning point as shown in Fig. 2A. At the same time, the cooling fluid is ejected from the nozzle (3a) or (3b) to the foot portion along the direction shown by the arrow (A). This sets the cut piles (51) upright.

Figures 4 and 5 show the devices utilized for the second type of ejection. Heaters (1c) and (1d) correspond to heaters (1a) and (1b), respectively, and are arranged in the same manner as shown in Fig. 2 and 3 respectively. Nozzles (3c) and (3d) correspond to nozzles (3a) and (3b), respectively, and are located at the rear ends of the heaters (1c) and (1d), respectively, positioned with their outlets facing the back surface of the fabric.

The fabric (50) to be finished is advanced to the heater (1c) or (1d) and heated in the same manner as described before. However, in the cooling region, the cooling fluid is supplied from the nozzle (3c) or (3d) to the back surface and passes through it to the pile side surface. The cut piles (51) are therefore blown upright from the foot portion and are set as they are. Thus, it is not necessary to turn the fabric running direction at the rear end of the heater (1c) and (1d).

In all cases, however, it is important that the region of the heater contacting the back surface of the fabric be convex. If not, close contact between the back surface and heater cannot be obtained and the ejected fluid may enter therebetween, causing uneven heating to the fabric.

Each of the devices shown from Fig. 2 to 5 may be utilized singlely or repeatedly, or may be combined each other.

The greater the number of devices or number of repetitions, the better the evenness of the pile side surface and the wider the range of application of the invention.

The invention is suitably applied to fabrics provided with cut piles of a length from 0.5 to 5 mm. When shorter than 0.5 mm, dishevellment of the cut piles seldom occurs even in the wet heat process and so application of the invention is meaningless. On the other hand, when longer than 5 mm, it is difficult to straighten the dishevellment of the cut piles even with the invention, because the deformation of the cut piles may reach their free end portions.

The heater temperature utilized for the invention differs in accordance with conditions of the fabrics to be finished, such as the kinds of fibers composing the cut piles and heat careers thereof. It is, however, essential that the temperature be high enough to substantially plasticize the foot portion of the cut pile. Therefore, the heater temperature must be higher than the second order transition temperature of the fiber composing the cut pile, and, preferably, should be higher than the maximum temperature, which the cut pile experienced during the preceding processes.

Too low a heater temperature reduces the effectiveness of the fluid applied soon after. On the other hand, if the heater temperature is excessively higher than the second order transition temperature, the cut pile will deform to much, thereby stretching, crimping, or discoloring.

A heating temperature from 150°C to 220°C is preferable for cut piles composed of polyester fibers, from 120°C to 170°C for polyamide fibers, from 110°C to 170°C for polyacrylic fibers, and from 150°C to 220°C for triacetate fibers.

Since dry heat is utilized during the heating process, the fabric to be finished does not have to be in the dry condition and can be dried at the same time as the heating process.

The nozzle is preferably provided with a slit-like outlet and is connected to a high pressure fluid source. The nozzle may have a fixed ejecting direction outlet. However, it is preferable that the ejecting direction be adjustable in accordance with the conditions of the fabric to be finished, such as the length of the cut pile, degree of dishevellment, and treating speed. Also, the nozzle should be disposed close to said heater for rapid cooling of the fabric and for greater compactness.

Since, in the case of Figs. 1 and 2, the running direction of the fabric is turned acutely just behind the heater, the used fluid, in spite of having been applied directly to the pile side surface, can pass rapidly out of the processing area and has no affect on the heater temperature or the position of the just straightened cut piles. In the case of Figs. 4 and 5, of course, it is apparent that the used fluid can pass away easily.

Figure 7 shows the shape of the resultant cut pile (51a) achieved by means of the invention. Figure 8 shows cut pile (51b) obtained by a conventional finishing process in which a pile is first heated directly with hot air, then cooled with cooling air. One of the main differences appears in the free end portion (52a) and (52b) of the cut piles (51a) and (51b). In the present invention, filaments (53a) composing the cut pile are fully separated into individual fibers and stand upright from a ground (54). Contrary to this, in the conventional process, filaments (53b) are bent at the foot portion (55) and are crossed with each other as well as being deformed at the free end portions (52b) thereof. As a result, the former shows a much better evenness in appearance than the latter.

Figure 6 shows a preferred arrangement according to the invention. The arrangement is a combination of the devices shown in Figs. 2 and 4. The same reference numerals are used in Fig. 6 as in Figs. 2 and 4.

The fabric (50), having been treated in dyeing process, is fed from a rolled package (60) to a spreading plate (10), utilized for removing wrinkles from the fabric, a feed roll (11), tension rolls (12), (13), a guide roll (14), and first arcuate heater (1a).

The fabric (50) is in contact with the first heater (1a) such that the back surface of the fabric closely faces the heater surface. During the process, the foot portion of the cut pile, which has been deformed by actions exerted during the dyeing process, are raised to a temperature to plasticize themselves. A nozzle (3a) disposed at the rear end of the heater (1a) ejects cooling air of a lower temperature than that of the heater (1a) to the pile side surface of the fabric (50) just at the turning point of the fabric running direction. The air is ejected in the direction along the fabric to make the cut pile stand upright.

As a result, the filaments composing the cut pile are individually separated and straightened. At the same time, they are set in the shape as they are. The fabric (50) is then advanced via guide rolls (15), (16) to a second arcuate heater (1c) for heat treatment. Next, it is subjected to cooling air ejected from a nozzle (3c) disposed beneath the path of the fabric. The cooling air passes through the back surface to the pile side surface of the fabric and has the same effects on the cut pile as nozzle (3a).

The air ejected from the nozzles (3a) and (3b) is supplied from a compressor (20) through a pipe (21) and control valves (22) and (23).

Finally, the fabric is guided to a swing roll (17) utilized for lowering the fabric orderly in a carrier (18).

In this arrangement, a combination of two different type devices is employed. However, there are many combinations other than the arrangement shown in Fig. 5. For example, it is possible to combine two same type devices or more than two devices of any type.

Other effects of the invention will be apparent in referring to the examples disclosed hereafter.

[Example 1]

Two kinds of gray fabrics having 3 mm and 5 mm length pile respectively were prepared with a 22G double raschel machine using polyester fiber filaments of 50 d/48 f as a ground component and polyacrylic fiber filaments of 100 d/120 f as a pile component.

The fabrics were introduced into a jet dyeing machine. First, the polyester fiber part was carrier-dyed, then the polyacrylic part was dyed. After being squeezed with a mangle, they were padded with a liquid containing a cationic softener in a ratio of 10 g/ℓ and were dried and tentered with a pintenter at a temperature of 120°C. Finally they were rolled up on a core.

Cut piles on the resultant fabrics were randomly tilted and dishevelled.

The fabrics were introduced to the arrangement shown in Fig. 6 and were finished at a rate of 4 m/min under the following conditions:

Temperature of first heater (1a):	150°C
Temperature of cooling air from first nozzle (3a):	40°C
Angle of ejection to pile side surface:	45°
Flow rate of cooling air:	approx. 1.5 m^3/min
Temperature of second heater (1c):	150°C
Temperature of cooling air from second nozzle (3c):	40°C
Angle of ejection to back surface:	60°
Flow rate of cooling air:	approx. 2.5 m^3/min

Both final fabrics obtained had upright standing cut piles with individual filaments separated fully from each other from the foot portion to the free end portion. As a whole, the fabrics had a soft touch and good velvet-like appearance both in evenness and in shade on the pile side surface.

[Example 2]

An gray fabric of 2 mm length pile was prepared with a pile loom using polyester fiber filaments of 50 d/12 f as a ground component and of 50 d/24 f as a pile component. The fabric was carrier-dyed with a jet dyeing machine, and was padded with a liquid containing antistatic agent in a ratio of 10 g/ℓ. After being dried and rolled up, the fabric, having dishevelled piles, was introduced into an arrangement, according to the invention, combining the devices shown in Figs. 3 and 5, in that order.

The fabric was finished at a rate of 3 m/min under the following conditions:

Temperature of heaters (1b), (1d): 180°C

Temperature of cooling air from nozzles (3b), (3d): 20°C

Flow rate of cooling air: 2 m^3/min

The resultant fabric had upright standing cut piles with individual filaments separated fully from each other from the foot portion to the free end portion. As a whole, the fabric was a high class velvet-like fabric good in appearance due to apparent denseness of the cut piles.

For comparison, the same prefinishing fabric as stated in example 2, was prepared. The fabric was treated separately by two different conventional processes. One was the process usually utilized for finishing rayon velvet, which comprises repeated brushing and shearing. The other comprises ejection of hot air from the nozzle shown in Fig. 2 directly to the pile side surface of the fabric.

The fabric according to the former process had tilted cut piles with deformed free end portions. The fabric according to the latter process had cut piles, with crossed individual filaments and deformed free end portions.

[Example 3]

An gray fabric of 3 mm length pile was prepared with a 22G double raschel machine using polyester fiber filaments of 50 d/48 f as a ground component and polyacrylic fiber filaments of 150 d/60 f as a pile component.

The fabric was introduced into a jet dyeing machine. First, the polyester fiber part was carrier-dyed, then, the polyacrylic fiber part was dyed. After being aqueezed with a mangle, it was padded with liquid containing a cationic softener in a ratio of 10 g/ℓ and was dried and tentered with a pintenter at a temperature of 120°C. Finally the fabric was rolled up on a core.

Cut piles on the resulted fabric were randomly tilted all over the surface.

The fabric was introduced into the device shown in Fig. 2 and was finished at a rate of 4 m/min under the following conditions:

Temperature of the heater (1a):	150°C
Temperature of cooling air from nozzle (3a):	40°C
Angle of ejection to pile side surface:	45°
Flow rate of cooling air:	2 m^3/min

For comparison, the same prefinished fabric as treated in example 3 was treated by a conventional process in which hot air was ejected from a nozzle directly to the pile side surface. The resultant fabric had cut piles with free end portions crimped by the heat from the hot air. In addition, the conventional process was very difficult to control in terms of operating conditions, such as ejecting pressure relating to the ejecting direction of the hot air, and was uneconomical due to its high heat-consumption.

[Example 4]

Four gray fabrics of 1, 3, 5, and 7 mm pile lengthes, respectively were prepared with a 22G double raschel machine using polyacrylic fiber filaments of 100 d/120 f as pile components and polyester fiber filaments of 50 d/48 f as ground components. The fabrics were introduced into a jet dyeing machine. First, the polyester fiber parts were carrier dyed, then, the polyacrylic fiber parts were dyed. After squeezing, they were padded with a liquid containing a cationic softener in a ratio of 10 g/ℓ, and were dried with a pintenter at a temperature of 120°C. Finally, they were rolled up on a core. All of the resultant fabrics had tilted cut piles. The fabrics were supplied to the device shown in Fig. 4 and repeatedly processed three times according to the invention at a rate of 4 m/min under the following conditions:

Temperature of heater (1c): 150°C

Temperature of cooling air
from nozzle (3c): 40°C

Angle of ejection to back

surface: 45°

Flow rate of cooling air: 2 m^3/min

All the resulting fabrics except that having 7 mm length pile showed splended surface effects and touch just like chiffon velvet. The exception had an appearance inferior to the three other fabrics due to the diffused reflection from the pile side surface caused by the slight dishevellment of the free end portions of its cut piles.

[Example 5]

A gray fabric of 2 mm length pile was prepared with a velvet loom using triacetate fiber filaments 120 d/55 f as a pile component and polyester fiber filaments 50 d/48 f as a ground component. The fabric was dyed with a jet dyeing machine, padded with a liquid containing antistatic agent in a ratio of 10 g/ℓ, and was dried with a pintenter.

The fabric thus obtained had cut piles tilted down on the surface randomly. It was introduced into the arrangement shown in Fig. 6 and was finished at a rate of 4 m/min under the following conditions:

Temperature of first heater (1a): 170°C

Temperature of cooling air from first nozzle (3a): 20°C

Angle of ejection to pile side surface: 45°

Flow rate of cooling air: 2 m^3/min

Temperature of second heater (1c): 170°C

Temperature of cooling air from second nozzle (3c): 20°C

Angle of ejection to back surface: 60°

Flow rate of cooling air: 3 m^3/min

As the resultant fabric was not satisfactory, the same finishing process was repeated once more whereby the desired product was obtained.

CLAIMS

1. A process for finishing a velvet-like fabric provided with a plurality of cut piles composed of thermoplastic fiber filaments, said cut piles being tilted randomly on a surface of said fabric, in which the back surface of said fabric is brought closely into face to face contact with a heater until foot portions of said cut piles are plasticized and in that immediately thereafter, a fluid having a temperature lower than that of said heater is ejected onto said cut piles along a direction to make said cut piles stand upright.

2. A process according to claim 1, in which said fluid is ejected directly onto the pile side surface of said fabric.

3. A process according to claim 1, in which said fluid is ejected onto the back surface of said fabric.

4. A process according to any one of claims 1, 2, and 3, in which any of said processes described in claims 1, 2, and 3 is repeated at least twice.

5. A process according to any one of the preceding claims, in which said fluid is air.

6. A process according to any one of the preceding claims, in which said cut piles have a length from 0.5 to 5mm.

7. A process according to any one of the preceding claims, in which said filaments are composed of a plurality of single filaments thinner than 1.0 denier.

8. A process according to any one of the preceding claims, in which said thermoplastic fiber filament is polyacrylic filaments.

9. A process according to any one of the preceding

claims, in which said fabric has been treated in a wet heating process.

10. An apparatus utilized for the process according to claim 1, comprising a heater provided with a convexed contact surface, a nozzle for ejecting said fluid disposed just behind a rear end of said heater, both said heater and said nozzle being arranged along a path of said fabric, and means for introducing said fabric into said path.

11. An apparatus according to claim 10, in which said nozzle is disposed above said path.

12. An apparatus according to claim 10, in which said nozzle is disposed beneath said path.

13. An apparatus according to any of claims 10, 11, and 12, in which more than two combinations of any of said heater and said nozzle described in claims 10, 11, and 12 are disposed in series.

14. An apparatus according to any of claims 10 to 13 in which said heater is an arcuate heater.

15. An apparatus according to any one of claims 10 to 13 in which said heater is a roll heater.

16. An apparatus according to any one of claims 10 to 15 in which said nozzle has a slit-like outlet.

17. An apparatus according to any one of claims 10 to 16 in which said nozzle is adjustable as to its ejecting direction.

18. A velvet-like fabric finished with a process and an apparatus claimed in any of the preceding claims.

Fig. 1

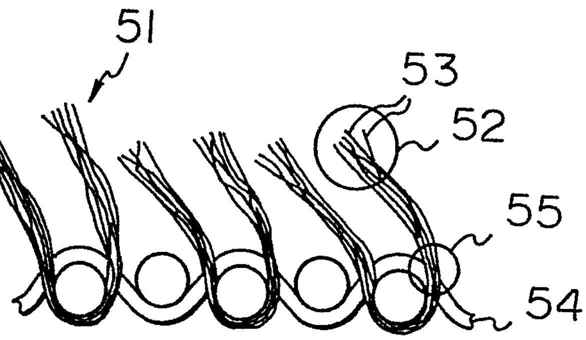

Fig. 2 A

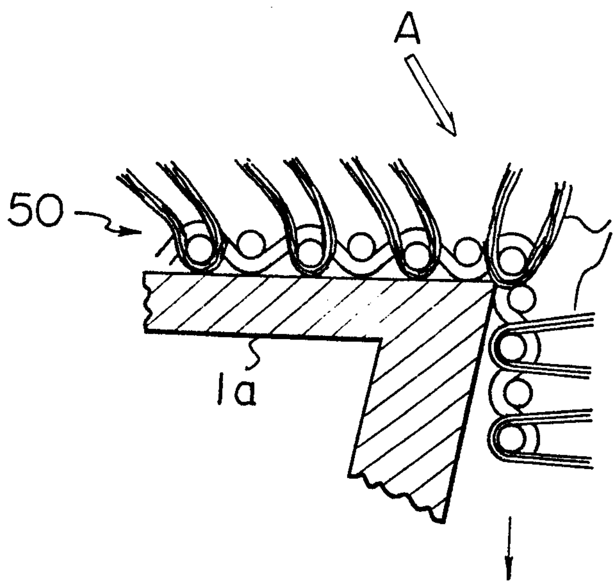

Fig. 2

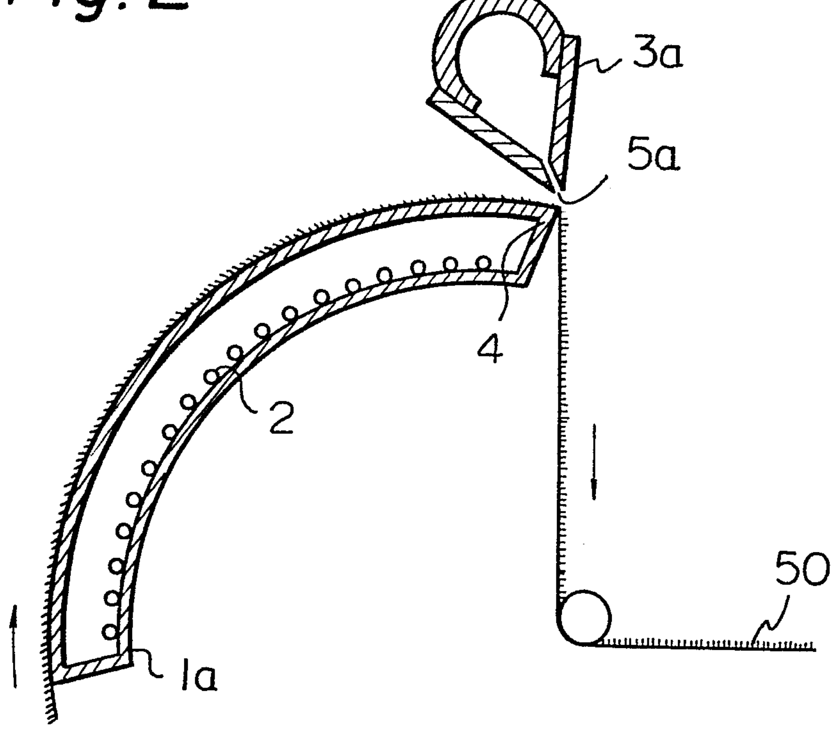

Fig. 3

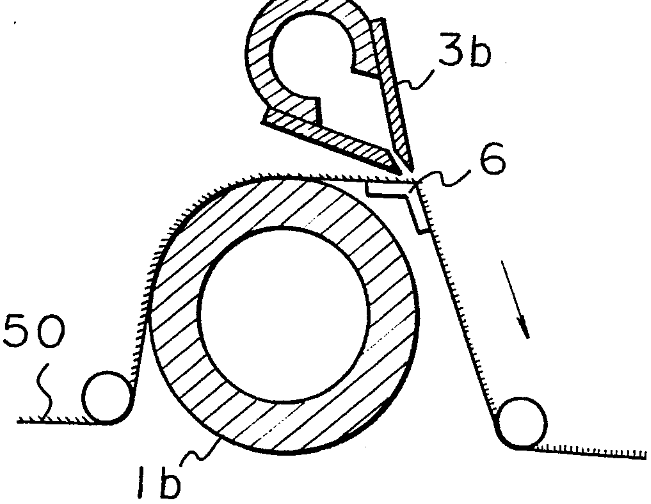

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Fig. 4

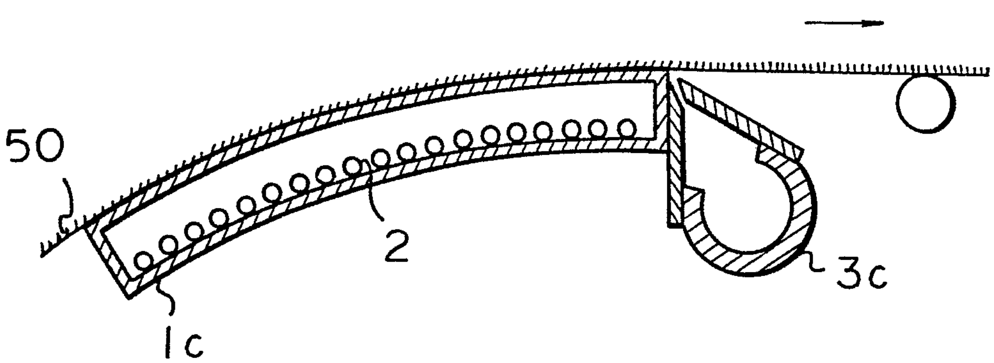
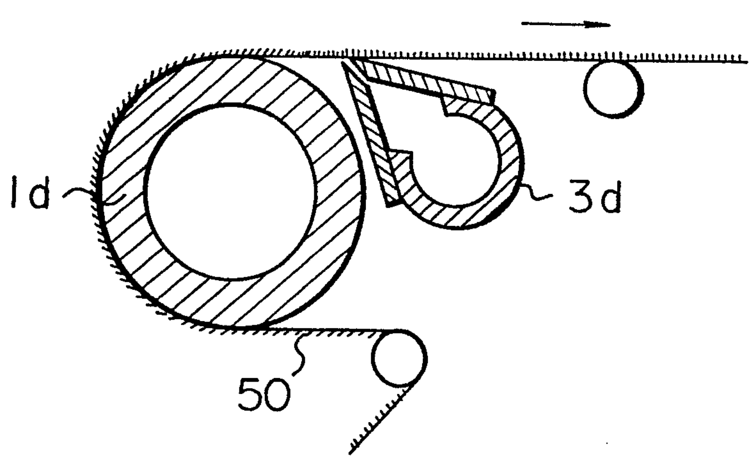


Fig. 5



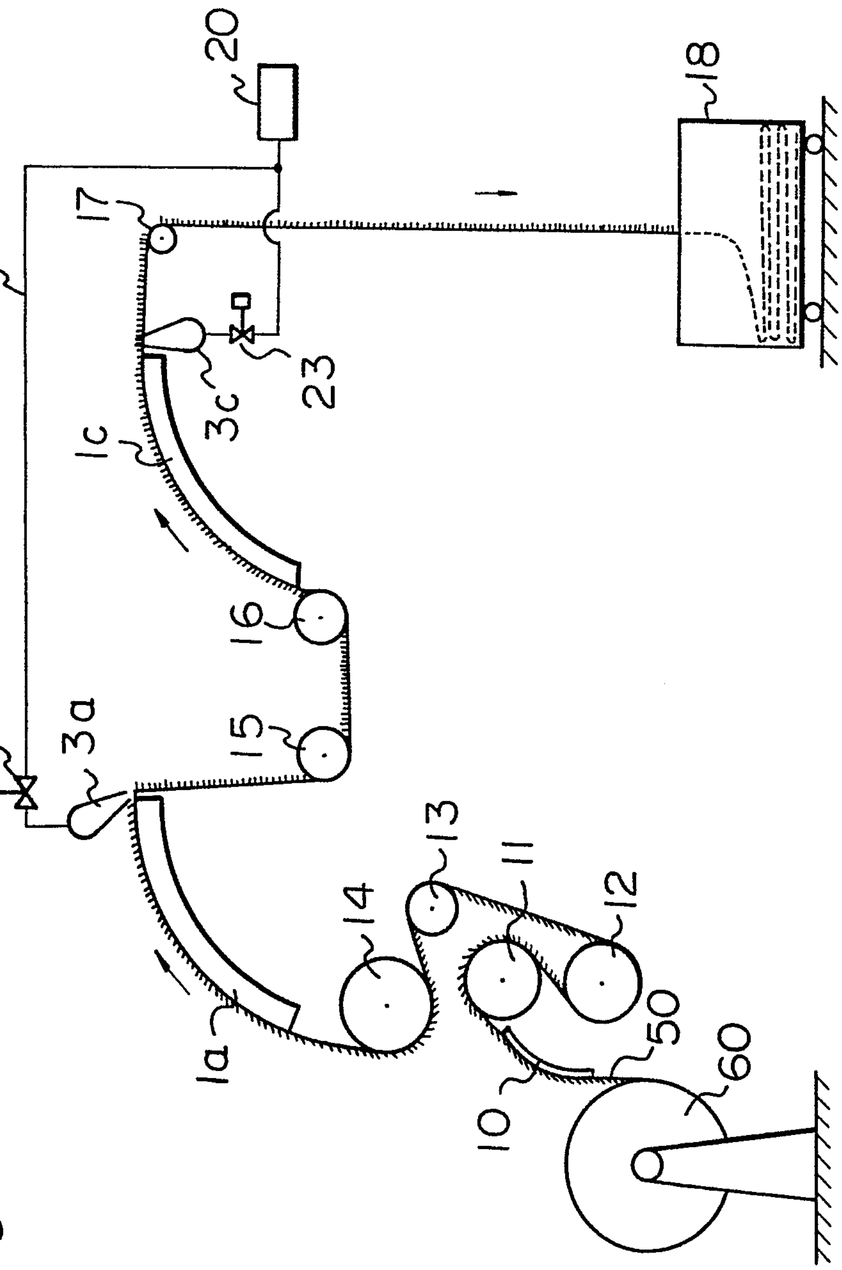


Fig. 6

Fig. 7

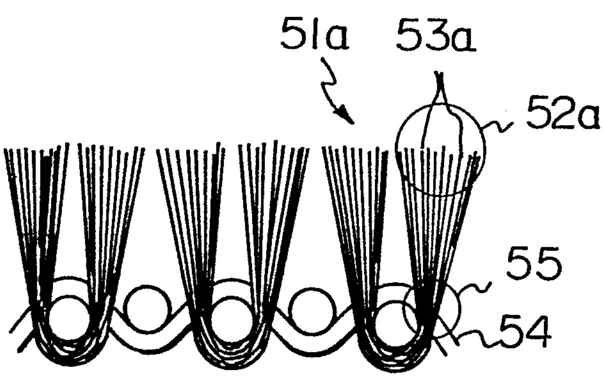
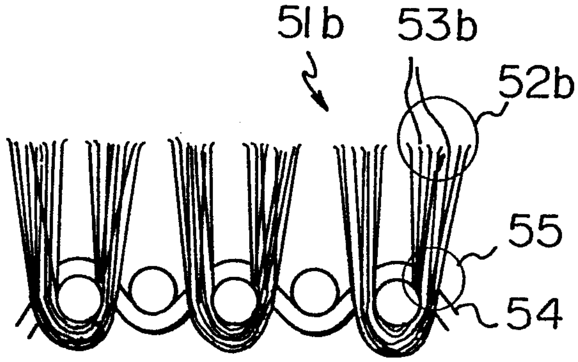


Fig. 8



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European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 82 30 2214

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
X	DE-A-3 031 665 (SISTIG) *The whole document*	1,4,8, 10,14	D 06 C 11/00
A	US-A-4 301 577 (BIGELOW-SANFORD)		
A	GB-A-1 380 071 (LAMBEG)		
A	FR-A-2 299 445 (CRAYE)		
A	FR-A-2 123 981 (BOSCH BALLETBO)		
A	FR-A-2 451 415 (ASTIN)		TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
A	FR-A- 826 390 (SONNINO)		D 06 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21-12-1982	PETIT J.P.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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