(1) Publication number:

0 070 708 A2

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EUROPEAN PATENT APPLICATION

21 Application number: 82303748.6

(51) Int. Cl.3: D 21 F 1/00

② Date of filing: 16.07.82

30 Priority: 17.07.81 US 284236

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- 43 Date of publication of application: 26,01.83 Bulletin 83/4
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- Paper-making belts of fused polymeric filaments.
- 57 A woven paper-making belt in which the filaments in at least one of the machine and transverse directions are coextruded monofilaments.

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TITLE

PAPER-MAKING BELTS OF FUSED POLYMERIC FILAMENTS BACKGROUND OF THE INVENTION

In the preparation of paper, woven support

5 belts are used for the initial casting and subsequent
treatment of the paper. These belts are known as
paper clothing. A variety of materials has been used
in the manufacture of such belts, including metals
and, more recently, thermoplastic monofilaments and
10 multifilaments.

While paper-making belts of thermoplastic materials have provided a number of advantages, paper clothing prepared from thermoplastic materials occasionally exhibits poor dimensional stability and 15 high water absorption. Various techniques have been suggested for the improvement of dimensional stability, including the use of thermoplastic monofilaments having different degrees of orientation in the machine and transverse directions or the use 20 of multifilaments having exceptionally high modulus of elasticity. However, previously suggested combinations of materials and filament configurations have not fully satisfied the need for paper clothing having excellent dimensional stability and low water 25 absorption and which is easily cleaned after long-term operation.

SUMMARY OF THE INVENTION

The instant invention provides, in a woven, heat set, paper-making belt of machine and transverse direction thermoplastic filaments, the improvement wherein the filaments in at least one of the machine and transverse directions are coextruded monofilaments having a core of a polymer selected from nylon 66; polyethylene terephthalate; and a tetrapolymer of tere- and iso- phthalic acids,

1,4-butane diol, and polytetramethylene ether glycol and a sheath of a polymer selected from the group consisting of nylon 11; nylon 12; nylon 6; nylon 610; nylon 612; polybutylene terephthalate; and a

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tetrapolymer of tere- and iso- phthalic acids,
l,4-butane diol, and polytetramethylene ether glycol
wherein the sheath is adhered to the core and has a
melting point at least about 25 Celsius degrees lower
than the core, and wherein the machine and transverse
direction filaments are bonded together at the
intersections of the filaments by the substance of at
least one of the filaments.

DETAILED DESCRIPTION OF THE INVENTION

The monofilaments used in at least one

15 direction in the woven structures of the present
paper clothing are coextruded structures having a
sheath and a core. These monofilaments are prepared
by conventional coextrusion techniques, as described,
for example, in U.S. Patent 2,936,482, hereby

20 incorporated by reference.

The materials which can be used for the core of the monofilaments include polyhexamethylene adipamide (nylon 66), polyethylene terephthalate and a tetrapolymer of tere- and iso- phthalic acids, 1,4-butane diol and polytetramethylene ether glycol preferably containing less than 50 weight percent of the

Polymers which can be used for the sheath component of the monofilaments include polyundecanoamide (nylon 11), polydodecanoamide (nylon 12), polycaprolactam (nylon 6),

resulting butane diol terephthalate.

polyhexamethylene decanoamide (610 nylon),
polyhexamethylene dodecanoamide (nylon 612),
polybutylene terephthalate, and a tetrapolymer of

35 tere- and iso- phthalic acids, 1,4-butane diol and

polytetramethylene ether glycol wherein the resulting butane diol terephthalate preferably comprises about from 70 to 90 weight percent of a tetrapolymer.

The tetrapolymers of the terephthalic acids, polytetramethylene ether glycol, and 1,4-butane diol which can be used for the core and the sheath can be prepared according to the teachings of Witsiepe, U.S. Patents 3,651,014 and 3,763,109, respectively, both of which are hereby incorporated by reference.

10 The sheath component of the monofilament must be adhered to the core. In this regard, certain combinations of sheath and core polymers are well suited for the preparation of a monofilament characterized by excellent adhesive bonding between 15 the sheath and core. These combinations include nylon 11 with either nylon 66 or polyethylene terephthalate; nylon 12 with either nylon 66 or polyethylene terephthalate; nylon 6 with nylon 66; nylon 610 with nylon 66; nylon 612 with either nylon 20 66 or polyethylene terephthalate; the terephthalic acid tetrapolymers with each other or with polyethylene terephthalate; and polybutylene terephthalate with polyethylene terephthalate. sheath material should be selected to provide a final 25 structure in which the polymeric sheath has a melting point at least about 25 Celsius degrees below the melting point of the core polymer.

Particularly desirable combinations of polymers in the instant invention include a core of nylon 66 with a sheath of nylon 11, a core of nylon 66 with a sheath of nylon 612, and a core of either polyethylene terephthalate or the terephthalic acid terpolymer with a sheath of terephthalic acid tetrapolymer high in butane diol terephthalate.

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The relative concentration of sheath and core polymers in the monofilament can vary widely. However, to fully realize the benefit of relatively low water absorption by the sheath polymer, it should comprise at least about 5% by weight of the monofilament, and can comprise up to about 50% of the total weight of the monofilament. For ease of operation, the sheath preferably comprises at least about 10% by weight of the monofilament.

After extrusion and quenching of the monofilaments, they should be oriented about from 3.4 to 6.0 times their original length, and preferably about from 3.5 to 4.75 times their original length to increase the monofilament strength. The

15 monofilaments generally have a diameter of about from 6 to 32 mils (0.15-0.81 millimeter).

one or both of the machine and transverse directions of the paper-making belts. When used in only one direction, it is preferred that the coextruded monofilaments make up the transverse, or fill, direction filaments. Other filaments which can be used for the machine, or warp, direction are polymeric homogenous monofilament or multifilament.

The coextruded monofilaments can be used in

25 Polymeric resins which can be used in such filaments include poly(metaphenylene diamine isophthalamide), polyethylene terephthalate, nylon 6, nylon 66, polybutylene terephthalate, polyhexamethylene adipamide, and polyacrylonitrile.

The filaments are woven into paper-making belts according to conventional weaving techniques. The type and density of the weave will, of course, depend on the type of paper and paper-making operation for which the belt is to be used. After weaving, the belts are heat set to stabilize the

weave and fuse the monofilaments at their intersections by melting or softening of the sheath polymer of the coextruded monofilaments. The sheath polymer will fuse to similar sheath polymers if a 5 coextruded monofilament is used in both directions of the weave, or to the homogenous monofilament or multifilament used in the machine direction of the weave. Specific conditions for such annealing or fusing will, of course, vary with the polymer, 10 filament geometry and weave, but will typically involve heating under tension for about from 15 minutes to 1 hour at a temperature of about from 150 to 235°C. Typically a hot air oven or radiant heaters are used for the heating. Fusion of the 15 intersections of the filaments in this manner eliminates the need for the immersion of a woven belt

in a separate resin for stabilizing the weave. Resin

treatment can, of course, be included for other

purposes, if desired.

20 The paper-making belts of the present invention exhibit excellent dimensional stability and performance characteristics. The core materials of the monofilaments provide the strength necessary for long-term operation of a paper-making belt while the lower melting sheath components not only fuse to stabilize the weave of the belt but may also reduce the amount of water absorption by the belt in operation. Moreover, the monofilamentary structure exhibits less tendency to pick up debris in operation, and, when the belt does become fouled, it is easier to clean.

The present invention is further illustrated by the following specific example.

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EXAMPLE

Monofilament was melt extruded on a coextrusion apparatus with a core of nylon 66 and a sheath of nylon 612, and oriented by stretching about 4.0% in a radiant oven at a temperature of 600°C. The filament was then relaxed in a second radiant oven at 600°C to control shrinkage. The oriented monofilament had a diameter of 20 mils.

A paper-making belt was woven using the monofilament in the fill or transverse direction. The longitudinal or machine direction filaments were poly (methaphenylene diamine isophthalamide) multifilaments of 1200 denier. The filaments in the woven belt were fused at their intersections by heating the belt to a temperature of 232°C to effect bonding. The resulting woven belts were evaluated and found to exhibit outstanding performance characteristics for paper-making operations.

BAD ORIGINAL

CLAIMS:

- 1. A woven, heat set, paper-making belt of machine and transverse direction thermoplastic filaments, characterised in that the filaments in
- 5 at least one of the directions machine and transverse are coextruded monofilaments having a core of a polymer selected from nylon 66; polyethylene terephthalate; and a tetrapolymer of tere- and isophthalic acids, 1,4-butane diol and
- 10 polytetramethylene ether glycol and a sheath of a polymer selected from the group consisting of nylon 11; nylon 12; nylon 6; nylon 610; nylon 612; polybutylene terephthalate; and a tetrapolymer of tere- and iso- phthalic acids, 1,4-butane diol and
- 15 polytetramethylene ether glycol wherein the sheath is adhered to the core and has a melting point at least about 25 Celsius degrees lower than the core, and wherein the machine and transverse direction filaments are bonded together at the intersections of the filaments by the substance of at least one of the
- 20 the filaments by the substance of at least one of the filaments.
 - 2. A paper-making belt as claimed in claim 1 wherein the core of the monofilament is nylon 66 and the sheath of the monofilament is nylon 612.
- 25 3. A paper-making belt as claimed in claim 1 wherein the core of the monofilament is nylon 66 and the sheath of the monofilament is nylon 11.
- 4. A paper-making belt as claimed in claim 1 wherein the core of the monofilament is nylon 66 and the 30 sheath of the monofilament is nylon 12.
 - 5. A paper-making belt as claimed in claim 1 wherein the core of the monofilament is polyethylene terephthalate and the sheath of the monofilament is a tetrapolymer of tere- and iso- phthalic acids,
- 35 1,4-butane diol and polytetramethylene ether glycol

wherein the resulting butane diol terephthalate comprises about from 70 to 90% of the tetrapolymer.

- 6. A paper-making belt as claimed in any one of the preceding claims wherein the sheath of the 5 monofilament comprises about from 5 to 50% by weight of the total monofilament.
 - 7. A paper-making belt as claimed in claim 6 wherein the sheath of the monofilament comprises at least about 10% by weight of the monofilament.
- 10 8. A paper-making belt as claimed in any one of the preceding claims wherein the monofilaments in the transverse direction of the belt are coextruded monofilaments.