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(54) **Yarn.**

(57) A radio-opaque yarn comprises a core yarn of filaments containing a radio-opaque filler wrapped with a wrapping yarn having a lower decitex than the core yarn. The core yarn is held in a wavy configuration by the wrapping yarn. Such a yarn is produced by twisting a wrapping yarn around core filaments containing a radio-opaque filler in wrapping means, the core filaments being overfed through the wrapping means by 2 to 100%.

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YARN

This invention relates to radio-opaque yarn, that is yarn opaque to x-rays. Such radio-opaque yarn is included in a surgical swab as a tracer yarn which can be identified by x-rays. For example a woven swab can contain one or more warp yarns of the radio-opaque yarn.

EP-A-154,423 discloses a radio-opaque yarn comprising a bundle of fibres filled with at least 54 per cent by weight barium sulphate, the bundle being bound with up to 20 per cent by weight of a substantially unfilled fibre.

EP-A-101,650 discloses a radio-opaque fibre comprising polypropylene, a coupling agent and 55 to 70 per cent by weight of barium sulphate.

GB-A-1,499,471 discloses a surgical swab comprising a sheet of absorbent fabric and a radio-opaque elongate element bonded to fibres in the fabric. The elongate element varies in width or in thickness or both along its length. The swab is produced by extruding a monofilament of thermoplastic material containing a radio-opaque filler onto a moving web of absorbent fabric and compressing filament bonded to fibres in the fabric. The compression is carried out in such a way as to impose on the filament a repeated pattern of variations in width and/or thickness.

GB-A-839,718 discloses a surgical dressing incorporating a flexible radio-opaque element which consists of a flexible strand which is loaded with radio-opaque material and has a smooth external surface combined with a flexible strand which wraps around the smooth-surfaced strand to reduce the liability of the strand to being pulled out of the dressing.

A radio-opaque yarn according to the present invention comprises a core yarn of filaments containing a radio-opaque filler, the core yarn being wrapped with a wrapping yarn having a lower decitex than the core yarn, and is characterised by the improvement that the core yarn is held in a wavy configuration by the wrapping yarn.

The wavy configuration of the core yarn gives a more distinctive image when viewed under x-rays than a straight yarn does. By a wavy configuration for the core yarn we mean that the core yarn is laterally displaced from its longitudinal axis, i.e. its general longitudinal direction, at substantially regular intervals along its length. The configuration of the core yarn can for example be a rounded wave pattern such as a sinusoidal wave or a zig zag pattern with sharper bends in the yarn. The preferred lateral displacement of the core yarn from the longitudinal axis in the wavy configuration is at least half the thickness of the yarn, for example half to twice the thickness. The yarn should be held

in its wavy configuration sufficiently securely that it is not pulled straight under the tensions encountered in weaving.

A process according to the invention for the preparation of a radio-opaque yarn comprises twisting a wrapping yarn around core filaments containing a radio-opaque filler and is characterised in that the core filaments are overfed through the wrapping means by 2 to 100 per cent.

The radio-opaque filler is generally barium sulphate. The radio-opaque core yarn generally contains at least 54 per cent by weight, for example 55 to 75 per cent by weight, barium sulphate. The core filaments are preferably based on a thermoplastic fibre-forming polymer, for example a polyolefin such as polypropylene or polyethylene. Polypropylene is preferred; the core filaments may contain a coupling agent as described in EP-A-101,650, preferably a titanate ester coupling agent. Examples of such coupling agents are isopropyl tri-(isostearoyl) titanate, isopropyl tri-(dioctylpyrophosphato) titanate, isopropyl tri-(dioctylphosphato) titanate and isopropyl tri-(dodecylbenzene sulphonyl) titanate. The barium sulphate preferably has a particle size of not greater than 1 micron.

The core filaments are generally prepared by melt spinning, for example at a temperature in the range 170 to 230°C. The radio-opaque filler, for example barium sulphate optionally pre-treated with the coupling agent, is mixed with the thinner plastic fibre-forming material and extruded through a spinneret. The core filaments preferably have a thickness equivalent to a decitex of 25 to 500 decitex per filament, with a total decitex for the core yarn of 1000 to 10000, preferably 3000 to 5000. The core filaments may be undrawn or may be partially drawn, for example using the process described in EP-A-298,767. Although the core yarn should be a multi-filament yarn, the filaments may be partially fused, for example as described in EP-A-298,767 with respect to Figures 3 and 4. The core filaments can be twisted or interlaced if desired, for example to hold them as a coherent yarn on a package before wrapping.

The wrapping yarn is preferably of higher tenacity than the core yarn and is preferably a multifilament yarn, such as a polyester yarn, for example a polyethylene terephthalate yarn, having a total decitex of 50 to 200 and containing 20 to 40 filaments. A nylon yarn of similar decitex and number of filaments is an alternative. The wrapping yarn is preferably a twisted or interlaced yarn. The wrapping yarn can alternatively be a monofilament yarn, for example a polyester or nylon monofila-

ment yarn having a decitex of 100 to 500. The wrapping yarn is preferably substantially unfilled, although it may contain up to 25 per cent by weight of filler or pigment.

The wrapped yarn is formed by twisting the wrapping yarn around the core filaments. Wrapping can take place before the extruded core filaments are taken up on a package or the core filaments can be taken up and subsequently wrapped. In one preferred method of wrapping, the core filaments are fed through a rotating hollow spindle on which the wrapping yarn is mounted as a package. The wrapping yarn can for example be twisted around the core filaments at 2 to 10 turns per centimetre. The core filaments are overfed through the hollow centre of the spindle by 2 to 100 per cent, preferably 5 to 25 per cent. The input speed of the core filaments to the wrapping means is preferably controlled by tensioning means, for example nip rollers. The output speed of the wrapped yarn may be controlled by the take-up mechanism for the yarn but is preferably controlled by tensioning means, for example nip rollers, between the wrapping means and take-up. The wrapping yarn is preferably withdrawn from its package under tension so that its speed is controlled by the output speed of the wrapped yarn. It may be possible to feed the core filaments directly to the wrapping means without passing through a tensioning device, particularly if the core filament yarn is withdrawn from a stationary package and the tension required to withdraw the core filament yarn from this package is less than the tension required to withdraw the wrapping yarn from its package. In this case the degree of overfeed cannot easily be measured by comparing yarn speeds. The overfeed can, however, be measured in all cases by dividing the decitex of the wrapped yarn by the total decitex of the core filaments and the wrapping yarn, and subtracting 100 per cent. The periodicity of the lateral displacement of the core yarn is generally substantially the same as the periodicity at which the wrapping yarn is wrapped around the core yarn, for example if the wrapping yarn is applied at 4 turns per centimetre the periodicity of lateral displacement of the core yarn is about 2.5 millimetres.

The invention will now be described with reference to the single Figure of the accompanying drawing, which is a diagrammatic side elevation of an apparatus for the production of yarn according to the invention.

The apparatus comprises a rotatable hollow spindle 1 positioned between input tensioning nip rollers 2, 3 and output tensioning nip rollers 4, 5. A package 6 of wrapping yarn 7 is mounted on the hollow spindle 1.

The core filament yarn 8 is withdrawn from

package 9 by nip rollers 2, 3 passing through guides 11, 12. The nip rollers 2, 3 control the speed at which core filament yarn 8 is fed to hollow spindle 1. The spindle 1 is rotated so that yarn 7 is wrapped around core filament yarn 8 as it enters the hollow spindle 1. The output speed of wrapped yarn 13 from the hollow spindle is controlled by nip rollers 4, 5; the degree of overfeed of the core filaments can be calculated from the peripheral speeds of rollers 2, 3 and of rollers 4, 5. The yarn is then taken up on side wound package 14.

The invention is illustrated by the following Example.

Example

59 parts by weight barium sulphate and 1 part blue pigment and stabiliser were compounded with 38 parts polypropylene. The composition was granulated, dried and fed to a melt-spinning extruder and extruded at a melt temperature of 175°C through a spinneret having 40 holes, each of 1 millimetre diameter. The yarn produced had a decitex of 3800, a tenacity of 2.1 cN/tex and an initial modulus of 4.0 cN/tex at 100 per cent extension. The yarn was taken up on a package.

The yarn produced as described above was withdrawn from the package by nip rollers controlling the yarn speed at 70 metres per minute and fed through the centre of a hollow spindle on which was mounted a package of 74 decitex, 24 filament polyethylene terephthalate yarn. The spindle was rotated so that the polyethylene terephthalate yarn was wrapped around the filled polypropylene yarn. The output speed of the wrapped yarn was controlled by nip rollers at 64 metres per minute and the yarn was taken up at this speed. The polyethylene terephthalate yarn was wrapped around the filled polypropylene yarn at 3.6 turns per centimetre. The wrapping yarn, which was substantially unpigmented, was barely visible in the wrapped yarn. The wrapping yarn held the core yarn in a wavy configuration with a periodicity of about 2.8 millimetres between peaks at which the yarn was laterally displaced by about half its thickness. The wavy yarn had a decitex of 4200.

Claims

1. A radio-opaque yarn comprising a core yarn of filaments containing a radio-opaque filler, the core yarn being wrapped with a wrapping yarn having a lower decitex than the core yarn, characterised in that the core yarn is held in a wavy configuration by the wrapping yarn.

2. A yarn according to claim 1, characterised in that the core yarn is laterally displaced from its longitudinal axis by half to twice its thickness at substantially regular intervals along its length.

3. A yarn according to claim 1 or claim 2, characterised in that the core yarn comprises a thermoplastic fibre-forming polymer containing 54 to 75% by weight barium sulphate and has a total decitex of 1000 to 10000 and a filament decitex of 25 to 500 decitex per filament.

4. A yarn according to any of claims 1 to 3, characterised in that the wrapping yarn is a polyester or nylon multifilament yarn having a total decitex of 50 to 200 and containing 20 to 40 filaments or a polyester or nylon monofilament yarn having a decitex of 100 to 500.

5. A process for the preparation of a radio-opaque yarn comprising twisting a wrapping yarn around core filaments containing a radio-opaque filler in wrapping means, characterised in that the core filaments are overfed through the wrapping means by 2 to 100%.

6. A process according to claim 5, characterised in that the degree of overfeed of the core filaments through the wrapping means is 5 to 25%.

7. A process according to claim 5 or claim 6, characterised in that the core filaments are fed through a rotating hollow spindle on which the wrapping yarn is mounted as a package.

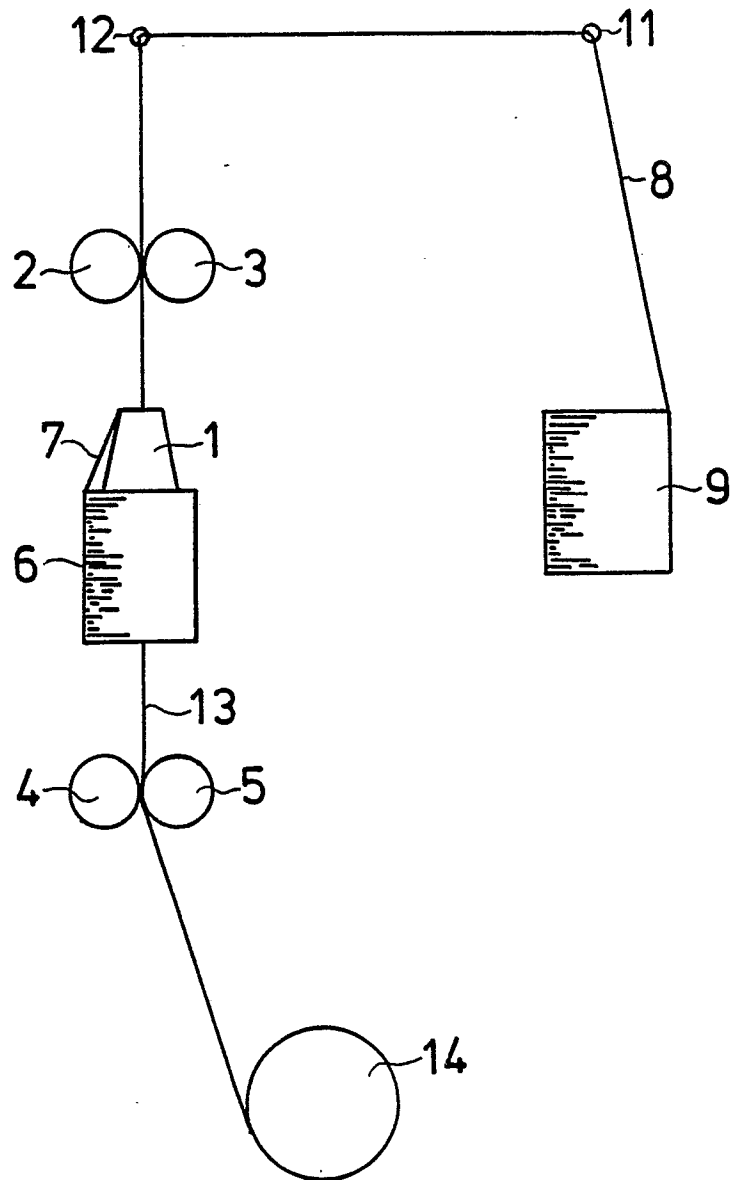
8. A process according to any of claims 5 to 7, characterised in that the output speed of the wrapped radio-opaque yarn is controlled by tensioning means positioned between the wrapping means and take-up mechanism for the yarn.

9. A process according to any of claims 5 to 8, characterised in that the input speed of the core filaments to the wrapping means is controlled by tensioning means.

10. A process according to any of claims 5 to 8, characterised in that the core filaments are withdrawn as yarn from a stationary package and fed to the wrapping means without passing through a tensioning device, the tension required to withdraw the core filament yarn from the package being less than the tension required to withdraw the wrapping yarn from its package.

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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.5)
A	Information technique of SUESSEN WST Le Fil Parallèle-Un fil marque de votre empreinte" No. 7.1-01001 F, 8.87, page 1, fig. 1 page 2, column 2, lines 1 to 8 ---	1, 2	D02G3/44 D02G3/38
A	MELLIAND TEXTILBERICHTE. vol. 67, no. 11, 01 November 1986, HEIDELBERG DE pages 774 - 777; J. Fischer: "Spinnsystem zur Herstellung von Parallelgarnen" * page 774, column 1, lines 39 - 46; figure 1 * ---	1, 2	
A	FR-A-2274714 (HOECHST AG.) * page 15, lines 1 - 33; figures 1-3 * -----	5, 7	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D02G
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 23 JANUARY 1990	Examiner HOEFER W. D.
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 & : member of the same patent family, corresponding document			