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EUROPEAN QUALIFYING EXAMINATION 2022

Paper C

Part 1

This paper contains:

Encrypted email from:
Ms M. Artha, iBalls Co., Ltd
Naples, Italy

To: Mr P. Eleh
Vertreterstr. 22
81830 Munich
Germany

Sent: 17 March 2022 09:00 hrs CEST per email
Subject: Opposition to EP 4 474 901 B1

Dear Mr Eleh,

We would like you to file a notice of opposition to European patent EP 4 474 901 B1 (Annex 1) on behalf of our company, iBalls Co., Ltd. We trust that the enclosed Annexes 2 to 6 will be of use to you in this regard.

As you know, we are close to the expiry of the time limit for filing an opposition. In addition to that, our server broke down this morning, so that we can currently only provide you with part of the patent to be opposed. We are therefore sending you what we have of Annex 1 (missing parts indicated). The remaining annexes attached to this email are complete. Once our server has been repaired (hopefully today), we will provide you with the full set of documents. We are sorry about the additional complication.

Yours sincerely,

Ms M. Artha for iBalls Co., Ltd

Enclosures:
Annex 1: EP 4 474 901 B1
Annex 2: Internet Newsletter from BrainTex AG
Annex 3: 12 Friends - The Modern Football Magazine
Annex 4: Slides (Conference on hybrid cord manufacturing)
Annex 5: US 2018/028635
Annex 6: EP 4 347 490 A1

(19) **Europäisches Patentamt**
European Patent Office
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(11) **EP 4 474 901 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:

18 June 2021 Bulletin 2021/06

(51) Int. Cl.[7] : **A03B41/08, A63B20/00**

(21) Application number: **20920105 .1**

(22) Date of filing: **25 January 2019**

(54) **Electronically detectable ball**
Elektronisch erkennbarer Ball
Ballon détectable électroniquement

(84) Designated Contracting States:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority:

-

(43) Date of publication of application:

25 July 2020 Bulletin 2020/32

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Description of the prior art

[0001] In ball games such as football or handball, the referee sometimes has to take controversial decisions about whether or not the ball has crossed the line into the goal.

[0002] To support referees, several electronic systems have been developed. What all these systems have in common is that they determine if the ball has crossed the goal line with the assistance of electronic devices and assist the referee in deciding to award a goal by indicating the detection result.

[0003] Currently, two basic technologies are employed for goal detection: optical systems which process images from a plurality of cameras, and systems measuring changes in electromagnetic fields.

[0004] The optical systems of the prior art are based on the principle of triangulation using images and timing data provided by several high-speed video cameras located at different locations and angles around the area of the goal. The system generates a graphic image of the path of the ball in the playing area. This means that information about the position of the ball on the playing field, such as the scoring of a goal, can be provided to the referee in near real time. However, these camera-based systems are expensive and encounter problems when the players come between the cameras and the ball.

[0005] Other systems of the prior art use the physical principle of electromagnetic induction. In such systems, a passive electronic circuit is incorporated into the ball. This passive electronic circuit comprises antennae attached to the inside of the segments of the ball's external covering, i.e. its "outer casing". If the ball crosses the goal line, this information is transmitted directly to the referee.

[0006] Because electromagnetic induction technology is less expensive than camera-based systems, it is also affordable at amateur level and is therefore becoming increasingly popular.

[0007] This technology, however, requires that the passive antennae be distributed uniformly across the ball's contour to provide a reproducible effect on the electromagnetic field. Footballs are subject to significant mechanical stress during use, causing the antennae to detach from the ball's external covering. This causes an increasingly uneven distribution of the antennae. Thus, such balls are not suitable for long-term use.

[0008] The present invention therefore proposes a new technology including a hybrid yarn, a method for producing the hybrid yarn and an electronically detectable ball.

Description of the invention

[0009] The features of the present invention are described by the independent claims and the claims dependent thereon.

Description of the embodiments

[0010] Figure 1 shows an intermediate product in the manufacturing process for a hybrid yarn for use under high mechanical stress conditions, such as for a ball.

[0011] Figure 2 shows a three-dimensional section of the electronically detectable ball according to the invention.

[0012] Figure 3 shows a goal with three transceivers for detecting the electronically detectable ball according to the invention.

[0013] Figure 1 shows a three-dimensional section of the elastic hybrid antenna yarn (1) for joining the segments of an electronically detectable ball before the yarn is chemically treated. This hybrid yarn (1) has an inner strand consisting of 1-5 elastic and chemically-resistant organic fibres (2) (e.g. polyester), which is enclosed by an intermediate layer of chemically-removable organic fibres (3) (e.g. polyamide). To obtain the hybrid antenna yarn (1), thin metal wires (4) are wound as an outer layer around the intermediate layer along its longitudinal axis, so that a twist is implemented. To preserve the legibility of the figure, only ten metal wires are shown.

[0014] For the thin metal wires, copper or its alloys combine good elasticity with excellent electrical conductivity and are therefore suitable to be used as antennae. We also tested other electrically-conducting and chemically-stable materials such as stainless steel, which has a significantly lower electrical conductivity (1.4×10^6 S/m compared with 58×10^6 S/m for copper). We found out that a hybrid yarn comprising at least 40 thin stainless steel wires of 25 µm diameter is needed to have a ball that produces detectable signals. Even then, however, signal strength is not sufficient to reliably indicate a goal.

[0015] If the hybrid yarn (1) is then exposed to a chemically aggressive solvent, the intermediate layer of chemically removable organic fibres (3) is dissolved and the core or inner strand of chemically resistant organic fibres (2) and the outer layer of thin metal wires (4) remain. This creates a structure having a void between the inner strand and the outer layer. This method of dissolving an intermediate layer has proven to be the most precise way of controlling the dimension of the void.

[0016] For any hybrid yarn to be used in high mechanical stress situations it is important to have a void with well-defined dimensions which are constant along the yarn's length. This allows to adapt and guarantee the yarn's elasticity and tensile strength. When the hybrid yarn is stretched, the outer layer of twisted thin metal wires (4) can elongate together with the elastic inner strand by changing its twist angle with respect to the longitudinal direction of the hybrid yarn. This structural elasticity during elongation is maintained until the outer layer comes into contact with the inner strand. The diameter and number of the chemically-resistant organic fibres (2) determine the size of the void, which together with the twist of the thin metal wires (4) determines the maximum elastic elongation of the hybrid yarn. An irregular void will cause an unpredictable behaviour of the hybrid yarn which may result in rupture even under low mechanical stress conditions.

[0017] For the solvent, a mixture of trifluoroacetic acid and acetone has shown to be a good compromise between chemical aggressivity and cost. We have tested mixtures comprising $^{2}/_{5}$ - $^{3}/_{5}$ by weight of trifluoroacetic acid, which all provided excellent solubility of the polyamide fibres.

PARAGRAPHS 18-22 NOT AVAILABLE IN PART 1

PARAGRAPHS

18 – 22

NOT AVAILABLE

IN PART 1

Claims

1. A hybrid yarn (1) for use under high mechanical stress conditions, such as for a ball (9) for a ball game, wherein the yarn (1) comprises an inner strand of chemically-resistant organic fibres (2) and a circumferential outer layer consisting of 10-20 thin electrically conductive metal wires (4), the thin electrically conductive metal wires (4) being twisted around the inner strand along the longitudinal axis of the yarn (1), whereby a void is formed between the inner strand and the outer layer by removal of material using a solvent.

2. Method for producing the hybrid yarn (1) according to claim 1, comprising the steps of
   a. providing an intermediate layer of polyamide fibres (3) around the inner strand of chemically-resistant organic fibres (2),
   b. twisting the thin electrically conductive metal wires (4) around the intermediate layer of polyamide fibres,
   c. chemically removing the polyamide fibres (3) by a treatment with a solvent consisting of 40-60 wt% of trifluoroacetic acid in acetone to provide a void between the inner strand and the thin metal wires.

CLAIMS 3-6

NOT AVAILABLE

IN PART 1

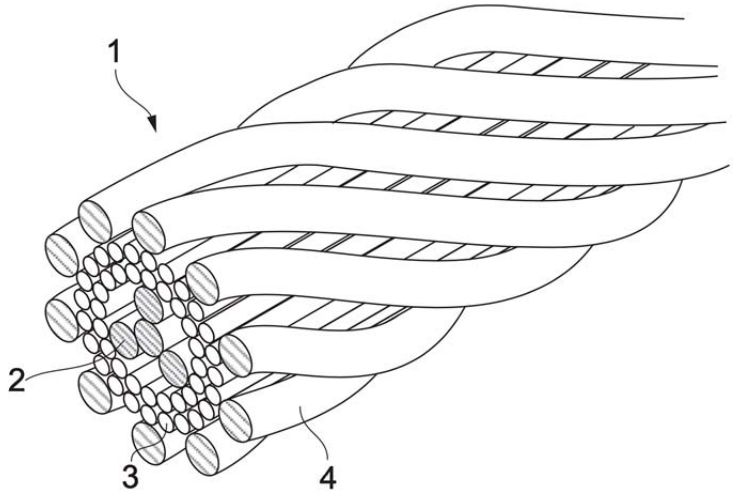


FIG. 1

FIG. 2

NOT AVAILABLE

IN PART 1

FIG. 3

NOT AVAILABLE

IN PART 1

Internet Newsletter from BrainTex AG, downloaded and printed out on 2 January 2022

Link:
https://archive.org/details/opensource?&and[]year=2016[]month=04[]day=11%and[]=subject%3A%22BrainTexNewsletter%22

BrainTex® Newsletter April 2016

BrainTex® has designed and created a full range of electromagnetic shielding garments which has been available on the market since the beginning of this year. The innovative material used for this product line consists of fabrics made of a hybrid polyester yarn having an outer layer of a plurality of metal wires of about 30 µm in diameter. These metal wires serve as passive antennae that interfere with electromagnetic waves such that the fabrics guarantee a high degree of protection against electromagnetic radiation.

The yarn is a hybrid (composite) yarn as it comprises organic polyester fibres and metal wires. We have called this yarn, which is suitable for a broad range of applications, “e(lectrical)po(lyester) yarn” or “epo® yarn”.

Apart from the electromagnetic shielding, we are convinced that there is great potential for our product in other applications which require the electronic detection of living beings such as humans or animals, or objects such as sports devices. In particular, sports devices are often subject to high mechanical stress due to dynamic deformation. Due to the use of polyester fibres and thanks to its construction, our yarn is lightweight, has controlled elasticity, and a high tensile strength compared with typical electrically conducting pure metal yarns such as copper yarns. Our yarn would therefore improve the durability of such devices.

Another application, already in pre-commercial development, is the BrainTex® Toddler series set. It can be used to detect whenever a small child strays further than allowed. The set comprises a romper suit made of BrainTex® fabric and a toddler detection system using a transceiver and a babyphone. The transceiver is an ultrahigh-frequency electromagnetic wave sending and receiving unit that is set up to create an electromagnetic field barrier. If the toddler passes that barrier, the transceiver detects a change in field strength. This is indicated by a flashing light on the display of our portable babyphone or by a buzzing noise. This means that you can carry the babyphone in your pocket.

For other applications, such as the detection of adults or objects, instead of using the fabric made from epo® yarn, it can be sufficient to use our epo® yarn to sew the different parts of the material together. This allows a wide range of natural materials to be used, e.g. cotton, silk or leather.

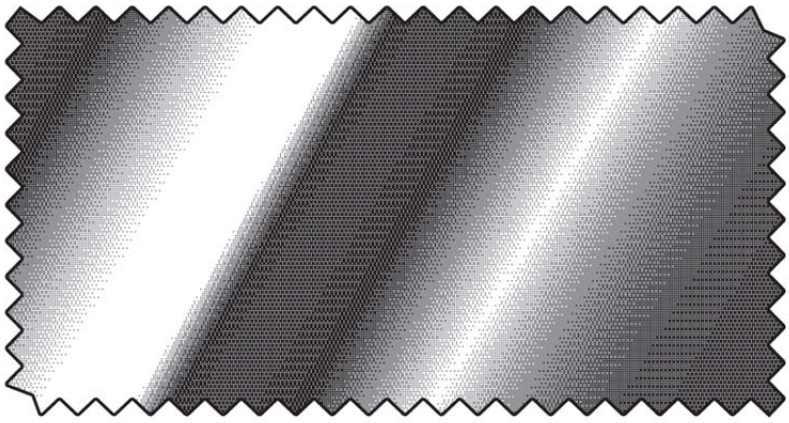


Figure: The new BrainTex fabric made from epo® yarn. The glossy appearance is attributed to the yarn's outer metal layer.

12 Friends - The Modern Football Magazine, Vol.2 02/2022

Last week we interviewed Ms Rachel Pinoe, the newly appointed technical lead of the Organizing Committee of the next men's Football World Cup. As readers will know, she had an amazing career as a professional football player, but now she also has a degree in engineering, so she could not be better qualified for the position. By way of a surprise, she brought along the new SmartDetect II® football, which has been designed for the tournament but which has not yet been presented to the public (see photo 1). We met in Melbourne, where the headquarters of the international football association is now located.

12 Friends: Thank you very much, Rachel, for bringing this new ball to show us. It has a classical appearance, with its external covering made from black and white leather panels.

Photo 1: High-tech in a classical casing: the SmartDetect II® football for the forthcoming Men's Football World Cup.

Rachel Pinoe: In recent years, bladderless balls with a seamless, synthetic casing have been popular, as they are cheaper to produce. However, there is now a clear trend towards returning to classical constructions with 20 white hexagon and 12 black pentagon leather panels and a bladder, as it has never been disputed that sewn balls provide optimum control and flight stability. In addition, this classical construction allows manufacturers to integrate some high-tech features that technically would not be possible using seamless synthetic materials or glued segments for the ball's casing.

12 Friends: That's interesting. So apart from the appealing retro design the engineers have packed some innovation into the product?

Rachel Pinoe: They have indeed. The ball is compatible with the standard electromagnetic goal detection technology used in most professional tournaments since 2010, when it was launched together with the first Vuwuseeler® ball.

12 Friends: OK, but this technology is already quite well established. So, what's new about the ball?

Rachel Pinoe: Before we come to the new ball technology, let's talk about the famous Vuwuseeler® balls (photo 2). The first model, introduced in 2010, was a classical hand-sewn one with a high-quality rubber bladder made from vulcanized natural caoutchouc. The innovation was that it included a passive antenna formed by a copper yarn. This metal yarn was used to sew the segments of the ball's outer casing, thereby creating a structure consisting of the segments and the yarn, with the yarn being evenly distributed on the ball's surface. The antenna coils produced in this way could interfere with an electromagnetic field generated by ultrahigh-frequency transceivers of a specific goal. These transceivers were integral parts of the two goal posts and the crossbar of the so-called "smart goal" launched simultaneously with the ball to provide an arrangement for electronic goal detection.

12 Friends: I remember that the first ball caused a lot of trouble for the manufacturer.

Rachel Pinoe: That's right. Many of these first Vuwuseeler® balls were returned to the manufacturer after just a few months, as the metal yarn had broken and the seams joining the ball's segments had ripped. The yarn was obviously unable to withstand the high mechanical stress resulting from the ball being kicked, due to the lack of tensile strength of the material.

12 Friends: Wasn't there even a product recall?

Rachel Pinoe: The manufacturer started a product recall and replaced all the balls with a modified second version. The second-generation Vuwuseeler® ball had a seamless casing with the passive electronic circuit formed by antenna coils glued to its inner surface. The seamless casing made it possible to have a bladderless construction which was standard at the time. The new technology using glued antenna coils allowed the manufacturer to recover from the consequences of the recall, which had almost forced them into bankruptcy.

12 Friends: And did this second-generation Vuwuseeler® ball prove to be sufficiently durable?

Rachel Pinoe: Well, when it first came out in 2011 it was phenomenally successful. It could be used together with a "smart referee" detection set which was launched at the same time. The set comprised three transceivers, one of which included a control and connectivity module. These transceivers could be removably attached to the frame of any existing goal using straps. The flexible design enabled a breakthrough of this technology at amateur level since the system could be easily fitted to any existing goal opening. Thus, unlike the first version, the otherwise technically identical system meant that it was not necessary to buy goals having an integrated detection system. However, during the years that the product was on sale, it became apparent that the second-generation Vuwuseeler® ball had a limited life span because goal detection became imprecise in the course of prolonged use.

12 Friends: Yes, we noticed that second-generation Vuwuseeler® balls often provided wrong indications when used for longer period, which is usual at amateur level.

Rachel Pinoe: Indeed, and the experts investigated that and found out that after a certain period of use the antenna coils became detached from the ball's casing and started to move freely inside the ball, which changed the ball's electromagnetic properties.

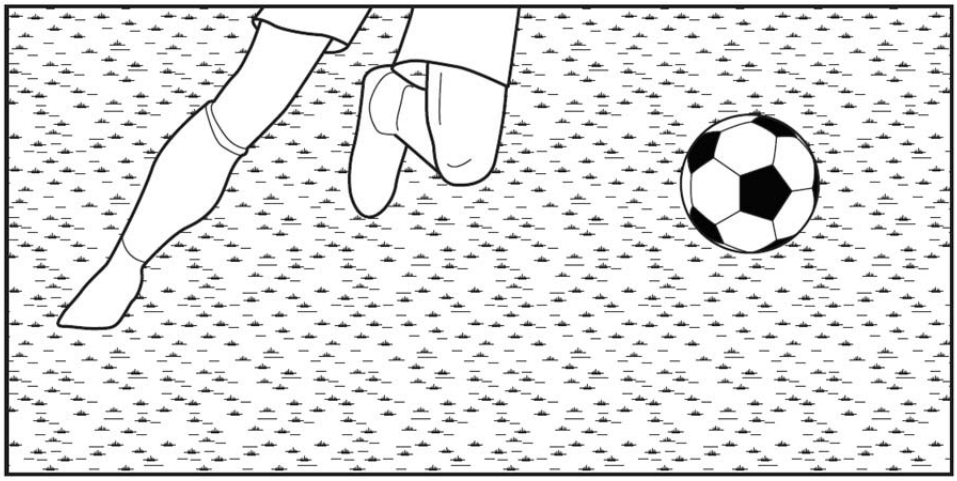


Photo 2: The first Vuwuseeler® ball as used in the 2012 South Africa tournament.

12 Friends: Ah, that's interesting. So the distribution of the electrical conductors forming the antenna coils is crucial to the technology?

Rachel Pinoe: Yes, it is. So, in the new technology, which has recently been patented by Sadida, GmbH & Co KG, the antenna is formed by a hybrid yarn comprising thin metal wire electrical conductors, which is used to join the casing's segments. As a result, an invariable distribution of the electrical conductors is achieved, while the yarn can better withstand mechanical stress.

12 Friends: That sounds innovative! What do the professional players say?

Rachel Pinoe: The manufacturer has conducted tests with a number of professional players, including Manuel Newone and Heinrich Stock. They all say that the new ball provides them with a ball control they have never experienced before. They can't wait for the World Cup.

12 Friends: And neither can we! By the way, do you have any tips, which team we should bet on?

Rachel Pinoe (smiling)**:** You want a tip? I'm afraid I'm not allowed to talk about odds for sports betting or other kinds of commercial issues because of my role on the Organizing Committee. But I can promise you, it has never been this close before.

Slides (Conference on hybrid cord manufacturing)

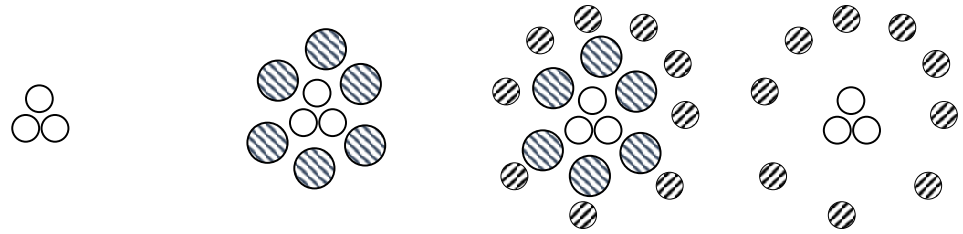
Institute for Cord Technology - Advanced Hybrid Cords – Slide 2

Step 1: chemically-resistant fibres are provided as the core.

Step 2: chemically-soluble fibres are twisted around the core.

Step 3: a further layer of chemically-stable fibres is twisted around the two layers.

Step 4: chemically-soluble fibres are removed[1]. A void is created.

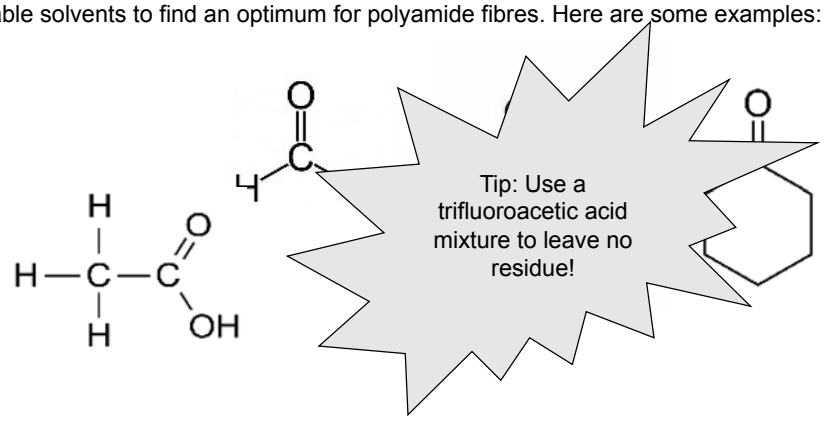


[1] We have found that polyamide is the best material to use as the chemically-soluble fibre, as it can be dissolved by several solvents. Therefore, if the cords are exposed to an aggressive solvent, a void is created between the inner and outer layers by dissolving the polyamide fibres.

Dr Lion Messti, University of Barcelona, 23.09.2018, Conference on hybrid cord manufacturing, 23.-25.09.2018 Slide 2/21

Institute for Cord Technology - Advanced Hybrid Cords – Slide 3

We have tested all suitable solvents to find an optimum for polyamide fibres. Here are some examples:
- formic acid
- glacial acetic acid
- protic polar solvents
- trifluoroacetic acid
- aprotic polar solvents
- cyclohexanone



All solvents were tested at a concentration of 50 wt% in pure acetone. The mixtures provided good solvent properties. However, the trifluoroacetic acid mixture was particularly fast and, in contrast to the other solvents tested, left no residue of the polyamide fibres at all.

Dr Lion Messti, University of Barcelona, 23.09.2018, Conference on hybrid cord manufacturing, 23.-25.09.2018 Slide 3/21

Slides printed from the USB stick provided to all participants together with conference material when checking in for the Conference on hybrid cord manufacturing 23.-25.09.2018, namely slides 2 and 3 of 21 from the presentation on “Advanced Hybrid Cords” given at the conference by Dr Lion Messti. Publisher: SACM - Society of Advanced Cord Manufacturing, Barcelona.

(19) USPTO

(21) Application number: **US 16/212,925**

(10) Publication number: **US 2018/028635 A1**

(22) Date of filing: **Nov. 13, 2015**

(45) Date of Publication: **Sept. 26, 2018**

(51) Int. Cl.: **B60C9/00** (2006.01)

(73) Assignee: **Intercontinental Tires**

(75) Inventors: **Nadin Angeré**

(74) Representative: **Luigi Bouphon**

(30) Priority Sept. 14, 2014 (GB), GB1234567A

FIELD OF THE INVENTION

[0001] The invention relates to bicycle tires with at least one reinforcement layer containing metal-polyester yarns.

PRIOR ART

[0002] Bicycle tires including a reinforcement layer arranged between the carcass and the tread rubber are well known in the art. The reinforcement layers serve to protect the tire against high mechanical stress resulting from strong deformation that may appear if the tire passes over a sharp stone or a pothole. In the worst case, this deformation may lead to a puncture.

[0003] Conventionally, these reinforcement layers are composed of yarns or cords which are made from organic fibres and are embedded in a rubber matrix. Such yarns or cords are a continuous length of interlocked, twisted or wound fibres. The term "cord" is used in particular in tire technology. As organic fibre materials aramid (aromatic polyamide) or other organic fibres, such as polyamide or polyester, are used.

[0004] However, the known reinforcement layers are heavy, as a high density of these cords needs to be used to achieve the desired protection against mechanical stress. Reinforcement layers comprising pure stainless steel cords have also been tested in bicycle tires. Stainless steel cords have a high tensile strength but lack elasticity and are also heavy.

[0005] There is obviously a need for a cord to be used in bicycle tires that combines a high tensile strength that protects the tire against puncture with a comparatively low weight.

SUMMARY OF THE INVENTION

[0006] The object of the invention therefore is to provide a bicycle tire that has a high resistance to mechanical stress while having a low weight. The object is attained by a reinforcement layer comprising a mesh of polyester-stainless steel cords embedded in an elastomeric matrix. The present invention thereby uses cords that combine the tensile strength of stainless steel cords with the lower weight and higher elasticity of polyester yarns.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Fig. 1 shows a bicycle tire section having bead cores (1), a carcass (2), which is wrapped around the bead cores (1) and the edges of which overlap under a tread rubber (4), and a reinforcement layer (3). The reinforcement layer (3) is positioned between the carcass (2) and the tread rubber (4).

[0008] Fig. 2 shows the reinforcement layer (3) as a final product. The reinforcement layer (3) comprises a mesh of polyester-stainless steel cords (5) which is embedded in a matrix (6) of synthetic rubber.

[0009] As indicated in Fig. 3, the cords have a core (7) of polyester fibres with stainless steel wires wrapped around it as the outer layer (9). A circumferential void (8) is implemented between the core (7) and the outer layer (9) of the cord.

[0010] In an intermediate step of manufacturing, polyamide fibres are wound around the polyester fibre core before the stainless steel wires are added. Polyamide has a lower melting point than polyester, such that by applying a thermal treatment to the intermediate product the polyamide fibres can be at least partially removed. Thereby, the above-mentioned void (8) between the inner polyester fibre core (7) and the outer stainless steel wire layer (9) is created. However, due to non-complete removal of the polyamide material from the region between the core and the outer layer the void may not be constant throughout the length of the cord.

[0011] To manufacture the reinforcement layer (3), the cords (5) are embedded in a matrix of synthetic caoutchouc. The resulting raw product is vulcanized in a mould. Due to the high pressure applied during this vulcanization process, the synthetic caoutchouc behaves like a fluid and is forced into the voids of the cords, such that any air (or residual polyamide material) between the core and outer layer is replaced and a stable and continuous vulcanized synthetic rubber matrix (6) is formed.

CLAIMS

1. A polyester-stainless steel cord (5), characterized by the cord having a core (7) consisting of 3 to 5 polyester fibres of 100 to 200 µm diameter and an outer layer (9) consisting of 15 to 30 stainless steel wires of 25 µm diameter wound around the core (7) along its longitudinal axis, wherein a circumferential void (8) is present between the core and outer layer of the cord.

2. A reinforcement layer (3) for a tire, comprising a mesh of the polyester-stainless steel cord (5) according to claim 1 embedded in a rubber matrix (6).

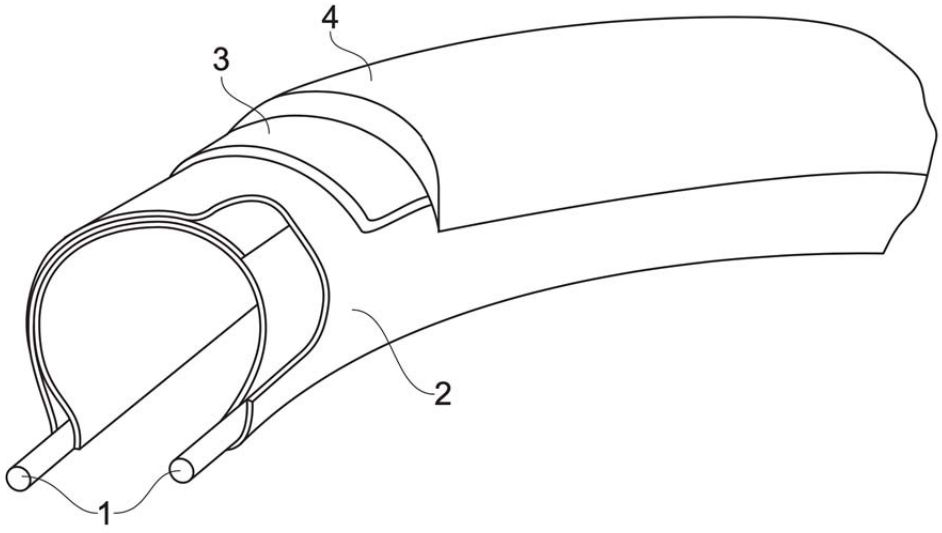


FIG. 1

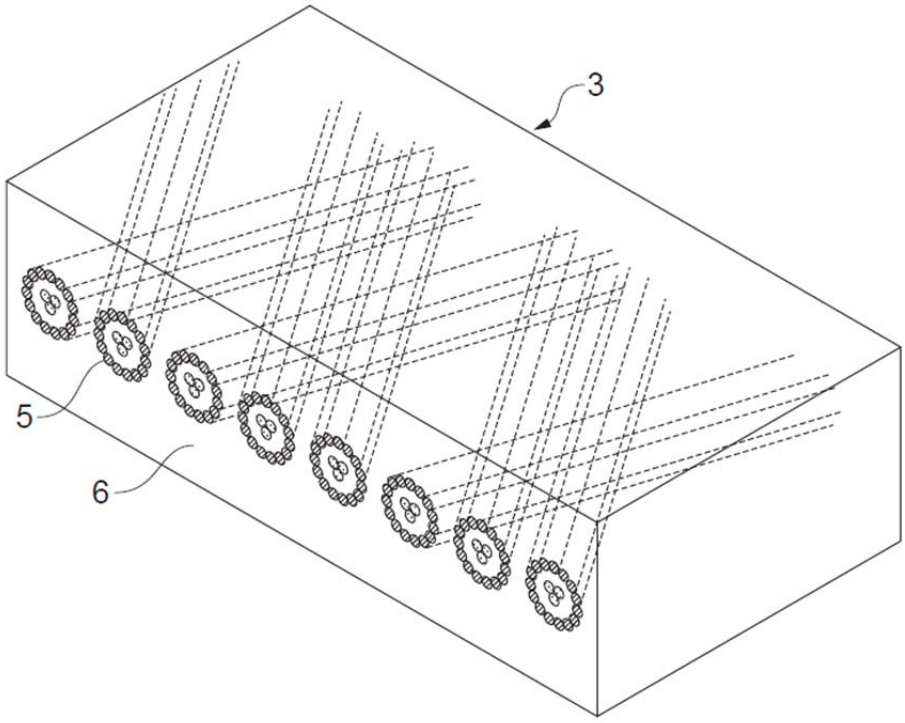


FIG. 2

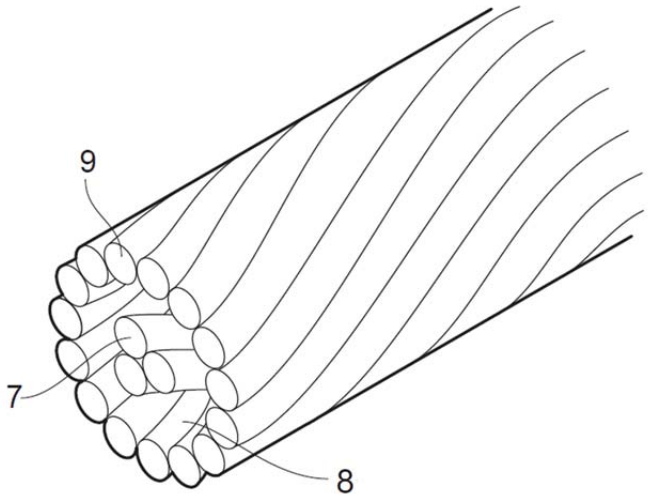


FIG. 3

(19) **Europäisches Patentamt**
European Patent Office
Office européen des brevets

(11) **EP 4 347 490 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication of application:
28 October 2019 Bulletin 2019/13

(51) Int. Cl.[7]: **D02G3/12**

(21) Application number: **18186754.3**

(22) Date of filing: **26 April 2018**

(54) **Composite Stainless Steel Yarn**

Verbundedelstahlgarn

Fil composite en acier inoxydable

(84) Designated Contracting States:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority:

-

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(74) Representative:

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[0001] This invention relates to the technical field of composite stainless steel yarns for use in machine stitching.

[0002] Due to their durability, composite stainless steel yarns enjoy a great reputation in the industry for sewing technical fabrics such as textiles for protective garments. They are also used in leather processing, for example for stitching of the outer casing segments of balls, or in anti-puncture layers for bicycle tires. In both applications, the yarns are exposed to extremely high mechanical stress.

[0003] However, the thin metal wires of composite stainless steel yarns are difficult to process as they are prone to breakage. Numerous processing steps, e.g. spinning, knitting or stitching, may cause the wires to break. They may also break during use.

[0004] It is therefore an object of the present invention to provide a composite stainless steel yarn with high elasticity, and a good resistance to cutting and abrasion.

[0005] When stainless steel wires are produced, the applied torsion results in an elastic memory such that the wire will exhibit a tendency to coil up. Such a wire is frequently said to be "lively". A wire without a tendency to coil up is often said to be "dead”, and will not twist around itself when held in a U-shaped loop. Stainless steel yarns made from “lively" wires pose substantial difficulties in stitching or fabricating fabrics. The present invention therefore employs stainless steel wires which are substantially free of the tendency to coil up, i.e. "dead".

[0006] The composite stainless steel yarns of the present invention provide low weight and beneficial physical properties, e.g. high elasticity and resistance to cutting and abrasion and low electrical conductivity, while the difficulties resulting from the usage of stainless steel yarns made from conventional "lively" wires are avoided. It should be noted that in this field of technology the term "metal wire" refers to a diameter of greater than 100 µm and the term "thin metal wire" to a diameter equal to or below that value.

[0007] In the prior art discussed above, the number of stainless steel wires incorporated into the composite yarns ranges from one to four.

[0008] In the present invention, however, the stainless steel wires have a diameter of 2-25 µm. This small diameter allows up to 90 wires to be combined while still providing a flexible, lightweight yarn.

[0009] Furthermore, even when stainless steel with high stiffness is employed, the "dead" wires with the small diameters employed in the present invention are quite flexible and free of the tendency to coil up, whether on their own or combined into a yarn.

[0010] Figure 1: Magnified photograph of a composite stainless steel yarn

[0011] The composite yarn (1) of the embodiment of the figure 1 comprises stainless steel wires (2). It can thereby resist bending stresses quite well and is remarkably durable, such that it can even be used for applications such as stitching together the panels of a traditional football. The yarn forms a long-life structural component of the ball's outer covering.

[0012] In the composite yarn (1) shown in figure 1, 90 stainless steel wires (2) having a diameter of 25 µm are bundled to form a core (3). The core is provided with two outer layers (4) and (5) of an organic fibre, in this case nylon polyamide fibres, twisted in opposite directions. This composite yarn is substantially free of tendency to coil up, as "dead" stainless steel wires are used and the organic fibres in the two layers are counterrotated.

CLAIMS

1. A composite stainless steel yarn (1), characterized by a core (3) and at least one layer (4,5) wound around said core (3), wherein said core consists of up to 90 stainless steel wires (2) which are free of the tendency to coil up, each wire (2) having a diameter of 2-25 µm, and said at least one layer (4,5) comprising at least one organic fibre.

2. The yarn (1) of claim 1, wherein said at least one organic fibre is cut- and abrasion-resistant and selected from the group consisting of polyamides, high-tensile strength polyolefins, glass fibres and mixtures thereof.

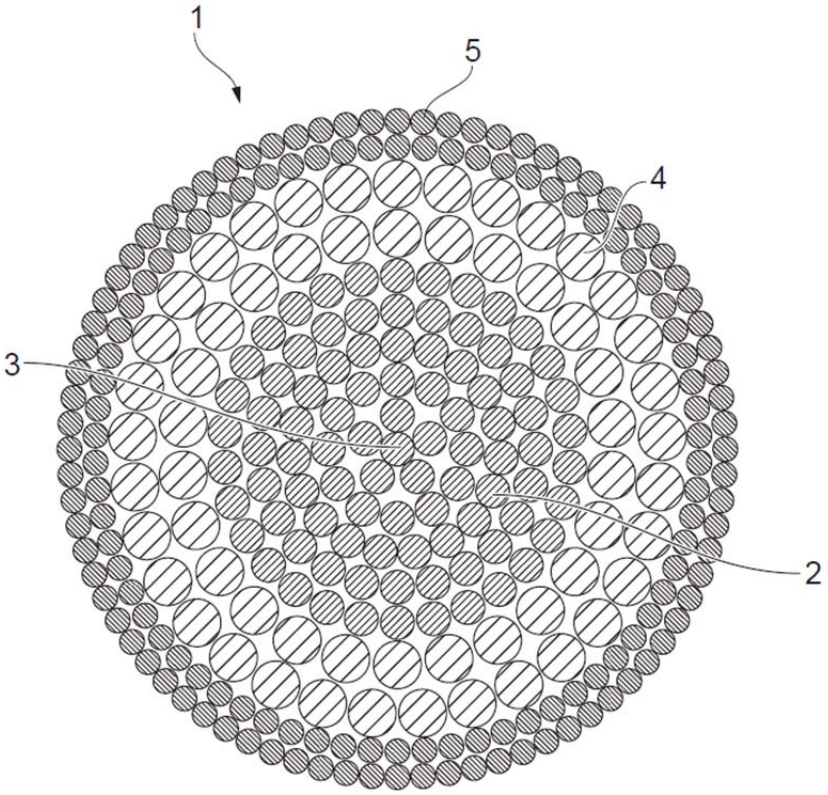

FIG. 1