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(54) Inflatable sports ball.

(57) An inflatable sports ball (1, 8) which comprises an inflatable bladder (2, 9) and an outer case (5, 10) surrounding the bladder, said outer case being built-up from a number of panels which are stitched together to form a shell within which the bladder can be inflated, in which each panel of the outer case comprises a laminate having an outer wearing layer (5, 10) to suit the type of sports ball, and at least one further layer (3, 13) of woven material adhering directly or indirectly to the outer layer (5, 10) and woven from yarns including high tensile yarns having high modulus of elasticity, whereby said further layer (3, 13) imparts to the laminate substantial resistance to circumferential expansion under load.

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This invention relates to an inflatable sports ball which comprises an outer case, and an inner bladder within the outer case and which can be inflated in order to form the outer case into the required overall shape of the sports ball.

The invention is primarily concerned with inflatable sports balls for use in playing football, hand ball or basketball, in which the outer case is substantially spherical, but the invention will also be applicable to other shapes of inflatable sports ball, such as rugby balls or American footballs, in which the outer case has a substantially oval shape.

As is well known, the bladder of a sports ball is inflated so as to expand radially and circumferentially into engagement with the inner surface of the outer case, and further inflation then causes the outer case to adjust itself on the outer surface of the bladder until it forms a required rigid outer covering to the bladder, which will be substantially spherical in the case of e.g. a football.

The outer case of a sports ball is much less resilient than the material from which the bladder is made (usually rubber or rubber based), and therefore the outer case does not yield to any appreciable extent circumferentially as it is engaged by the outer surface of the inflating bladder. Therefore, the outer case exerts a substantial confining force to the expanding bladder, and once the bladder engages the inner wall surface of the outer case, further inflation of the bladder soon brings the ball to the required overall shape and to a required internal pressure.

However, while it is a fact that the component parts of a typical outer case are much less resilient than the bladder, there is a measurable degree of circumferential expansion of the outer case of existing manufacture of sports balls, as the bladder is inflated, part of which expansion is a resilient expansion of the material of the outer case, and an additional part of which usually comprises some degree of inelastic expansion between adjacent stitched-together panels of the outer case. The inelastic expansion arises due to the manner in which the outer case of conventional sports balls are manufactured.

Thus, the manufacture of the outer case of footballs, especially for organised and professional sports, remains a craft industry in which the outer case is built-up from a number of panels which are hand-stitched together. Typically, an outer case is built-up from pentagonal and hexagonal panels, with each pentagon being surrounded by five hexagons, whereby each side of each pentagon forms one of the six sides of an adjacent one of the five hexagons surrounding the pentagon.

The panels are stitched together by stitching along overlapping edges of the pentagonal and hexagonal panels, and evidently the quality of the final product is largely dependent upon the skill and attention give to the task by the operative concerned.

However, while the circumferential expansion of the outer case of a sports ball is of a much lower order than the resilient circumferential expansion of the unconfined bladder, the outer case largely determines the overall inflated shape of the sports ball, and even small variations in expansion from one ball to another can result in markedly different flight profiles of the balls. Also, local surface imperfections i.e. departure from a truly spherical shape, can result in unpredictable movement of the ball through the air, and non-uniform production of sports balls.

It is therefore very important to ensure as far as possible that the outer periphery of the ball can be manufactured on a repeated basis to uniform standards of shape e.g. in the case of a football the "sphericity" should be as accurately as possible a true sphere, and successive balls produced in a manufacturing process should be capable of being manufactured on a repeatable basis to consistent standards.

The requirement for sports balls of accurate external profile is particularly important for professional sports, but is also important for serious sportsmen who regard their particular sports as a leisure activity. By way of example, the sport of handball is one in which it is particularly important that the ball should have a precise standard for its circumference, and a sphericity which is as near perfect as possible.

Conventional materials used in the manufacture of sports balls, however well chosen, do not always permit a sports ball to be obtained which, in its new form, will always be a true sphere and which can maintain a true spherical form and circumference in all conditions of weather. It is a known phenomenon that a deformed ball i.e. a ball which departs from a required overall shape, results in unpredictable behaviour during play, such as a false bounce, unpredictable movement through the air and sometimes difficulty to handle by reason of differential expansion of portions of the surface of the ball. These inconveniences are clearly unfavourable to players, and in addition the referee controlling a game, referring to official rules, can refuse to allow play with a ball whose sphericity is poor and / or whose circumference exceeds standards laid down by official organisations, such as the International Handball Federation (IHF).

These problems also apply to balls used for outdoor sports, such as football, in which current manufacture of footballs results in one set of measurements applicable to a dry pitch, and a different set of figures for a water-logged pitch. At present, there is no football, the outer case of which does not distort to an excessive manner in use, nor does it avoid non-uniform circumferential expansion to unacceptable levels in use. Even newly manufactured footballs of current manufacture, when unused, often do not have sufficiently true sphericity to guarantee true behav-

iour in particularly important games, such as football league games, or cup matches. It is known that the standard circumference of a football is between 68 and 71 cm with an internal pressure during a normal game of about 1 bar. However, at the end of a relatively short period of play, the ball circumference can measure more than 71 cm, which is more than the standard permitted by FIFA. This variation in the circumference of a football becomes intensified on a water-logged pitch, in which the tendency towards non-uniform deformation is accentuated.

It is therefore very important to ensure, as far as possible, that the outer periphery of a sports ball can be manufactured, and maintained in a required shape within permitted tolerances, since even small variations from a true shape e.g. a sphere can result in an unpredictable flight path of the ball, especially if any spin is imparted to the ball upon impact and / or there are windy conditions prevailing through which the ball is caused to travel.

It is also known to manufacture sports balls of the "wound ball" type, in which an internal bladder has a textile covering adhering to its outer surface, with the textile covering being made of natural or synthetic fibres and being progressively wound around the bladder. To ensure the integrity of the textile covering layer, it is usually combined with and impregnated by a general vulcanising compound with a synthetic rubber base. A final outer lining is then applied to this covering layer by suitable adhesive.

The manufacture of the wound ball type of sports ball is suitable for certain uses, but does not provide a finished product which is acceptable for organised and professional sports, where the traditional hand sewn outer case panel type construction is demanded.

The invention is concerned with the first discussed type of sports ball i.e. stitched outer case panels, in which the outer case is built-up from separate panels which are stitched together, and seeks to provide an outer case which has improved resistance to circumferential yielding under load and thereby to provide a design of inflatable sports ball suitable for mass production to required standards of external shape, and having more predictable performance.

According to the invention there is provided an inflatable sports ball which comprises an inflatable bladder and an outer case surrounding the bladder, said outer case being built-up from a number of panels which are stitched together to form a shell within which the bladder can be inflated, in which each panel of the outer case comprises a laminate having an outer wearing layer to suit the particular type of sports ball, and at least one further layer of woven material adhering directly or indirectly to the outer layer and woven from yarns including high tensile yarns having high modulus of elasticity, whereby said further layer imparts to the laminate substantial resistance to circumferential expansion under load.

Therefore, as the bladder is inflated, it expands radially and circumferentially until it comes into contact with the inner surface of the outer case, and further inflation then forms the outer case into a tight required external shape which confines the bladder. In the preferred application of the invention to the manufacture of sports balls which require a substantially spherical shape e.g. footballs and handballs, the outer case is formed into a spherical shell.

The laminated panels from which the outer case is built-up are strongly resistant to circumferential expansion, by reason of the high tensile yarns incorporated in each layer of woven material, and therefore subject to a satisfactory level of skill in the production of the stitching-together of the panels of the outer case, a substantially truly spherical shape of sports ball can be obtained on inflation of the bladder, and substantially without risk of localised flaws being produced by differential expansion of portions of the outer case.

The invention therefore enables sports balls to be manufactured on a mass production basis to high standards of quality meeting acceptable tolerances with regard to the required outer shape of the ball e.g. sphericity in the case of a football or handball.

Conveniently, the panels are cut or stamped out of a single lamination which is assembled from a number of layers which are required to constitute each panel, and which will be a minimum of the outer (wearing) layer and the supporting layer of woven material incorporating high tensile yarns.

The outer layer can be made of any suitable material selected solely on the grounds of the required function of the outer layer itself e.g. resistance to water impregnation, textured surface to make the ball easy to "handle" or kick, and ability to bear decorative surface markings and without need to have any particular strength to resist circumferential expansion, since this will largely be provided by the high tensile yarns of the woven support layer of each lamination.

The use of a woven layer i.e. with warp and weft yarns, and incorporating high tensile yarns in the layer enables a support structure to be provided for each laminate which resists circumferential expansion, preferably to resist circumferential expansion in mutually perpendicular directions.

The entire woven fabric support layer may be made from high tensile yarns if required, but as the high tensile material is more expensive than conventional materials, such as cotton, polyester, polyester / cotton mix, or polyamide, it may be sufficient for many purposes to weave the fabric only partly from high tensile yarns, provided that the distribution of the high tensile yarns in the fabric is such as to provide substantial resistance to circumferential expansion in predetermined directions.

The high tensile yarns may be mixed or blended with lower cost yarns, or may be distributed as part only of the array of warp and / or weft yarns.

Alternatively, and as one preferred variant, two fabric layers may be provided, with high tensile yarns running in one direction in each fabric layer (say the warp yarns) and less costly yarns running in the perpendicular direction, and with the two fabric layers superposed so that the high tensile yarns of one layer extend substantially perpendicular to the high tensile yarns of the other layer.

Preferred high tensile material which may be used comprise para-aramide threads of Kevlar (registered trade mark of DuPont de Nemours), although other generally equivalent material with a high modulus of elasticity may be used.

The lamination from which the outer case panels are formed may include further layers, such as an intermediate layer of expanded plastics foam, so as to give a degree of resilience to the "feel" of the ball when handled or kicked.

The invention may be applied to sports balls for use indoors or outdoors, and the use of high tensile yarns incorporated in the woven fabric support layer provides both more readily reproducible standards of ball manufacture to acceptable tolerances in external shape, a longer useful life of the ball, and improved resistance to the adverse effects of weather and climate. Further, despite the use of novel components in the internal support structure of the outer case, the external appearance of the sports ball can be made to conform to traditional designs if required.

The high tensile yarns incorporated in the fabric support layer of the outer case offer excellent dimensional stability, and minimal stretching under tensile load because of the very high modulus of elasticity of the high tensile yarns. Suitable adhesive will be used in order to link the outer face of the inner strengthening fabric layer to the outer (wearing) layer, which is only required to provide resistance to wear and tear, and having necessary aesthetic qualities. The outer layer may be made from any traditional material used to make sports balls, whether this be natural materials such as leather or synthetic materials e.g. with a polyurethane, polyvinylchloride or rubber base. The inner face of the strengthening fabric layer may be engaged directly by the outer surface of the internal bladder as the latter is inflated, with the respective faces making a direct (non-adhesive) contact with each other.

As indicated above, the preferred high tensile material for making the high tensile yarns incorporated at least partly within the fabric support layer comprises Kevlar, and woven according to the following requirements:

base: para-aramide threads, Kevlar, DuPont de Neumour types;

size: 40/2 Nm

weave: serge 2/1

structure: 24 x 18 warp / weft

thickness: approximately 0.6mm

mass: 220 grammes / approximately square meter

lengthening / rupture in accordance with standards DIN 53857

warp: 19.5%

weft: 10%

rupture force according to DIN 53857

warp: 320 daN

weft: 280 daN

As an example, the high tensile (HT) material used has been employed in a double layer, one of which is superposed 90 degrees in relation to the other in order to guarantee a maximum lengthening equilibrium in the two directions of the threads. The generally superior lengthening is thus balanced in one of the directions of the threads in relation to the other on the woven material, by orienting the second material through 90 degrees in relation to the other. These superposing or lamination techniques to form a complex of inner strengthening materials are very well known to the man of ordinary skill in the art.

The HT material is adhered perfectly to the natural latex with a twisted thread base and not a continuous filament base, and has the capacity to be impregnated in a homogeneous manner until complete saturation to become totally sealed. Because of the good mechanical anchorage of the adhesive, the liaison of the warp and weft threads is perfectly guaranteed to the points of interweaving and thus avoids fraying at the edges of the sewing of only three millimetres in width. For reasons of flexibility, resilience and mobility of the outer case, the craftsman is almost bound to use natural latex to:

assemble the HT materials to form the high dimensional stability inner strengthening layer

to adhere the inner strengthening layer with the HT material base to the outer material to form the laminate for the hand sewn ball cases

As an example, 60 dry extract full ammonia natural latex is used. One preferred characteristic which is very favourable for the requirements of the invention is that the HT material, in the inner strengthening layer for balls, brings out for the latter a maximum dimensional blockage in dry or damp conditions and whatever the atmospheric temperature (both summer and winter for the staggering of the football season for example) to ensure substantially true sphericity (when new) and in accordance with the weather, together with a circumference stability so as to keep the ball within the regulatory standards. But the HT material is equally favourable for balls used for indoor sports. For example for handball, such a material gives the ball excellent sphericity which does not fall into disrepair when used despite excessively violent impacts resulting from the power of blows together

with a stable circumference even after prolonged usage thus avoiding difficulties brought about by present or conventional balls. The mass of the HT material which may be used to form the whole of the inner strengthening is not limiting. In accordance with the latter the inner strengthening layer may be formed with two materials in the case of an increased mass, for example with three or even four HT materials in the case of a low mass. In specific cases such as handball, it is necessary to form the inner strengthening layer with four or even five materials and with an increased mass for the increased weight per square meter which must accentuate the laminate on hand sewn ball cases (layer a and layer b). The weight of a square meter of the laminate varies according to the type of ball manufactured. As an example the weight of the laminate for football cases is approximately 2.1kg, whereas that of a handball must exceed 3kg per square meter.

These techniques are well known to the craftsman and do not need to be described in further detail.

For economic reasons, given the raised cost of HT materials with a para-aramide thread base, these could be combined with other types of material for example cotton, polyester, polyester / cotton mix or even polyamide, this being when two or more materials are necessary to shape the inner strengthening layer according to the weight required. However, two HT materials at least are desirable one of which preferably is oriented at 90 degrees in relation to the other, to produce an inner strengthening layer for balls accentuating a dimensional stability and an optimal lengthening equilibrium in the two directions of the threads. To the knowledge of the applicant, the para-aramide polymer base threads used in the manufacture of the HT materials in the inner strengthening layer for balls, are marketed by DuPont de Neumour under the brand name Kevlar and by Akzo under the brand name Twaron. Japanese companies also recently have been marketing these threads and which may be suitable for use in carrying out the invention.

The intrinsic characteristics of the para-aramide threads comprise:

density: approximately 1.45

lengthening / rupture: 2% maximum

point of fusion: in excess of 500 degrees centigrade

chemical name: polyparaphenylanterephtalamid

structure: 100% crystalline high molecular orientation

high tenacity, from the extremely high mechanical properties

As a comparison below are the lengthening / rupture figures for different types of threads:

para-aramide 2%

polyester: 13%

polyamide: 20%

E glass: 2%

Two embodiments of inflatable sports ball according to the invention will now be described in detail, by way of example only, with reference to the accompanying drawing, in which:

Figure 1 is a section of part of the outer case structure of a football embodying the invention;

Figure 2 is a similar view of a handball forming a further embodiment of the invention; and,

Figure 3 is a perspective illustration of the exterior of an inflatable sports ball to which the invention may be applied.

The two embodiments of the invention comprise sports balls which can be inflated to a substantially spherical shape, and comprising a football and a handball, but it should be understood that the invention may be applied to other types of inflatable spherical sports ball, or to other shapes of inflatable sports ball, such as rugby ball and American football.

A typical example of inflatable sports ball to which the invention may be applied comprises a football, the exterior of which is shown in Figure 3. The case of the football is designated generally by reference 20, and is built-up from modules each comprising a central pentagonal shape 21 which is surrounded by five hexagonal shapes 22 in known manner.

In the two embodiments shown in Figures 1 and 2, which will be described, a woven fabric support layer of the outer case of the sports ball incorporates high tensile material comprising a 100% para-aramide twisted thread base with a metric number of 40/2, a mass of 220 grammes per square meter approximately and a serge weave 2/1.

Referring first to Figure 1, this shows a section of the outer structure of a football, which is designated generally by reference 1, and which comprises an outer case which will be built-up from outer case panels stitched together by any known techniques. Usually, the outer case panels comprise pentagonal and hexagonal panels, which are stitched together with hand sewing along overlapping edges. The ball has an inflatable bladder 2 made of rubber and each panel of the outer case comprise a laminate having an outer wearing layer 5 to suit the particular type of sports ball, and at least one further layer 3 of woven material adhering directly or indirect to the outer layer 5 and woven from yarns including high tensile yarns of high modulus of elasticity, whereby the further layer 3 imparts to the overall laminate substantial resistance to circumferential expansion under load.

In the embodiment illustrated in Figure 1, the layer 3 of woven material comprises a strengthening support layer which provides the major part of resistance to circumferential yielding of the outer case as a whole, and is woven from two materials with a para-aramide base. The strengthening fabric layer provides high dimensional stability to the football, when

new, and after prolonged use, and desirably an intermediate layer 6 of expanded plastics material, such as expanded polyurethane, underlies the outer wearing layer 5. Desirably, there is also incorporated in the laminate an intermediate textile layer 7, between fabric layer 3 and underlayer 6, which acts as a coating support. The textile layer 7 is woven desirably from a 50% cotton and 50% polyester mix.

The component layers of the laminate (5, 6, 7, 3) are adhesively united to form the lamination by use of any suitable adhesives to link the layers together, and desirably using adhesives having a natural latex base. Reference 4 designates the outer layers of the football, comprising outer wearing layer 5, which may be made of polyurethane (unexpanded), and the underlying layer 6 of expanded polyurethane.

Referring now to Figure 2, this shows a section of the outer structure of a hand sewn handball, in which the outer structure is designated generally by reference 8. The outer case 8 confines an internal inflatable bladder 9 made e.g. of natural latex. The hand stitched panels of the outer case comprise, facing inwards, a high dimensional stability inner strengthening fabric layer, comprising four layers assembled in a laminate as shown by reference 13, two of which are of high tensile woven yarns with a para-aramide thread base 11 to give the ball the required properties, and two layers 12 of conventional materials, with a polyester / cotton thread base generally with a ratio of 70:30 to limit the overall cost of the final product. The outer case lining 10 is leather. The presence in the inner strengthening layer 11 of the high tensile material with a para-aramide thread base gives the ball very favourable properties, with regard to sphericity, both as new and after prolonged use together with a stable circumference in relation to the weather, which remain within international standards even after prolonged usage.

Claims

1. An inflatable sports ball (1, 8) which comprises an inflatable bladder (2, 9) and an outer case (5, 10) surrounding the bladder, said outer case being built-up from a number of panels which are stitched together to form a shell within which the bladder can be inflated, in which each panel of the outer case comprises a laminate having an outer wearing layer (5, 10) to suit the type of sports ball, and at least one further layer (3, 13) of woven material adhering directly or indirectly to the outer layer (5, 10) and woven from yarns including high tensile yarns having high modulus of elasticity, whereby said further layer (3, 13) imparts to the laminate substantial resistance to circumferential expansion under load.

2. A sports ball according to Claim 1, in which the panels are cut or stamped out of a single lamination which is assembled from a number of layers required to constitute each panel, and which comprises a minimum of said outer wearing layer (5, 10), and the layer (3, 13) of woven material.

3. A sports ball according to Claim 1 or 2, in which the entire woven fabric layer (3, 13) is made from high tensile yarns of high modulus elasticity.

4. A sports ball according to Claim 1 or 2, in which the high tensile yarns are distributed throughout the woven fabric in required directions to resist circumferential expansion in these predetermined directions.

5. A sports ball according to Claim 1 or 2, in which the high tensile yarns are mixed or blended with lower cost yarns.

6. A sports ball according to any one of Claims 1 to 5, in which two woven fabric layers are provided, one arranged above the other, and with distribution of high tensile yarns therein so that the high tensile yarns of one fabric layer extend substantially perpendicular to the high tensile yarns of the other layer.

7. A sports ball according to any one of Claims 1 to 6, in which the high tensile yarns are made of para-aramide threads of high modulus of elasticity.

8. A sports ball according to Claim 7, in which the high tensile yarns are made of Kevlar.

9. A sports ball according to any one of the preceding claims and having an outer case which is arranged to take-up a spherical shape upon inflation of the bladder.

10. A sports ball according to Claim 9, in which the sports ball comprises a football, handball or basket ball.

11. A sports ball according to any one of Claims 1 to 8, in which the outer case is arranged so as to take-up, upon inflation of the bladder, an oval shape so that the sports ball can form a rugby ball or American football.

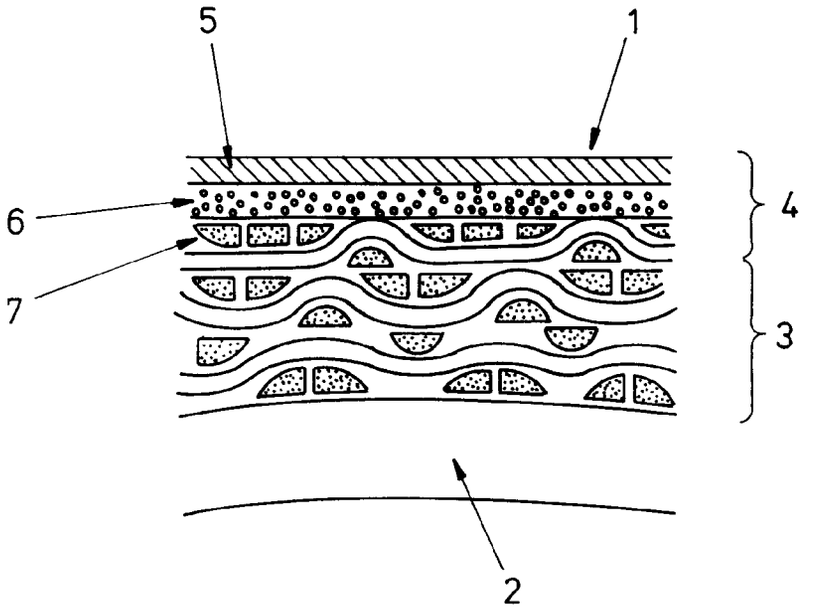

FIG. 1

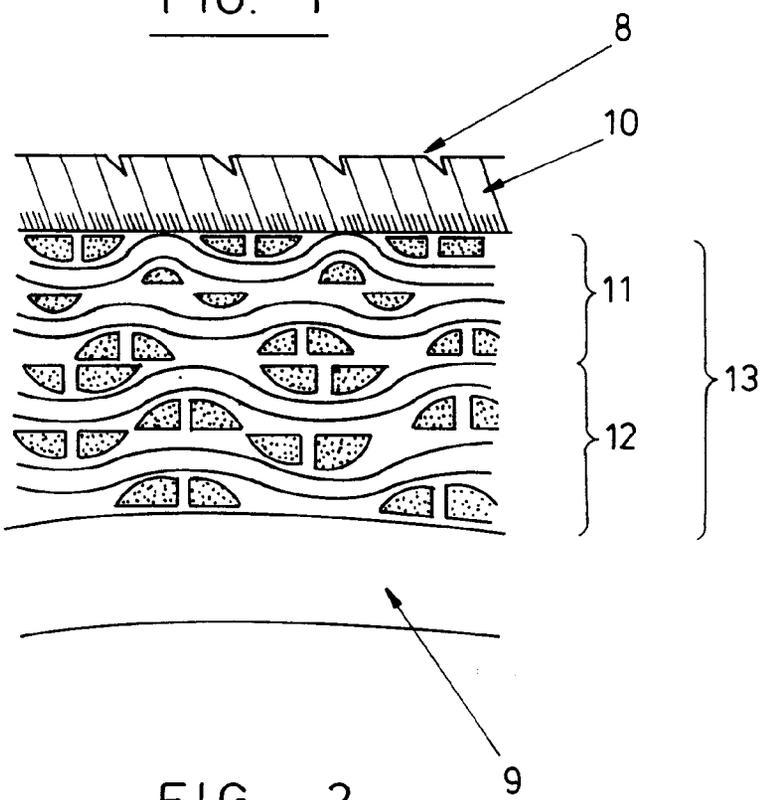

FIG. 2

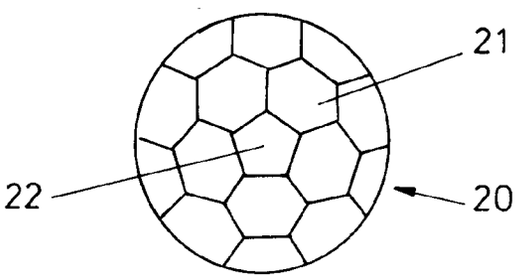

FIG. 3