

July 4, 1944.

W. J. VOIT ET AL
REINFORCED GAME BALL
Filed Aug. 13, 1941

2,352,872

Fig. 1.

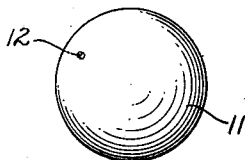


Fig. 5.

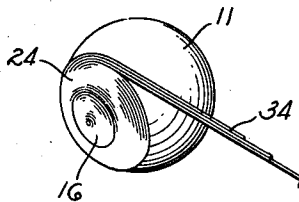


Fig. 9.

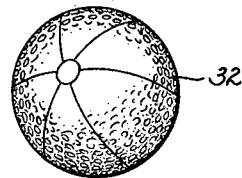


Fig. 2.

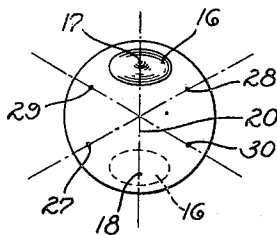


Fig. 6.

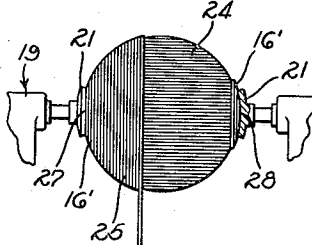


Fig. 10.

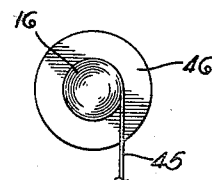


Fig. 3.

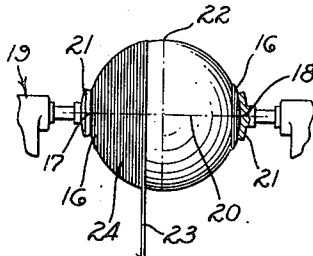


Fig. 7.

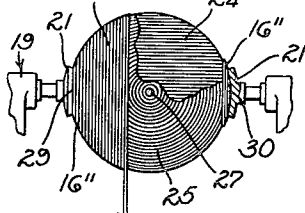


Fig. 11.

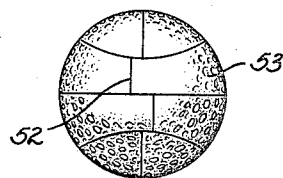


Fig. 4.

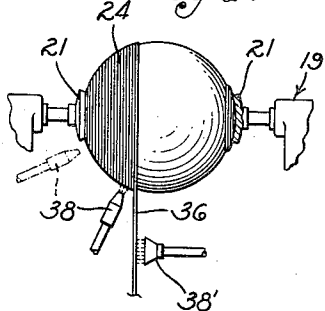


Fig. 8.

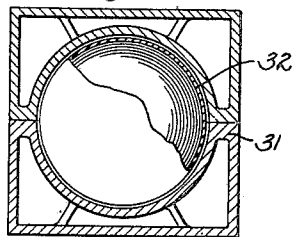
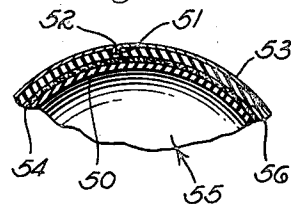


Fig. 12.



INVENTORS
WILLIAM J. VOIT
LEITH C. WEIMER
BY
HARRIS, KIECH, FOSTER & HARRIS
Ford A. Harris
FOR THE FIRM
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,352,872

REINFORCED GAME BALL

William J. Voit, Los Angeles, and Leith C. Welmer,
Southgate, Calif.; said Welmer assignor to said
Voit

Application August 13, 1941, Serial No. 406,684

3 Claims. (Cl. 273-65)

This application is a continuation-in-part of our application Serial No. 262,792, entitled Reinforced game ball, filed March 18, 1939.

This invention relates to athletic balls, and more particularly to that class of resilient, flexible, hollow athletic balls which comprises a central bladder having a relatively thin rubber wall and provided with a valve whereby the ball may be repeatedly inflated and deflated, and an outer protective covering of rubber, leather, or other material to resist surface abrasion and wear.

In the inflatable ball art it has been standard practice for many years to make such a ball by assembling a seamed leather cover with an inflatable thin-walled rubber bladder therein, and balls so made have been in wide use for such a long period that their rebound and surface characteristics have become the standard for such balls. For example, leather-covered basketballs of this standard type have been in almost universal use until but recently, and the characteristics thereof have been adopted by the users of such balls as standard.

There are, however, many recognized disadvantages to such standard leather-covered balls. For example, they are relatively expensive to manufacture, tend to stretch and lose their required shape and diameter, and are prone to breakage or rupture along their seams.

Many attempts have been made to obviate the foregoing disadvantages by making a reinforced center for such a ball. Such ball centers have been made in either of two ways: First, a woven textile material has been cut into small pieces of various configurations and applied to an inner thin-walled, inflatable rubber bladder, or to a form, and bonded in lapped or butted joints with suitable bonding material such as vulcanizable rubber cement; second, elongated fibrous material, such as thread or yarn, has been wound upon the inner bladder, or upon a form, in great circles and circles approximately great circles and recrossing each other in every direction, and bonded to the bladder with such a suitable bonding material. In using either of the methods just described, obviously, a cover of rubber, leather, or other material is molded or otherwise formed on the ball center to complete the game ball. It has been found difficult and expensive to employ the first method since, when flat pieces of fabric are laid upon a curvilinear surface either the central portion of each piece is stretched more than the edge portions, or the

edge portions present folds. Correspondingly, either the bladder is deformed or the reinforcing layer is of uneven thickness. It has also been found difficult with this method to firmly unite contiguous pieces of fabric. Lap joints present an uneven surface which gives the ball uneven resiliency. Butt joints require accuracy in cutting and fitting the pieces and, also, such joints are difficult to make so as to afford a strong tension-resisting union. In using the second method of winding thread in great circles, it has been found difficult to wind the thread upon a bladder because of the non-rigid character of the bladder and, even when the thread is wound upon a solid form, the resultant layer presents an uneven erose surface upon which it is difficult to mold or apply a cover; furthermore, the body of the layer contains interstices and is relatively thick, heavy, and stiff for any given degree of tensile strength.

Balls made with reinforced centers as described in the preceding paragraph have two inherent disadvantages which it has hitherto been impossible to avoid. First, since all yarn or fabric commonly used in the manufacture of the centers of such game balls is inherently stretchable, balls made with such yarn or fabric, when exposed to substantial inflation pressures, will quickly enlarge, either uniformly or locally, deforming the ball from its proper shape or size. Since such balls are ordinarily required to meet rigid size specifications, this inherent tendency to enlargement is particularly objectionable. Second, since such yarn or fabric is inherently stretchable, the rebound of a ball made in accordance with either of these methods is substantially greater than the rebound of a standard leather-covered ball inflated to the same inflation pressure, which is very undesirable in that such a ball will not conform to the rebound requirements established among users of such standard leather-covered balls. For example, if a basketball is made with yarn or fabric applied on a rubber bladder, as described hereinabove, and provided with a rubber cover and inflated to an inflation pressure of 15 pounds per square inch, it will ordinarily have more than 50% more rebound than a standard leather-covered ball inflated to the same pressure. Similarly, such a ball covered with a leather cover will have a substantially greater rebound than the standard leather-covered ball, although of course not as great as that of such a ball having a molded rubber cover. We have found in practice that

it is impossible to provide such a rubber-covered center-wound basketball with the same rebound characteristics as a standard leather-covered basketball unless the inflation pressure is reduced below six pounds per square inch. With such a reduction in pressure, however, the playing surface of the ball becomes too soft for normal use. We have found that with such basketballs it is desirable to maintain an inflation pressure of at least nine pounds per square inch to maintain sufficient surface hardness, and with such inflation pressure the rebound of the ball is increased substantially above that of a regulation leather-covered basketball. Consequently, it has heretofore been impossible to manufacture a ball on a yarn or fabric wound center, with either a molded rubber or a leather cover, which is comparable in both surface hardness and rebound characteristics with a regulation leather-covered ball.

It is therefore a primary object of our invention to provide an inflatable game ball having a yarn wound center, and having either a molded rubber or a leather cover, which has approximately the same surface hardness and rebound characteristics as a regulation leather-covered inflatable game ball of the same type. We prefer to accomplish this by providing a game ball having a center including an inflatable rubber bladder with yarn wound and bonded thereon, in which the yarn is stretched to a point just short of rupture prior to the application of the cover to the center, so that the yarn cannot stretch further when the ball is inflated to playing pressure. Such a ball will not enlarge substantially during play, as the stretched yarn acts as a reinforcement against such further stretching, and will maintain its size and shape under normal inflation pressures over long periods of time and throughout hard use. Furthermore, since the yarn cannot be stretched further, the ball will have substantially less rebound than if the yarn were not pre-stretched, and this enables us to simulate closely the rebound characteristics of a standard leather-covered ball while at the same time retaining a relatively hard playing surface by the use of a relatively high inflation pressure.

To produce a ball embodying one form of our invention, thread, cord, yarn, strips of fabric, or other elongated material, preferably rubberized either before or after application, is wound upon a substantially spherical rubber bladder, preferably without tension, in contiguous coils or convolutions of gradually increasing diameter, and preferably in a continuous spiral, beginning at one polar point and passing over the median equatorial great circle, and then in circles of gradually decreasing diameter until the opposite polar point is reached. This winding produces a layer of an even thickness which is equal to the diameter of the thread, cord, or yarn, or to the thickness of the fabric, as the case may be. A second winding is then applied to the first winding, with its polar axis perpendicular to the polar axis of the first winding. A third winding is then applied to the second winding, with its polar axis perpendicular to both the first two axes. It is an object of our invention to provide by this construction a reinforcing layer which will have, with a minimum of thickness and weight, a maximum of pliability and tensile strength in all directions, and which will have a smooth exterior face upon which to apply a leather or rubber cover. When the elongated material is wound

without appreciable tension, our method has an advantage in that the flexible bladder is not pressed in or distorted thereby.

It is a further object of our invention to provide an intermediate reinforcing wall of stretched, elongated fibrous material which will not be subject to additional stretch under conditions of use.

In one form of our invention, the reinforcing layers formed of rubberized thread wound as above described surround a rubber bladder and are covered with a rubber cover, and the whole is vulcanized into one integral structure, either by one operation after the several elements of the ball are completely assembled, or in a series of vulcanizing operations at various stages in the building of the ball. It, therefore, is a further object of our invention to provide such a ball which will combine inflatability, tensile strength, light weight, pliability, and uniform elasticity, with resistance to abrasive wear and deformation, and resistance to internal breakdown. It is a further object to provide a ball which is capable of manufacture by a practical inexpensive method.

Our invention contemplates the use of any type of outer cover. We have shown two forms of our invention, in one of which the outer cover is made of rubber and in the other of which the outer cover is made of leather. One of the objects of this invention is to provide a ball construction in which an outer leather cover is secured to an intermediate reinforcing layer in a manner to afford durability, satisfactory performance, and attractive appearance.

Other objects and advantages of our invention will be disclosed and apparent from the following description and drawing, in which:

Fig. 1 shows a bladder, inflated preparatory to the manufacture of an athletic ball in accordance with the principles of our invention.

Fig. 2 shows a bladder with polar discs applied thereto.

Fig. 3 shows a bladder mounted in a lathe and with a portion of the primary winding in place.

Fig. 4 shows a modified means of rubberizing the thread of the winding.

Fig. 5 shows a modified method of feeding the thread to the ball.

Fig. 6 shows the bladder in a lathe, with the primary winding complete and a portion of the secondary winding in place.

Fig. 7 illustrates the manner of applying the tertiary winding.

Fig. 8 shows the ball in a vulcanizing mold after application of all three windings and rubber cover.

Fig. 9 shows the completed ball.

Fig. 10 shows a plan view of a machine for making the polar discs used in manufacturing the ball.

Fig. 11 shows a ball constructed in accordance with a modified form of our invention.

Fig. 12 is a section of a portion of the wall of the ball shown in Fig. 11, taken in the plane of a great circle of the ball at a point normal to one of the seams of the outer cover.

In the following description, it will be convenient, for reference purposes, to speak of the poles and the equator of an athletic ball.

It will also be convenient to refer to latitudinal coils or convolutions. These latitudinal coils or convolutions are the "latitudinal windings" illustrated in Figs. 3, 4, and 6 of the drawing. Hence, the coils of convolutions are "latitudinally

wound" upon the bladder, and this term, as used hereinafter, means that the windings extend in a direction transverse to an imaginary axis through opposite polar points of the bladder, or, in other words, that all parts of a given coil or convolution are a substantially equal distance from either of the opposite polar points.

The term "hollow athletic ball," as used herein, is intended to include any hollow ball capable of repeated inflation and deflation and used for play or exercise, or athletic purposes, such as footballs, basketballs, volley balls, soccer balls, and push balls.

While the ball depicted in the drawing is spherical, our invention is also applicable to athletic balls which are either elliptical in longitudinal cross section or of some other shape suitable to the purpose for which they are designed. Whenever words applicable to a spherical ball appear in this description, it will be understood that it is for convenience of description only and that corresponding words applicable to some other shape may be substituted throughout.

Fig. 1 shows a cured or semi-cured rubber bladder 11 having an inflating valve 12 of standard construction. This bladder is inflated to a size having a radius which is less than the radius of the finished ball by an amount slightly greater than the total thickness of the layer or layers of material which are to be applied thereto in subsequent steps of manufacture.

Two small discs 16 are made by feeding from a winding machine (not shown) a thread 45 coated with rubber cement to a revolving plate 46 in the manner illustrated in Fig. 10, preferably beginning at the center of the plate and working outwardly until a disc of relatively small diameter has been made, or these discs 16 may be small circular pieces cut from woven fabric. They are applied to the bladder, which has been previously coated with rubber cement, at two polar points diametrically opposite each other, as indicated at 17 and 18, Fig. 2, and adhere thereto through the action of the rubber cement. The bladder is then placed in a lathe 19, with the axis 20 of the polar points 17, 18 coincident with the axis of the lathe, and the discs 16 in position under lathe chucks 21. The diameter of the discs is slightly larger than that of the chucks.

Thread, cord, yarn, strips of fabric, or similar elongated fibrous material 23 is wound upon the bladder from a thread-feeding machine (not shown) in contiguous latitudinal coils or convolutions, beginning at the edge of one disc 16 and continuing up and over the equatorial great circle 22 and down to the other disc 16. Preferably, this thread is "rubberized" by coating the same with latex or other rubber cement material prior to its application to the ball. The thread may be passed through a bath of the coating material as it passes from the feeding machine to the bladder, or the thread may be sprayed with the material just as it is applied to the bladder, or the bladder may be dipped in the material before or after it has received its first winding of thread and has been removed from the lathe 19.

A dry uncoated thread 36 (Fig. 4) may be fed to this bladder after the polar discs have been placed thereon in position under the chucks 21 of the lathe 19. Liquid rubber cement may then be sprayed from a gun 38 which is moved in timed relationship with the winding machine from which the thread 36 is proceeding, so that the outer surface of the layer of thread will be thoroughly coated with cement after application to

the bladder. This spray method of coating the thread has the advantage of more completely filling the longitudinal, outwardly facing spaces between the contiguous coils of thread than when pre-coated thread is used.

A spray gun 38' may be mounted to apply the rubber cement to the thread at a point between the winding machine and the ball so as to coat all surfaces of the thread.

The thread may be wound upon the ball in a single strand, or two or more contiguous strands may be fed to the ball as it turns in the lathe. Fig. 5 is a perspective showing of a ball to which three strands of thread 34 are being fed by a winding machine.

This first or primary winding is designated in the drawing by the numeral 24. The bladder, after the primary winding 24 of rubberized thread has been completed, is removed from the lathe and two additional small discs 16' are applied to the outer surface of the winding 24 at two diametrically opposite polar points 27 and 28 at an angular distance of 90° from the first polar points 17 and 18. The axis connecting points 27 and 28 is perpendicular to the axis connecting points 17 and 18. The bladder is then replaced in the lathe 19, or in a similar lathe, with discs 16' against the lathe chucks 21. A secondary winding 25 is then applied in the same manner as before.

After the secondary winding has been completely applied, the ball is removed from the lathe, and two additional discs 16'' are applied to the ball at two diametrically opposite points 29 and 30, of which the connecting axis is perpendicular to both the axes of points 17 and 18 and points 27 and 28. A tertiary winding 26 of thread is applied in the same manner as were the primary and secondary windings, and the ball is removed from the lathe.

It is apparent that, if the several layers or plies of thread windings are applied with their axes perpendicular, as has just been described, not less than three such plies should be formed on the ball to give it a tensile strength of equal degree in every direction. While it is within the scope of our invention to form a ball with any number of plies of latitudinal coils, in practice the number of plies will be three, six, or some other multiple of three. Since no coil of a given ply crosses any other coil of said ply, it is also apparent that each ply is of uniform thickness at all points, and that this thickness is equal to the diameter of the thread or the thickness of the yarn, or other elongated fibrous material used.

A leather cover can be adhesively applied to the outermost winding of thread or cord, or, if it is desired, in accordance with one form of our invention, to complete the ball with a rubber cover, the outermost winding of thread or cord is coated with rubber cement, and the material 32 of the cover is applied to this outermost winding in any suitable manner. The ball is then placed in a mold, such as shown at 31, Fig. 8. This mold is slightly larger than is the ball after the material for the rubber cover has been applied. This difference in size between the mold and the ball makes it possible to inflate the ball through the valve 12 and force the outer wall thereof into intimate contact with the inner face of the mold.

We so correlate the maximum stretch capacity of the thread or cord used in the latitudinal windings with the difference in diameters of the ball and mold that, when we place the ball in the

mold and inflate it sufficiently to bring its outer face into intimate contact with the inner face of the mold, the thread or cord is longitudinally deformed and given approximately its maximum stretch, and it is substantially incapable of being stretched additionally without rupture. We then apply vulcanizing heat to the ball, which is thereby given a permanent form and a permanent size which is the same as that of the mold.

The thread or cord, due to its surface coating of rubber cement or similar material and due to its impregnation with this material, is incorporated in the wall of the ball so as to be immovable therein. This incorporation takes place at a time when the thread or cord is stretched, and it will not be subject to any appreciable additional elongation under conditions of use. It is not possible with an intermediate reinforcing wall of segmented fabric to attain the same degree of success which we attain in securing this result since, in our construction, the elongated threads are continuous and without breaks, such as exist between the segments of woven fabric. When, in a ball constructed of woven fabric, it is attempted to overcome this difficulty by lapping the joints, and securing them by lacing or a partially vulcanized cement bond, the cost of manufacture is increased and ridges are presented which lessen the uniformity of pliability and resiliency of the ball.

It will be understood that it is not necessary, in order to provide a construction in which stretched cords or threads are embedded permanently in vulcanized rubber, that the ball be encased in a rubber cover. It is common practice to make athletic ball "centers" which may be made in one manufacturing plant and sold to a second manufacturer who covers the center with a rubber or leather cover, or, the centers can be made and later covered with either rubber or leather material in the same manufacturing plant, according to the requirements of the trade.

These centers can be vulcanized before they are covered. The cement coating of the cords or threads or other elongated fibrous material can then be relied upon to embed and fix the stretched fibrous material during the process of vulcanization. If the material is liberally coated with a layer of rubber cement or raw rubber in some other form, a better result will be obtained. If a rubber cover is to be applied to the ball in a vulcanizing mold, the size of this latter mold can be gauged to additionally stretch the elongated fibrous material and fix it while subjected to this additional elongation.

Fig. 9 shows the completed ball after removal from the mold. If the face of the mold is formed with the design in inversion, the rubber cover of the ball may be molded to have an exterior surface imitative of the grain and seams of a leather-covered ball.

The reinforcing stranded elements of a reinforcing wall should be both very pliable and substantially incapable of elongation when subjected to tensile stress.

It is characteristic of the thread, cord, yarn, strips of fabric, or other elongated material which applicants use in the reinforcing layer of the ball that it is fibrous and inelastically flexible. A fibrous strand is one in which a large number of short sections or fibers are united by an interlock of lateral extensions of adjacent fibers in longitudinally staggered relationship. Such strands are inelastically flexible in that they may be readily bent to arcs of small radii relative to the

diameter of the strands without any appreciable tendency to resume their former shape. Thread or cord or other stranded material of a fibrous, inelastically flexible nature is therefore to a high degree pliable, and in that respect greatly to be preferred to wire or other stranded elastic material.

It can, however, be readily stretched in its normal condition as it comes from the manufacturer and is in that respect inferior to wire and similar material which will not appreciably elongate under the tensile stresses of that degree created by the pressure of inflation of an athletic ball. The reason that fibrous material, such as thread, can be stretched and permanently lengthened lies in the above described interlocking character of the union of the short sections, i. e., of the individual fibers which make up the thread. Under a tensile stress the fibers are longitudinally displaced with reference to each other in a permanent manner. If the stress be sufficiently increased, the interlock of adjacent longitudinally staggered fibers will be broken, and the thread will break.

The stress required to displace the fibers longitudinally prior to breaking the interlock between fibers is comparatively small, but the additional stress increment required to break the interlock is comparatively great. It is therefore apparent that if stress be applied of a degree just sufficient to displace the fibers longitudinally without breaking the interlock, or, as it may be expressed, take up the slack in the interlock but not sufficient to break the interlock, the thread will be stretched to a point at which it is in a condition to resist greater stresses without elongation.

Treated by the application of a stress of such a degree, fibrous strands embedded in the wall of a hollow athletic ball will afford pliability to the wall when the ball is subjected to inwardly directed blows, but will prevent any enlargement of diameter of the ball from the outwardly directed pressure of inflation, since this pressure is not sufficient to apply tensile stresses to the thread sufficient to rupture it. Also, we have found that a ball having a center formed in our manner will have materially less rebound than a similar ball made without pre-stretching of the yarn, which is an important feature of the invention as it permits us to simulate the relatively low rebound characteristics of a regulation leather-covered inflatable ball.

In a ball constructed in accordance with this form of our invention, we have an inner gas-retaining rubber lining equipped with a valve structure by which the original bladder can be given the proper size for having wound thereon the threads of the intermediate reinforcing layer, by which the ball can be expanded in the mold to secure accurate molding and stretching of the thread windings, and by which the ball can be inflated to any desired degree for play purposes. We also have an intermediate flexible, pliable, relatively thin, relatively light, tension-resisting wall of continuously wound stretched threads which will not stretch further when the ball is in use and will insure a ball of constant diameter and true shape, irrespective of repeated inflation and deflation and irrespective of variation in the pressure of such inflation, and we have an outer protective cover to resist abrasive wear or puncture. The three walls are permanently secured by vulcanization or other means in one integral structure which can be inflated or deflated at

will. A ball constructed in accordance with our invention can be given more or less rigidity according to the pressure of inflation, without change in the diameter of the ball.

It is obvious that the various layers of coils of latitudinally wound thread, or other elongated reinforcing material, may be successively applied to the ball with the axis of the coils of one layer at any angle to the axis of the coils of the preceding or following layers, and need not be perpendicular thereto, as has been above specified in describing the preferred embodiment of our invention.

The essence of this form of our invention resides in the latitudinal arrangement of coils of elongated longitudinally deformed reinforcing material to resist tensile stresses circumferentially in a hollow athletic ball, having an integral rubber, gas-retaining lining, and capable of repeated inflation.

Figs. 11 and 12 show a form of our invention in which the ball center is provided with a leather cover. In making a ball in accordance with this form of our invention, a ball center 55 comprising an inner air-retaining wall 50 and a superimposed reinforcing wall 54 characterized by any suitable fibrous material is placed in a ball-shaped mold having formed on its inner face inwardly projecting ridges adapted to form grooves, each in cross section like the groove 51 shown in Fig. 12, and all presenting a pattern preferably like that of the seams 52 of Fig. 11. That it may be possible to form these grooves, the material of the outer portion of the ball center must be provided with vulcanizable rubber to a degree sufficient to render it capable of lateral displacement or "flowing" during the molding operation to present shallow grooves on its outer surface like that at 51. This may be accomplished by liberally impregnating with raw rubber in any manner the fibrous material of which the wall 54 is made, or by applying an extra layer 56 of unvulcanized or partially vulcanized rubber material to the exterior surface of the wall 54 of fibrous material before placing the center in the mold. The center 55 is then vulcanized and removed from the mold. Panels 53 of leather are then cut in the form shown in Fig. 11 and applied with the aid of an adhesive to the surface of the center. Preferably the meeting edges of the panels are folded inwardly and seated in the grooves 51. These meeting edges may, however, form butt joints along lines other than the seam lines and the grooves occupied by inwardly projecting folds of the leather panels. The covered ball may, if desired, be then placed in a second mold and additionally vulcanized.

A leather-covered ball constructed in accordance with this form of our invention has a number of advantages. If the panel joints are seated in the grooves, the meeting edges of the leather panels are protected from wear and abrasion, and are less liable to become separated from the center than is the case when the panels are cut and applied so as to present butt joints. Furthermore, the public is accustomed to a standard type of leather-covered ball with a removable bladder which has depressed seams produced by first stitching together with outwardly projecting seams the leather panels in a manner to leave an opening for insertion of the bladder, then inverting the leather cover so formed, and finally inserting therein the bladder. The seams of such a standard type ball are pleasing to the eyes and afford finger grips for handling the ball. A

leather-covered ball of this form of our invention having grooves in the leather cover simulates the appearance of this standard type of leather-covered ball and is less likely to encounter the sales resistance which is encountered by a ball of a strangely new appearance. The depressed grooves present an attractive design and relieve the appearance of the ball from the monotony of an unbroken smooth exterior surface and afford the players a finger grip to which they are accustomed.

The intermediate reinforcing layer of a leather-covered ball embodying this form of our invention may contain either wound strand material or suitably joined segments of woven fabric. The completed ball may have as an integral element an inner air-retaining bladder, or the bladder may be omitted and the reinforcing layer may be so constructed as to be air-tight.

If a leather-covered basketball, football, or soccer ball is manufactured with an underlying reinforcing layer constructed in accordance with our invention, the thickness of the leather casing may be substantially less than is the present practice since this reinforcing layer acts to resist the internal air pressure which, in balls as at present constructed, is withstood by a heavy thick leather cover. Thin, relatively pliable leather stock may be cut to form the panels, which will more readily conform to and lie flat on the surface of the ball. Pliability of the leather facilitates the seating of the meeting edges of the panels in the grooves formed in the ball center. If the panels are shaped and applied to the ball with butt joints and folds of the panels intermediate their meeting edges are seated in grooves formed in the ball center, the advantage of using thin, pliable stock for the panels is apparent.

While we have described several embodiments of our invention, we do not wish to be limited to these embodiments, but have defined our invention in the following claims.

We claim as our invention:

1. In a hollow, gas-inflatable, flexible-walled athletic ball having means for repeated inflation and deflation: a reinforcing layer adapted to resist circumferentially acting stresses and comprising substantially inelastically flexible strands of longitudinally secured fibers, said strands being unwoven relative to each other and disposed in latitudinally arranged convolutions around the ball within said flexible wall and being incorporated within said wall in adhesive relationship to the contiguous incorporating material of said wall, said strands being, at inflation pressures suitable for play, in a state of tension-produced, deformative elongation with respect to their normal state to a substantially uniform degree which is substantial but which is less than that at which rupture occurs, and said strands being substantially more resistant to elongation under tensional stress than is normally characteristic thereof.

2. In a hollow, gas-inflatable, flexible-walled athletic ball having means for repeated inflation and deflation: a reinforcing layer adapted to resist circumferentially acting stresses and comprising substantially inelastically flexible strands of longitudinally secured fibers, said strands being unwoven relative to each other and disposed in convolutions around the ball within said flexible wall and being incorporated within said wall in adhesive relationship to the contiguous incorporating material of said wall, said strands being, at inflation pressures suitable for play, in

a state of tension-produced, deformative elongation with respect to their normal state to a substantially uniform degree which is substantial but which is less than that at which rupture occurs, and said strands being substantially more resistant to elongation under tensional stress than is normally characteristic thereof.

3. In a hollow athletic ball adapted to be repeatedly inflated and deflated: a reinforcing wall

having two layers of latitudinally wound, elongated, tensionally deformed, inelastically flexible fibrous material incapable of substantial further elongation without rupture, the axis of one layer being at a substantial angle to the axis of the other layer, and said layers being bonded together in adhesive flexible material.

WILLIAM J. VOIT.
LEITH C. WEIMER.