Nov. 3, 1942. W. J. VOIT ET AL 2,300,441

METHOD OF MAKING ATHLETIC BALLS

Filed Dec. 3, 1940

Fig. 1.

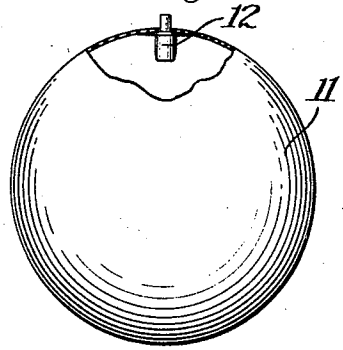


Fig. 2.

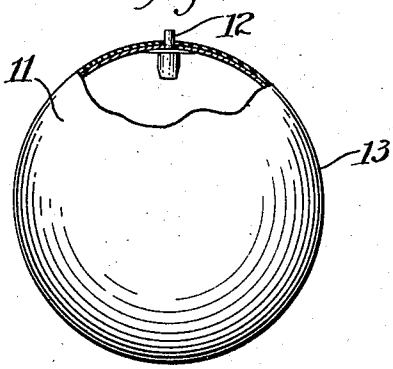


Fig. 4

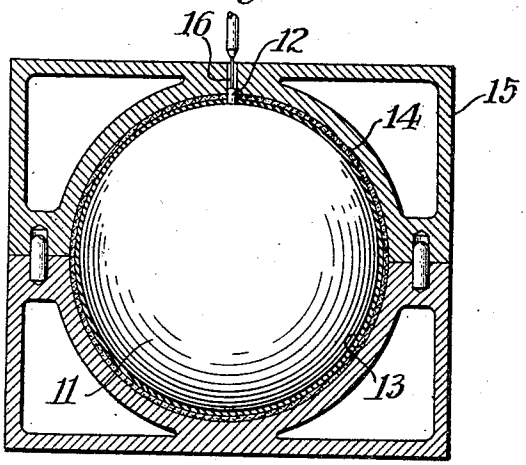


Fig. 3.

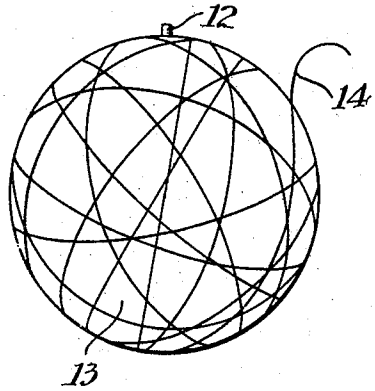


Fig. 7.

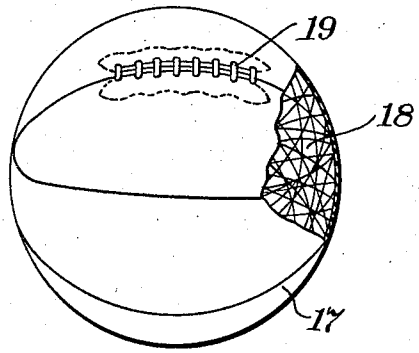


Fig. 5.

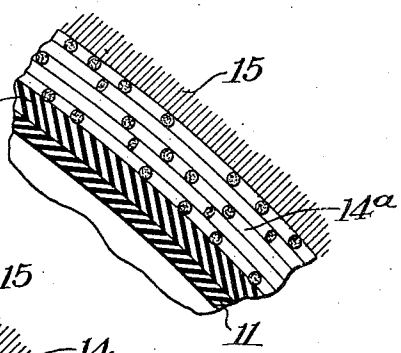
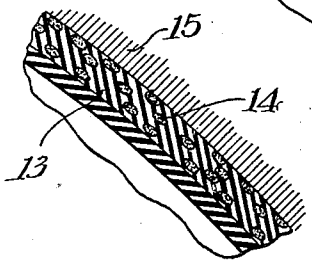


Fig. 6.



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

Patented Nov. 3, 1942

2,300,441

UNITED STATES PATENT OFFICE

2,300,441

METHOD OF MAKING ATHLETIC BALLS

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

Application December 3, 1940, Serial No. 368,356

9 Claims. (Cl. 154—16)

This invention relates to hollow inflatable athletic play balls and a method of making the same.

The walls of athletic play balls of this type are usually built up of a number of layers, each layer being adapted to fulfill a distinctive purpose. An innermost layer is adapted to receive and retain the air of inflation. An outermost layer is adapted to resist wear and abrasion caused by contact of the ball with external objects. An intermediate layer or layers are adapted to provide additional material to resist puncture and to strengthen the ball against enlargement in diameter under the pressure of inflation. All of the several layers, by their composition and in their relationship to each other, are adapted to give the ball the requisite play qualities as to resiliency and in other respects.

A layer of wound stranded material, such as fibrous thread or cord, has been found to be effective to serve as an intermediate reinforcing layer between the air-retaining innermost layer and the outermost protective covering layer. Sometimes this stranded material is wound upon the ball in great circles, or near great circles, the crossing points of the circles being scattered and rather generally distributed over the surface of the ball. In other cases the stranded material is spirally wound about an axis of the ball as a center, the winding beginning at or adjacent one pole of this axis and terminating at the other pole thereof.

These two methods of winding stranded material upon the ball, i. e., the great circle method and the spiral method, each have their relative advantages and disadvantages and each has its own field of use in which it possesses a superiority over the other method.

Of the two methods, the great circle method requires less expensive winding equipment, less skill and attention from the operator, and provides a reinforcing envelope completely covering all parts of the ball. The spiral method requires more expensive and complicated winding equipment to avoid piling of the strands one upon the other, is a slower process, and leaves vacant polar areas which must be covered by separate caps.

On the other hand, the spiral winding method gives to the intermediate reinforcing wall a more uniform thickness than that of a wall formed by great circle windings, gives an even outermost surface for the application of the wear-resisting cover and a relatively smaller depth for the same degree of reinforcement afforded and a more uniform density, the contiguous spiral convolutions lying closer together, and there being no polar crossings such as are present in the case of the great circle windings.

It is one object of this invention to provide a method of manufacture of athletic balls which shall utilize the great circle method of winding the reinforcing layer of stranded material, which shall retain the advantages of that method, i. e., low cost of equipment, rapidity of operation, and complete coverage of the ball with a continuous unbroken reinforcing wall, and at the same time eliminate its disadvantages, i. e., a rough outer surface on the intermediate re-inforcing wall, undue thickness in proportion to strength, a density of relatively low degree and uneven character, and uneven thickness.

It is another object of this invention to provide an inexpensive and practicable ball manufacturing process which shall afford in the completed ball a reinforcing wall of strands in great circle convolutions which shall be both inelastically flexible and substantially incapable of elongation when subjected to the stresses arising from the inflation of the ball and from the impact incident to its use. Metallic wire used for this purpose is highly resistant to tensile stresses but being elastically flexible imparts undue stiffness to the ball. Strands of fibrous material such as cord, yarn, and thread are inelastically flexible and therefore do not interfere with the desirable play characteristics of the ball, but in their normal condition will elongate when subjected to tensile stresses. It is therefore necessary, to provide a ball of the best quality, that fibrous material such as cord, yarn, or thread be employed in the reinforcing layer of the ball and that this stranded fibrous material be present in the completed ball under sufficient tension that the application of tensile stresses will not cause appreciable elongation of the strands.

There are only two methods by which this tension may be given the stranded fibrous material in the completed ball. Either the stranded material may be wound upon the ball at the desired tension in the first instance or it may be wound thereon initially substantially without tension or at a low tension and later the ball be placed in a mold somewhat larger than the completed ball and inflated sufficiently to create in the stranded material the desired tension.

The first of these two methods of providing the desired tension in the stranded reinforcing material is difficult to attain by any manufacturing process. The bladder will be temporarily depressed and furrowed by the stranded material at the point of winding contact with the result

that the wound ball will be misshapen and will present undulations interfering with the proper performance of the completed ball when placed in use. To avoid this the bladder may be made rigid for the reception of the windings by building it originally upon a form of solid material. This form may be collapsible in character or may consist of some material which may be liquefied at a higher temperature. The use of either type of form is expensive and slow. The collapsible form must be removed through an opening in the ball provided in both the bladder and the envelope of wound stranded material. Either provision must be made for lacing this opening or the opening must be permanently closed at later stages of manufacture of the ball. It is impossible in a manufacturing method which involves the use of a collapsible form to provide a continuous, strong, unbroken wall in the completed article. Even when a form of any kind is used it is difficult to apply the stranded material with an equalized even tension.

By initially winding the stranded material on the bladder at no tension or at a low tension and thereafter providing tension in the stranded material by inflating and expanding the wound bladder and vulcanizing it with the strands under tension, both of the disadvantages attendant upon the use of a high initial winding tension are eliminated. A form is not necessary and the high tension in the strands of the completed ball is uniform. During the time the strands are subjected to the inflation pressure the tension in them is evenly distributed and equalized throughout their entire length. High tension so produced is therefore more uniform in character than that produced by initially winding the stranded material at high tension.

An initial low feed tension is preferable to no initial tension. It is difficult with a loose feed to lay the cord or other stranded material upon the bladder in a layer of even density. The final tension of inflation will be more uniform if a small initial feed tension is used. By using a low initial feed tension a smaller pressure of inflation need be subsequently applied and a smaller expansion of the layer of cord windings in the vulcanizing step will be required.

It is therefore an object of this invention to provide means for applying at a low initial feed tension stranded material to a bladder without the use of a form and without deformation of the bladder.

In the drawing:

Fig. 1 shows in elevation a bladder upon which the ball is to be constructed;

Fig. 2 shows in cross-section the bladder coated with soft uncured rubber material;

Fig. 3 is a view in elevation of the coated bladder partially wound with cord;

Fig. 4 shows the ball center placed in a mold ready for the vulcanizing operation;

Fig. 5 is an enlarged cross-sectional view of a portion of the ball center wall and the mold showing the structure of the wall after the winding operation is completed and its position relative to the mold;

Fig. 6 is an enlarged cross-sectional view of a portion of the ball center wall and the mold showing the construction of the wall and its position relative to the mold after completion of the vulcanizing operation; and

Fig. 7 is a view of the completed ball including a wear-resisting cover.

The first step in the manufacture of the ball is the making of the air-retaining innermost layer of the ball, commonly called the "bladder." This may be made in any suitable manner, but preferably pieces of relatively thin sheeted rubber or other rubber-like material are secured together along their marginal edges in the shape of a ball to form an air-retaining bladder **11**. Assuming that the diameter of the completed ball is 9½", the stock used for the bladder may, for example, be $\frac{1}{32}$" thick. An inflation valve **12** of a suitable character is secured in place in the bladder **11**. The bladder is then placed in a mold, is provided with air-conveying means by which air may be forced into the interior of the bladder through the valve **12**, is then inflated and while under inflation is subjected to a heat treatment which cures the rubber material of the bladder and gives it the definite form of an athletic ball.

Present practice is to cure the bladder as a flat double-sheeted circular disk, which assumes a spherical form when inflated to prepare the bladder for building thereon the outer walls of the ball. Such a bladder, when inflated, is obviously under a minimum circumferential tensile stress at the equatorial line which, prior to inflation, was the periphery of the double-sheeted disk, and at a maximum circumferential stress at the two poles remote from this equatorial line, the circumferential tensile stress progressively increasing from this equatorial line to the two poles. Obviously, also, the thickness of the inflated wall at any point varies from its thickness when deflated inversely as the tension at that point. The wall of a bladder cured in spherical form in accordance with this invention is under an equal tension and of a uniformly decreased thickness at all points when inflated.

The air pressure in the bladder is then removed; the bladder is taken from the mold and reinflated to a size somewhat less than that desired for the completed ball. The bladder **11** is then covered with a coating or layer **13** of soft uncured rubber (see Fig. 2) which may be applied by several dippings of the bladder in a bath of rubber material or by any other approved method. As an example, for a ball 9½" in diameter, when completed, such a coating may be $\frac{3}{64}$" thick.

Cord, thread, yarn, or other stranded material **14** (see Fig. 3) is then wound upon the layer of soft rubber in great circles by any means satisfactory for the purpose. A standard means comprises two parallel rollers spaced a small distance from each other and driven in the same direction of rotation. Means is provided for effecting a reciprocating relative longitudinal movement of these two rollers while they are being rotated. The coated bladder to be wound is placed upon the upper surfaces of the two rollers by which it is given a movement of rotation about an axis parallel to the axes of the rollers. Due to the relative longitudinal movement of the two rollers the cord, which is fed under a light tension from below the rollers up over the outer side and top of one of the rollers to the ball, is wound upon the coated bladder in near great circles about axes constantly changing with respect to the coated bladder. When the winding operation is completed, a layer **14a** of wound cord of substantially uniform thickness has been laid upon the coating of soft rubber, as illustrated in Fig. 5, to produce an uncured ball center. During the winding operation the tension of the cord may be gradually and slightly increased. However,

neither the initial tension at the beginning of the winding operation nor the tension at the completion of the operation is sufficient to deform the bladder, although the innermost windings may become partially embedded in the coating 13. In making a 9½" ball this layer of cord may, for example, be ⅛" thick, and the cord used may be of a diameter of $^{25}/_{1000}$".

The wound ball center is then placed in a mold 15 provided with an air duct 16 which registers with the valve 12 (see Fig. 4). The cavity of this mold is preferably of substantially the same diameter as that of the ball center. The ball center is then heated sufficiently to bring the soft rubber to a semi-fluid state, and is inflated to a sufficient pressure to force the ball center into heavy pressural contact with the mold cavity walls. A vulcanizing cure is then given the ball center in the mold.

When the ball center is subjected both to heat and the pressure of inflation, the bladder 11 forces the material of the soft rubber coating 13 through the interstices of the windings of the layer of cord, the outermost portion of the soft rubber material coming into contact with the walls of the mold cavity. The very outermost cord convolutions are held against outward movement by the mold walls and the remaining convolutions are pressed outward against them. The initial winding tension is sufficient to partly restrain the remaining convolutions from being pressed too tightly against the outermost convolutions and against each other, thereby preserving interstices of a size such that the soft rubber material may be forced among the cord convolutions, completely encasing them and forming a layer of vulcanized rubber in which the cord convolutions are embedded. But this initial tension is not sufficient to prevent the inner convolutions from being moved outward into a closer relationship with the outer convolutions, with the result that the thickness of the layer 14 of rubber embedded cord after vulcanization is much less, and the density much greater than was true of the layer of cord windings prior to vulcanization (see Figs. 5 and 6). Also, since the initial tension progressively increases somewhat as between the inner and outer windings of the cord, both the final tension of the windings in the more compact layer in the cured center and the final density of this layer will be substantially uniform. It is to be observed that if the mold cavity is larger than the uncured wound ball center, similar results are obtained except that the tension increase in all the convolutions is proportionately greater.

If the pressure applied internally to the ball center during this molding operation be, to illustrate the process by an example, 90# per square inch, and if the completed ball is to be a 9½" ball, and the uncured ball center have a bladder wall, soft rubber layer, and cord windings of thicknesses, as mentioned above, the various elements of the ball center will move outwardly to provide a cured center having an outer wall of rubber $^{1}/_{8}$" in thickness in which is embedded the cord windings and an inner bladder wall $^{3}/_{32}$" in thickness. The initial layer of soft rubber of $^{3}/_{64}$" in thickness and the overlying cord windings of $^{8}/_{64}$" in thickness, the two layers having a total initial thickness of $^{11}/_{64}$", will have been compressed and reduced to a thickness of $^{4}/_{64}$". The diameter of the outer surface of the cured center will be substantially the same as that of the uncured center, but the internal diameter will be greater by $^{14}/_{64}$" or $^{7}/_{32}$".

The ball center, after being cured, is removed from the mold and is given a wear-resistant cover 17. This cover may be of rubber, in which case the assembled center and cover are given a vulcanizing cure under pressure in a mold, or the cover may be of leather applied in segments with a suitable adhesive and pressed tightly upon the ball center in a mold preferably in conjunction with the application of a low temperature heat. Fig. 7 shows the completed ball with a rubber cover 17 applied to the cured ball center 18.

Preferably the cavity of the mold in this final operation is slightly larger in diameter than that of the cured ball center. In the case of the 9½" ball above mentioned, this difference in diameter may be $^{1}/_{16}$" to $^{1}/_{4}$", giving the cord windings an additional elongation and constituting them more resistant to tensional stresses. The walls of this mold may also be formed to impress designs, such as the simulated lacing 19, on the surface of the ball.

The soft rubber coating upon the bladder makes possible an initial feed tension of low degree, the rubber material yielding locally to receive the initial convolutions of cord without deformation of the bladder. It provides a layer of uncured material which may later be forced outwardly into the interstices of the cord windings to form a matrix and binder for these windings. It also provides the material for a smooth outer surface upon the cured ball center, upon which surface the wear-resisting cover may be readily and smoothly applied. It will also be observed that the operation of supplying internal air pressure to the ball both places the fibrous cord winding under tension and drives the soft rubber coating into its outer position where it encases all of the individual cord windings and affords a smooth outer surface for application of the wear-resisting cover.

That feature of the invention by which the initial feed tension of the cord is progressively increased during the winding operation makes possible a higher average initial feed tension for all of the cord windings. This progressive increase in feed tension is practicable because as the wall of the ball becomes thicker it is more resistant to deformation by the later applied windings. This feature also makes it possible to subsequently compress the cord windings into a relatively thin layer of even density, and all the windings of which are of uniform tension. The initially greater tensed outer convolutions are more resistant to outward movement by reason of their greater tension and because they are held to their position by the surrounding mold. The initially less tensed inner convolutions are moved outwardly against the outer convolutions, acquiring an increased tension substantially the same as that of the outer convolutions and forming therewith a thinner and denser layer. This relatively thin, dense layer is superior to the loose, low-density wall which has hitherto resulted from the large number of great circle crossings of the windings.

We claim as our invention:

1. A method of making a hollow inflatable athletic ball, comprising: making a cured air-retaining bladder of rubber material; inflating said bladder; coating said bladder with a layer of soft uncured rubber material; winding said coated bladder with stranded material; further

inflating said coated and wound bladder in a mold in a manner to drive said soft rubber material outwardly to encase said stranded material and to form a smooth outer surface outside said stranded material; and thereafter curing said soft rubber material.

2. A method of making a hollow inflatable athletic ball, comprising: making a cured air-retaining bladder of rubber material; inflating said bladder; coating said bladder with a layer of soft uncured rubber material; winding said coated bladder with stranded material in substantially great circles in all directions to completely cover said coated bladder; further inflating said coated bladder in a mold in a manner to drive said soft rubber material outwardly to encase said stranded material and to form a smooth outer surface outside said stranded material; and thereafter curing said soft rubber material.

3. The method defined in claim 1, in which the inflation of said coated and wound bladder in a mold is accompanied by application of heat to further soften said coating.

4. The method defined in claim 2 in which the stranded material is wound on said coated bladder at an appreciable tension.

5. The method defined in claim 2 in which said stranded material is wound on said coated bladder at a progressively increasing tension.

6. The method defined in claim 1 in which a wear-resisting cover is bonded to the cured coated bladder.

7. The method defined in claim 1 in which a rubber cover is vulcanizably bonded to the cured coated bladder.

8. A method of making a hollow inflatable athletic ball, comprising: making a cured air-retaining bladder of rubber material; inflating said bladder; coating said bladder with a layer of soft uncured rubber material; winding said bladder at an appreciable tension in substantially great circles in all directions to completely cover said coated bladder; further inflating said coated and wound bladder in a mold, said pressure of inflation driving said soft rubber material outwardly to encase said stranded material and form a smooth outer surface outside said stranded material, said inflation being accompanied by the application of heat to facilitate said outward drive of said soft rubber material; thereafter curing said soft rubber material; removing said coated and cured bladder from the mold; applying to said coated and cured bladder a rubber cover; and giving a final cure to said rubber covered coated and cured bladder while under inflation in a mold having a cavity appreciably larger than said rubber covered coated and cured bladder.

9. The method of making an inflatable and deflatable athletic ball, comprising: taking an inflated rubber body having an inflating valve permanently secured thereto and winding elongated fibrous material upon said body in great circle convolutions; placing said wound body in a mold having a cavity of a size larger than said wound body; further inflating said wound body to press the fibrous material into intimate contact with the inner walls of said mold and thus place said fibrous material under tension; vulcanizing said wound body while said fibrous material is under tension; and deflating and removing the vulcanized wound body from said mold.

WILLIAM J. VOIT.
LEITH C. WEIMER.