INFLATABLE BALL WITH COMPOSITION COVER AND SYNTHETIC THREAD WINDING


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3 Claims. (Cl. 273—65)

This invention relates to inflatable athletic balls, and has particular reference to spherical balls such as basketballs, soccer balls and volleyballs, although the invention is not limited in all aspects to a spherical ball.

An important object of the invention is to provide an inflatable athletic ball in which the size and shape of the article as manufactured or fabricated will be maintained thereafter under effective control, and will be kept within very close limits.

A further object of the invention is to provide a ball of the basketball type having a very strong wall structure which is very simple and easily built, and in which the use of rubberized fabric is altogether eliminated or reduced to a minimum, and in which the process of manufacture is considerably simplified.

Another object of the invention is to provide a very durable ball which is "playable" and has a resilient and flexible cover or outer layer that is not subject to cracking and breaking, and has further advantages as hereinafter set forth.

Another purpose of the invention is to coordinate in an improved manner the several layers of material that are used in the ball wall, so that, with regard to the finished ball as a unit, a considerable improvement is provided.

In the accompanying drawings:

Fig. 1 is an elevation of a basketball embodying the invention;

Fig. 2 is a broken view showing different layers of material in the wall;

Fig. 3 is an elevation showing the bladder after it has been covered with a winding of cord or thread;

Fig. 4 is a somewhat diagrammatic sectional view showing a manufacturing step following the application of the cord winding;

Figs. 5 and 6 are views similar to Fig. 4, showing later stages in the manufacture;

Fig. 7 is a perspective view showing a form of cord used in winding the bladder; and

Fig. 8 is a perspective view showing a cord of modified form.

By way of example there is described a basketball and the steps employed in its manufacture. In making the ball shown, a spherical pre-cured valve-equipped bladder of rubber is provided, and, after inflation of the bladder to such an extent that a rather firm sphere of the proper size is provided, a winding of cord or thread is applied to the bladder, the turns of the cord or thread being disposed approximately on great circles. Then, with or without preliminary impregnation of the cord with rubbery tacky material, a layer of uncured rubber called "intermediate rubber" is applied to the winding. Then an uncured layer of cover stock is applied to the intermediate rubber, the same being a curable material such as hereinafter described. Following this, the article is placed in a mold and inflated so as to shape properly and densely the wall structure, as hereinafter more particularly described.

In the drawings, the rubber bladder is indicated at 10, and the inflating valve at 11. The valve may advantageously be of the type shown in the Delaney and Madsen Patent No. 2,065,121, dated December 22, 1938. The valve has a rubber stem 12' into which the inflating needle can be introduced, and which extends through the ball wall so as to be accessible at the exterior. The cord with which the bladder is wound is shown at 12, the intermediate layer at 13, and the outer layer, which provides the cover, at 14. The structure of the wall will be more fully understood from the following description of a preferred method of constructing the ball.

The bladder 10 has a relatively thin rubber wall, and it may be made by accurately cutting a number of quadrants and seaming them together in the manner described in the Madsen Patent No. 2,218,919, of October 22, 1940, and then molding the bladder accurately to shape in a spherical mold. By proceeding in this manner it is possible to provide a precisely spherical bladder. The bladder is vulcanized in the process of making it, as by heating of the mold, so that the spherical shape will be maintained. In the process of making the ball the bladder is inflated to provide a rather firm sphere of the proper size. The next step is to apply the winding of cord, this winding being applied directly to the bladder surface over the entire surface except for the inflating valve stem. One end of the cord 12 is adhered to the bladder surface in a suitable manner, as by using a little piece of uncured rubber for adhesion purposes, and the winding is then commenced and carried on in such a manner that a relatively thin and open layer of intersecting cord turns is provided, the turns being disposed substantially on great circles.

Before the layer of intermediate rubber 13 is applied to the cord winding, the cord may be impregnated with a suitable curable impregnating substance in liquid form which is rubbery and tacky. It is preferred to impregnate the cord with such a tackifying agent, but it is not necessary in all cases.

The next step is to apply the intermediate rubber, and this is done preferably by applying to the wound bladder a thin cover of uncured rubber sheet, the cover being made up of quadrants which are joined together at their adjacent edges so as to provide a complete covering layer through which the valve stem projects.

The next step is to apply the external layer or cover 14. For this layer a special rubber compound is used, as hereinafter described. This compound in uncured condition, and in the form of a sheet, is applied to the article in substantially the same manner as the intermediate rubber layer is applied.

The next step is to place the article or blank, made up as previously described, in a mold having a spherical inner surface, in which mold the ball wall will be condensed under air pressure and given its final form. The mold is usually heated so that, concurrently with the shaping, the curable components in the wall structure will be cured or vulcanized. The inflation of the ball in the process of molding is carried out by introducing air into the bladder through the inflating valve.

After the steps just described, the article having been left in the mold for a period sufficient for complete setting and curing, the ball is removed from the mold, and after minor finishing operations is ready for use.

In the drawings the showing of the cord layer is somewhat diagrammatic, and in practice the number of turns of cord will usually be in excess of those shown in Fig. 3, although the layer of cord will be relatively thin and relatively open. The openings or interstices that go through the winding layer may have an area which averages, say, .005 sq. in. This figure is also given only by way of example. Where the cord is made of synthetic fiber, such as nylon, it has great strength, and a thin
open layer of turns has all the necessary strength, and has the additional advantage of firmly anchoring and holding the intermediate rubber on account of the fact that the intermediate rubber goes through the interstices of the winding and has the cord turns well distributed through the thickness of the intermediate rubber layer, as shown in Fig. 6. It is preferred to use for the cord material 12 a suitable cord formed of nylon, a portion of such cord, greatly enlarged, being illustrated in Fig. 7. In this form the cord 12 comprises two intertwined fibrous strands or elements of nylon, one of which, indicated at 12', is of relatively large cross section, and the other of which, indicated at 12", is of relatively small cross section. The thicker element 12' is composed of continuous parallel filaments, and the thinner element is composed of short or staple fibers spun together in a body to create a yarn-like member from which the fine short fibers project, as shown somewhat schematically in Fig. 7. The short fibers may have a length of say one inch to three inches, and this provides upon the yarn a large number of fine filamentary projections. The two elements or strands are intertwined in the manner schematically shown in Fig. 7, the element 12', on account of its smaller diameter, taking more of the twist or deviation. One effect of combining the two elements in this manner is to provide a cord of two strands or components, of which the larger is relied upon for providing strength in a linear direction, while the other component, by virtue of its being twisted about the first one, provides a ridge formation, or, in other words, rib-like roughening members or portions upon the cord, as well as providing the projecting or exposed ends of the fine short fibers. A cord structure as above described is of particular advantage where, as in this case, the cord turns are substantially in great circles and intersect each other, because the cord turns are securely held by reason of the interengagement of the roughening or ridge formation of crossing turns, and also the interentanglement of the fiber ends of one turn with those of an intersecting and contacting turn. It will be apparent how a cord portion such as shown in Fig. 7 will interlock and become entangled with a similar cord portion crossing and contacting the first portion. It will also be apparent that a cord of this kind provides most effective engagement and embedment of the intermediate rubber when, in the course of making the ball, the intermediate rubber and the cord layer are forced toward each other under the molding pressure. The bladder, being pre-cured, gives greater resistance to the threads than does the intermediate rubber. The thread turns, while becoming embedded in the intermediate rubber, usually do not to any great degree go beyond the outer surface of the intermediate rubber layer although they do roughen this surface to a certain extent by providing thereon a multiplicity of ridge-like formations. These ridge-like formations naturally are of considerable value because they press to a certain extent into the inner surface of the covering layer so as to interlock therewith. The roughening and interlocking effect upon the covering layer and upon the bladder is indicated in Fig. 6, which shows on an enlarged scale a portion of the wall of the completed ball. In Fig. 8 there is shown at 15 a plain cord which can, if desired, be used in place of the special cord shown in Fig. 7. The cord 15 is made of synthetic fibers, preferably nylon fibers, and in the particular form shown is one made up of a large number of parallel continuous filaments. Such a cord has great strength and this makes it possible to provide a winding layer which is relatively thin in cross section, as above described, although the features provided by the ridge formation of spun fibers are absent. In some cases a cotton cord can be used. The rubber used in the intermediate layer 13 is customarily an ordinary rubber compound comprising natural rubber or synthetic rubber. The covering layer, however, is of a special composition, employing, in conjunction with natural rubber, a certain amount of high-styrene styrene-butadiene copolymer, the composition being of such character that the cover is markedly superior to a rubber cover or a cover of leather. In the cover we use there may be employed, with natural rubber, a copolymer having 75% of styrene and 25% of butadiene. With these two rubbers there are used inorganic activators, a certain amount of sulphur, and a suitable accelerator, the ingredients being mixed together by customary mixing procedures and the compound being very readily cured by bringing it to a vulcanizing temperature. The composition used for the cover stock is especially valuable in providing material that is more resilient than compositions previously used for the same purpose, thereby making the ball more "playable." The ball is also made more durable by reason of the fact that the cover layer flexes with the underlying part of the ball and does not break away on continued flexing, as has commonly been the case in the past. When the covering layer is too stiff it is very likely to be broken or ruptured as the underlying carcass of the ball is repeatedly flexed, but in the present case the covering layer, being very flexible, follows the flexing of the carcass. In balls such as basketballs and footballs it is common practice to provide in the outer ball surface a number of grooves such as shown in Fig. 1, which are formed in the material of the covering layer for the purpose of providing a better grip upon the ball, and in these grooved portions or parts of such portions the covering layer is customarily thinner than in other regions and more susceptible to cracking on flexing of the carcass. The flexibility of the covering layer provided upon the present ball is sufficient to overcome or inhibit the cracking of the cover within the grooves, and the longevity of the cover is increased insomuch as the "flex life" is exceptionally long. Another feature of great advantage also is the strong adhesiveness of the cover layer to the layer of intermediate rubber. The following is a typical cover stock composition, the ingredients being measured by weight:

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<tr>
<th>Example No. 1</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Natural rubber</td>
<td>52.0</td>
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<tr>
<td>75/25 styrene-butadiene copolymer</td>
<td>29.0</td>
</tr>
<tr>
<td>Inorganic activators</td>
<td>12.5</td>
</tr>
<tr>
<td>Coloring pigment</td>
<td>3.0</td>
</tr>
<tr>
<td>Organic accelerator</td>
<td>3.0</td>
</tr>
<tr>
<td>Sulphur</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Another example of the cover composition is as follows:

<table>
<thead>
<tr>
<th>Example No. 2</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural rubber</td>
<td>50.0</td>
</tr>
<tr>
<td>70/30 styrene-butadiene copolymer</td>
<td>29.0</td>
</tr>
<tr>
<td>Inorganic activators</td>
<td>13.5</td>
</tr>
<tr>
<td>Coloring pigment</td>
<td>3.0</td>
</tr>
<tr>
<td>Organic accelerator</td>
<td>3.0</td>
</tr>
<tr>
<td>Sulphur</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

As far as the styrene-butadiene copolymer is concerned, the percentage of styrene may vary between 80 and 60. Above the upper limit the copolymer becomes too stiff, and below the lower limit the composition will lack among other qualities, the necessary strength and durability, and also the leathery feel which is characteristic of the composition will not be present. For the cover composition the ranges of the natural
rubber, styrene-butadiene copolymer and inorganic activ-
ators are:

Natural rubber ------------------ from 45% to 55%
High-styrene styrene-butadiene copoly-
mer ------------------ from 35% to 25%
Inorganic activators ------------------ from 10% to 15%

As is apparent, the composition includes in addition coloring matter, sulphur, and an accelerator. These may be varied in amounts so as to accord with the charac-
teristics of the principal ingredients above named, and to meet as far as possible the existing conditions and requirements.

Tests of compositions made up as herein described reveal that the initial tensile strength is in the range of 2500 lbs. to 2750 lbs., the elongation in the range 425% to 450%, and the tear resistance, as measured by the A. S. T. M. rubber tear test, in the range of 90 lbs. to 110 lbs. per square inch. In connection with the tear resistance, it is noted that in comparison to previous com-
positions used for the purpose the tear resistance figure is rather low, but it is quite sufficient for the purposes in view by reason of the fact that the cover layer is so flexible and soft, and with the underlying layer of fibrous material made up of fabric, cord or the like. With regard to resistance to abrasion, this, of course, is of great importance, especially as basketballs and like balls are commonly used on outdoor courts of concrete or trap rock as well as on polished gymnasium floors. Compositions of this kind meet all of the requirements in this respect, as it has been found that these compositions, as tested by the Tauber abrasion test, show a loss of the order of 1.5% in weight in 2,000 revolutions of the emery wheel.

It has also been determined that these compositions pass the customary aging tests and have the necessary longevity. The cover stock has been tested likewise for resiliency, and admirably meets the requirements in this respect, the resiliency being quite high considering the great abrasion resistance of the cover. The flexibility of the covering layer is also high so as to present the advantageous features mentioned above. The resiliency and flexibility of the cover stock will, however, be noticeably less than that of the intermediate rubber providing the layer 13. The rubber in layer 13 is preferably quite soft, bouncy and resilient, for the purpose of providing a cushion-
ing layer between the cover and the bladder. Were it not for this relatively soft layer the ball playing condition would be too stiff and hard and would not have the desirable playing qualities that are provided in this instance. The ball wall has ample resiliency and bounce where the covering layer is backed up by the cushioning layer, without, on the other hand, using a greater internal pressure than, say, 8 or 9 pounds, and by being able to use a relatively low air pressure in the ball so as not to make it too hard the stinging of the hands of the players or like detrimental effect is avoided.

For the bladder it is preferred to use butyl rubber, be-
cause this holds air better than other rubbers. It is not necessary to use butyl rubber, however, in all cases. Where butyl rubber is used there is a certain decrease of resiliency in comparison to natural rubber, but in our ball structure this low resiliency is compensated by the resiliency given to the intermediate cushioning layer which is greater than that of the bladder. It is, therefore, clear that the character of the cushioning layer modifies the resiliency and other characteristics of the ball in a man-
er to compensate for characteristics possessed by the covering layer and the bladder, respectively.

It is usually preferred to make the bladder wall con-
siderably thinner than the other two layers, as shown in Fig. 6, but variation may be made in this and other respects.

For a basketball having an outside diameter of 9% inches the wall may have, for example, a thickness of .130 inch, of which the bladder thickness is .020, the in-
termediate rubber (and cord) thickness .070 inch, and the cover .040 inch. These dimensions are by way of example and for purposes of explanation.

The cover stock as above described has good adhe-
sion to the intermediate rubber and, when the cord turns project outwardly from the intermediate rubber, to the cord turns of nylon. The intermediate rubber, on the other hand, has very good adhesion to the cord turns and to the bladder. In addition to the good adhesion between the cover and the intermediate rubber, and between the bladder and the intermediate rubber, so far as adhesion per se is concerned, there is the locking effect heretofore mentioned produced by the cord turns that are embedded in the intermediate layer and provide on said layer ridges or projections that extend into and interlock with the adjacent layers. The effect just referred to, moreover, is increased owing to the fact that the cord layer is a rela-
tively thin one presenting relatively large interstices in which the intermediate rubber is engaged and locked.

It will be seen from the foregoing that it is made pos-
sible to provide a ball that is shaped very precisely and has a tough durable wall that will maintain its shape in hard service. The process of making the ball is very simple and the amount of textile fiber used in the ball is reduced to a minimum. While having the necessary strength and durability, the ball wall can be made rela-
tively thin in comparison to the prior ball orals of this general type. So far as the official specifications of the ball are concerned, such as size, weight, etc., these can be met with relative ease. Owing to the fact that only a rela-
tively small amount of fibrous material is used in the ball wall, the proportion of the wall thickness given over to the abrasive-resistant cover stock can be increased in comparison to prior ball structures, thus giving the ball a longer life.

A further important advantage of the new ball is that, with a cover of the described composition, there is elimi-
nation of undesirable noise or so-called squeaking effect incident to squeezing or high compression of the ball in play.

The term rubber is used herein in a broad and general sense unless there is indication to the contrary. Various changes can be made in the ball structure as herein described without departure from the principles of the invention or the scope of the claims.

What we claim is:

1. An inflatable athletic ball having a valve-equipped bladder of butyl rubber, a relatively thin and open winding of cord comprising synthetic fibers having the cord turns substantially on great circles and in close proximity to the outer surface of the bladder, the cord comprising an inner element of continuous filaments having a surface rough-
ening of ridge-like formation acting to anchor the cord turns relatively to each other and to the bladder, a cushioning layer of rubber embedding said cord turns and extending through the interstices between them, the rub-
ber of said cushioning layer being more resilient than that of said bladder, and an outer cover applied to said cushioning layer comprising natural rubber mixed with a lesser amount of styrene-butadiene copolymer containing between 60% and 80% of styrene.

2. An inflatable athletic ball of spherical shape having an inflatable valve-equipped bladder, a layer made up of
turns of cord or thread disposed on great circles having the innermost turns lying against the outer surface of the bladder in the entire external area of the bladder except for the valve area, the winding being relatively thin and having relatively large interstices and the cord turns being of synthetic fibers and for more that one strand twisted together, one of these strands being a heavier strand composed of parallel filaments and the other strand being a lighter strand of a yarn-like charac-
ter having externally projecting filaments, said project-
ing filaments serving to anchor the cord turns of the
open winding to each other and to the bladder, a cushioning layer of soft bouncy rubber embedding the cord turns and extending through the interstices between them and into bonding relationship to portions of the bladder, and an outer cover applied directly over and bonded to said cushioning layer comprising natural rubber and a lesser amount of a styrene-butadiene copolymer having a styrene content between 60% and 80%, the cushioning layer and the cord turns constituting the entire filling between the bladder and the cover.

3. An inflatable athletic ball having a valve-equipped spherical bladder of butyl rubber, a relatively thin and open winding of cord comprising synthetic fibers laid directly against the bladder surface substantially throughout its area and having the cord turns substantially on great circles, the cord having an inner element of continuous filaments and an outer element of less diameter twisted about the inner element comprising spun fibers having projecting filamentary ends for anchoring purposes, a cushioning layer of rubber embedding said cord turns and extending into contact with the bladder surface, and an outer or cover layer applied to said cushioning layer and comprising natural rubber mixed with a lesser amount of styrene-butadiene rubber containing between 60% and 80% of styrene, the cushioning layer being thicker and more resilient than the cover and the cover being thicker than the bladder.

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<th>Date</th>
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