Aug. 1, 1939. B. BOGOSLOWSKY 2,167,869

METHOD OF MAKING A GOLF BALL

Filed Sept. 15, 1936 2 Sheets-Sheet 1

Fig. 1

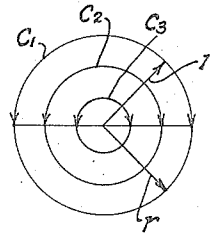


Fig. 2

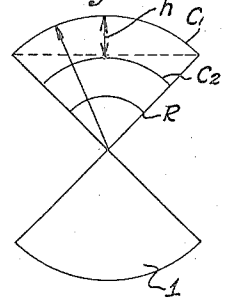
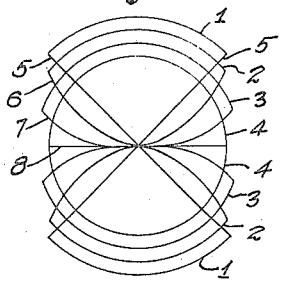


Fig. 3



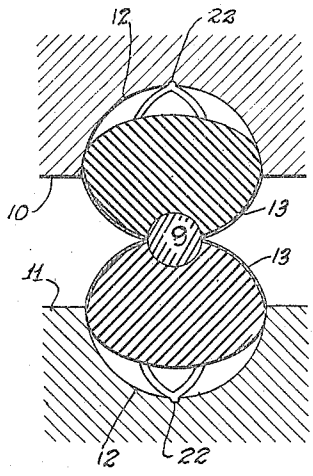


Fig. 6

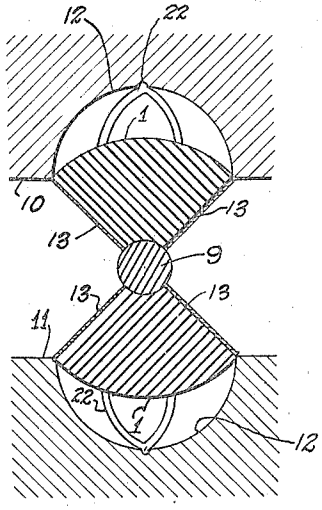


Fig. 5

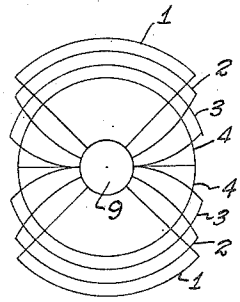


Fig. 4

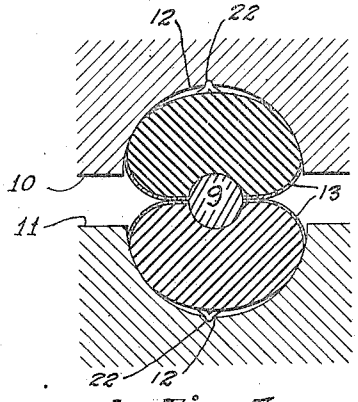


Fig. 7

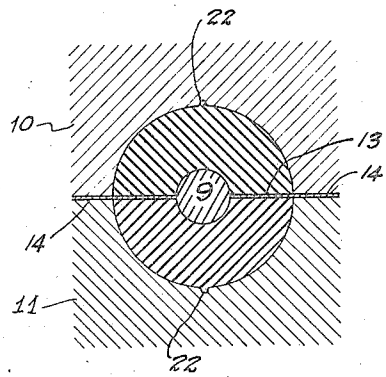


Fig. 8

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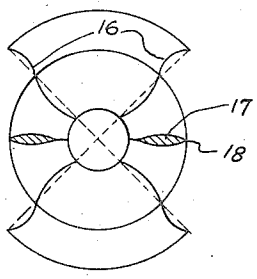
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Aug. 1, 1939. B. BOGOSLOWSKY 2,167,869

METHOD OF MAKING A GOLF BALL

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Fig. 10



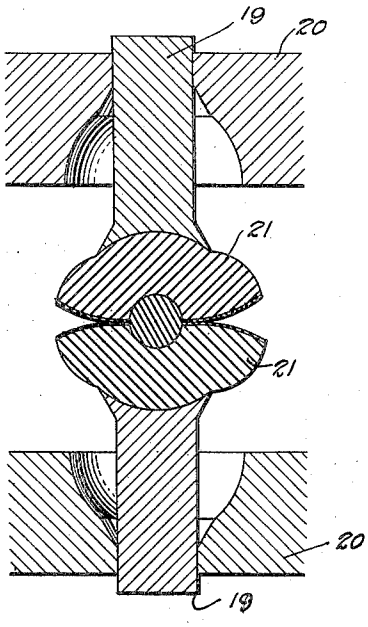


Fig. 11

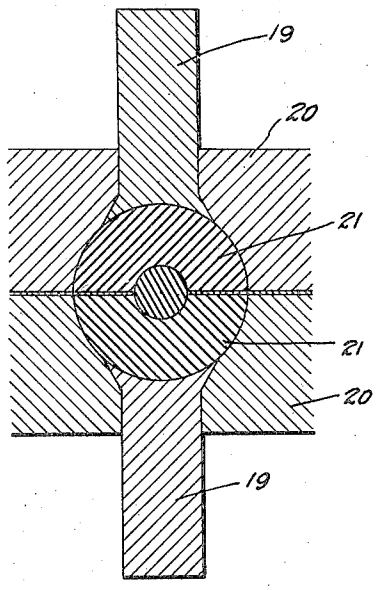


Fig. 12

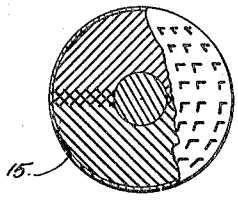


Fig. 9

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UNITED STATES PATENT OFFICE

2,167,869

METHOD OF MAKING A GOLF BALL

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Application September 15, 1936, Serial No. 100,869

13 Claims. (Cl. 154—16)

This invention relates to golf balls and is directed to a ball of novel construction and a method of making the same.

Golf balls are universally now made by wrapping a rubber band or bands about a suitable core until there is produced a ball body of desired size, after which the resulting structure is encased within a gutta-percha cover.

This method of manufacturing golf balls is open to a number of well-known disadvantages. For example, it is extremely difficult with this procedure to make a ball body wherein the core is positioned at the geometrical center of the ball, and consequently, the ball body, after being wrapped, is not a true sphere and the center of its weight is not at its geometrical center. It is, of course, true that golf balls, as now made, have a surface which is spherical in shape, but in order to accomplish this result, the gutta-percha covering must be of variable thickness in order to compensate for the deviation from true spherical form during wrapping of the elastic bands, and also to compensate for the ridges produced at the surface of the body by the wrapping of such bands. By varying the cover thickness to meet the requirements, the non-spherical ball body may be made to produce a spherical ball, but it cannot correct the off-center condition of weight of the ball and in many cases tends to aggravate it.

When a ball, wherein the center of weight is not positioned at the geometrical center of the ball, is struck by a golf club, it will not follow a true trajectory but will tend to wobble or gyrate and produce an effect similar to a "hook" or "slice". Furthermore, when a ball wobbles during its passage through the air, its resistance is increased and its length of travel is correspondingly decreased.

These facts are recognized by those skilled in the art and it is a common practice to subject every ball, after its manufacture, to appropriate tests primarily intended to disclose whether or not the center of gravity of the particular ball is at the geometrical center thereof. Actual experience shows that such is seldom the case, but manufacturers operate within predetermined tolerances and a ball which tests within these tolerances is considered a first-class ball. Balls which test close to but without the tolerances are sold as cheaper or inferior balls, but under prior practice there is a large percentage of balls which are wholly unmarketable.

Aside from the question of center of gravity and the effect of a cover of variable thickness thereon, it is well recognized that gutta-percha or balata is practically non-elastic, and when a cover thereof is of variable thickness, the effect of a given stroke will depend upon that portion of the ball which may be struck. Consequently, with balls as now made, uniformity in effect of the propulsive stroke is questionable. Moreover, gutta-percha, while hard and tough, is obviously no stronger than its weakest point which is generally its point of minimum thickness. When such a cover is subjected to the stresses of inherent, internal elasticity of the ball body, it is not uncommon for the cover to be fractured and split at this point of weakness.

My research and experimentation in connection with balls of the character specified convinces me that conventional methods of manufacture are wrong in principle and that appropriate changes in such methods are highly desirable. I also concluded that the ball in present-day universal use is wrong in principle for several reasons. For example, when a so-called wrapped ball is subjected to impact, the corresponding flattening must take place through relative movement between consecutive wrappings of the elastic bands which enter into its construction, and where there is such relative movement or shifting, there must necessarily be mechanical friction. Such mechanical friction is also present when the ball reacts to reassume its original form, and this friction, which is unquestionably very material, must necessarily consume considerable power and must be considered as waste power insofar as effective propulsion is concerned.

A further effect of these conditions will be appreciated, particularly if it is borne in mind that the exterior wrappings of the elastic bands are encased within a practically non-elastic coating of gutta-percha. The said elastic bands, when the ball is played, tend to stretch or retract but they are held tightly by the gutta-percha or balata cover, and consequently the tendency is to break the cover at its weakest point.

With the foregoing considerations in mind, the invention has several objects, among which may be enumerated: a method whereby a golf ball may be made more economical than heretofore; a golf ball wherein the center of gravity will be, to all intents and purposes, at the geometrical center of the ball; a golf ball wherein the cover, which may be of gutta-percha or any other suitable material, may be made of substantially uniform thickness devoid of such variations as are inherent in the balls of the prior art; a golf ball

body, all internal parts of which will be under substantially uniform radial compression and under substantially uniform circumferential tension, as will hereinafter be more fully explained.

Through the attainment of these objects and others which will be presently described, I am able to economically and efficiently manufacture a golf ball without appreciable internal, mechanical friction in the body of the ball's structure, eliminate ununiform thickness of the cover, and attain uniformity in reaction of all parts of the ball to propulsive force.

In practically carrying out the method of this invention, I start with preformed and substantially cured spherical sectors of elastic, compressible material, such as rubber, so shaped that when uniformly and collectively compressed on all radii by suitable molds, either with or without a central core, they may be distorted into a ball body of spherical form and, while thus held under compression, they are secured to one another in such a way as to preclude their return to initial shape when the external pressure of the mold is relieved. When the mold is open, however, the inherent radial compression of the ball body will set up a pronounced circumferential tension through all parts of the body, adapted to effect a balanced condition with the radial compression of the body, serving to maintain and elastically hold the body in spherical form. The body thus produced is encased within a cover of gutta-percha or the like of substantially uniform thickness.

Features and advantages other than those hereinbefore enumerated will appear from the following detailed description and claims and from the accompanying drawings.

In the drawings, I have shown various methods of practicing the present invention and the resulting ball, but these showings are to be understood as illustrative only, and not as defining the limits of the invention.

Figs. 1 and 2 illustrate the geometrical principle of the invention.

Figs. 3 and 4 are diagrammatic views showing illustrative modified forms of the method of this invention.

Figs. 5, 6, 7 and 8 show successive operating steps in the method as shown in Fig. 3.

Fig. 9 shows the finished ball.

Fig. 10 is a view similar to Fig. 3 and Fig. 4 but showing a further modified form of the method of this invention.

Figs. 11 and 12 show a modified method of procedure.

Fig. 1 and Fig. 2 illustrate diagrammatically the principle of this invention. Fig. 1 shows a cross section of a ball in which all the radii r are under compression. It is obvious that in order to maintain truly spherical form all these radii should be under the same compression forces and should be of equal length. It is also obvious that in order to maintain this radial compression, all the circumferences C_1, C_2, C_3 throughout any diametrical section of the ball should be under uniform tension.

If such a ball is cut in two on any diametrical plane the circumferential tension and radial compression will be released simultaneously and all the half-circumferences C_1, C_2, C_3 will contract, while all the radii r will expand; and two equal hemispheres of ball Fig. 1 will assume the form of two equal spherical sectors of Fig. 2. Radii r, r before the ball was cut, were under equal compression and were of equal length; therefore radii R of spherical sectors also will be equal in length to one another. If the compression ratio is x then radii $R=xr$. On the other hand, the spherical sectors should have volumes substantially equal to the volumes of hemispheres of the ball. From this relation could be determined all the dimensions of spherical sectors in order to produce a truly spherical ball with radial compression and circumferential tension.

The volume of the hemisphere of the ball is

$$V_1=\frac{2}{3}\pi r^3$$

and the volume of spherical sector is

$$V_2=\frac{2}{3}\pi R^2 h$$

where $R=xr$; therefore

$$V_2=\frac{2}{3}\pi x^2 r^2 h$$

where h is the height of the segment of the sectoral body.

But V_1 is equal to V_2; therefore

$$\frac{2}{3}\pi r^3=\frac{2}{3}\pi x^2 r^2 h$$

or

$$h=\frac{r}{x^2}$$

In other words, in order to produce a ball with radial compression x, two sectors should be preformed of elastic material with the radius $R=rx$, and the height of their segments h should be equal to

$$\frac{r}{x^2}$$

These geometrical relations give fundamental explanation of this invention, and with the help of these formulae, the ball could be produced with desired radial compression and corresponding circumferential tension.

In practice, the form of spherical sectors might be modified as it will be hereafter shown; nevertheless with modification for all practical purposes, a satisfactory ball could be produced with internal stresses desired.

The general method of the present invention is graphically illustrated in Fig. 3 of the drawings. Here two sectors 1, of compressible elastic material, are shown. These sectors are identical with one another and each constitutes a sector of a sphere of such larger radius than the ball body to be formed that when said sector is subjected to substantially uniform pressure along all of its radii, it may be compressed and deformed into a semisphere of the radius of the ball body. When these two sectors are positioned with their apexes in coincision, either actually or geometrically, as the case may be, and radial pressure is applied to the said sectors through the use of appropriate dies, said sectors may be progressively compressed in a radial direction, through an infinite number of shapes, until they respectively partake of the final shapes indicated at 4 in Fig. 3, and which shapes are respectively semispherical. For the purpose of graphic illustration, two intermediate forms, 2 and 3 are shown. Thus, as radial pressure is applied on the sectors 1, they are compressed into the shape indicated at 2 wherein their major circumferential arcs are increased while their radial lines 5 are caused to bulge as indicated at 6. Continued application of radial pressure forces the sectors to the position 3 wherein their circumferential

arcs are further increased and the lines 7 are further bulged to such extent that the said lines of the respective sectors will contact with one another throughout an appreciable extent.

As radial pressure is increased, the sectors are finally forced into the positions indicated at 4 to bring the lines 8 into contact with one another throughout the entire diameter of the resulting semispheres, so that said semispheres collectively constitute a figure of spherical form, all parts of which are under relatively high radial compression.

If the said radial planes of the respective semispherical bodies are thereupon firmly united to one another throughout their entire extents, and that external pressure which has forced them into this condition is relieved, the said sphere will autogenously tend to radially expand uniformly in all directions, and in so doing will place all portions of the body thus formed under circumferential stress, which, in the preferred form of this invention, is substantially uniform throughout the entire body.

There will thus be present in the said body a balanced condition of radial and circumferential stresses, acting throughout the entire molecular structure of the body. In other words, every molecule of the body will be under radial compression and under circumferential or tangential tension, and such compression and tension will be in substantial balance so as to tend to maintain the true spherical contour of the entire mass.

Any force, such as the impact of a golf club, which serves to disturb this balanced condition will, upon secession of application of the force, produce a reaction serving to bring about a return of such balanced conditions, and it is by virtue of these facts that the ball of this invention is able to function satisfactorily as a golf ball and produce, along with other features hereinafter explained, a highly satisfactory coefficient of restitution.

In the showing of Fig. 4, the method is the same as described in connection with Fig. 3, but with the exception that the preformed sectors, which are to form the ball body, are pressed against and about an interposed spherical portion 9 which, in the finished ball, constitutes a center filler. It will be noted, however, from Fig. 4 that the center of the spherical part 9 is at the geometrical center of the sectors 1, so that when the sectors 1 are compressed as described in connection with Fig. 1, all parts of the sectors 1 will be placed under uniform radial compression throughout, with the resulting uniform circumferential tension.

In practically carrying out this invention, the sectors 1 may be made of any appropriate compressible elastic material, such, for example, as natural, artificial, or synthetic rubber, while the spherical portion 9 may be made of metal, rubber, or any other appropriate material which will stand the pressure to which this part must be subjected, without squeezing out or disintegration. Furthermore, in Fig. 4, the sectors 1 have been referred to as separate from one another and from the part 9, but it is possible in practice to make these parts integral with one another and in some cases it is more convenient to do so.

I have referred to the fact that after the sectors are compressed into semispherical form, they are secured together along their common diametrical plane. The manner of accomplishing this result may vary depending upon the materials employed and upon commercial expediency, but when acting upon rubber blanks, this result may be satisfactorily accomplished through vulcanization of interposed unvulcanized or partially vulcanized rubber, either natural or synthetic in character. When the sectors are of rubber and are to be vulcanized together as stated, I find it advantageous to make the sectors of the desired shape and either separate or integral as may be preferred, and thereupon vulcanize them to a point which is preferably slightly under complete vulcanization or curing. In this condition, the sectors are manipulated in appropriate molds under pressure as hereinafter explained in detail, with unvulcanized rubber layers covering the conical surfaces of the sectors, and after the sectors have been compressed fully to form the spherical body of the ball, a vulcanizing step is carried on which serves to vulcanize said unvulcanized layer of the rubber in the joint between the sectors, and at the same time produce unity between the two sectors. In this way I obtain a substantial, homogeneous engagement between the sectors at the joint with proper vulcanization in this zone and without over-vulcanizing the rubber in the sectors themselves.

In Figs. 5–8, I have shown consecutive operating steps in the making of a ball in accordance with the method herein disclosed. In Fig. 5, two sectors 1 of the character shown in Fig. 4, with an interposed spherical center 9, are positioned between molds 10 and 11, these molds being complementary and here illustrated in retracted position. The said molds have mold chambers 12, complementary to one another and preferably substantially spherical in shape. The sectors are shown in position in the mold cavities in the condition in which they were preliminarily formed and free from compression by the mold sections. In Fig. 6, compression of the sectors by the mold sections has commenced and proceeded to about the position indicated at 2 in Fig. 3, it being noted in Fig. 6 that the resulting radial compression has deformed the blanks somewhat to increase the arc of their circumference and bulge their radial surfaces.

Fig. 7 shows a further stage in the closing of the molds, the stage corresponding to about the position 3 of Fig. 4, and Fig. 8 shows the molds almost fully closed to correspond with the position 4 of Fig. 4. While the molds are held in this closed position, the layer of uncured rubber 13, 13, either natural or synthetic, which was smeared upon the radial faces of the sectors, is vulcanized to cause said faces to firmly adhere to one another and become, in effect, homogeneous. Heavy lines 14, 14 show overflow of excess of uncured rubber. This overflow may easily be trimmed after the ball is taken out of the mold.

At the conclusion of the vulcanizing operation, the molds are first cooled to give full strength to the vulcanized seam and then the mold sections are separated. Coincident with this mechanical operation the molecular structure of the component parts of the resulting mass seek to return to their initial condition and in so doing set up the balanced condition of radial and circumferential stresses to which I have referred.

The product of the operating steps described is a solid spherical rubber ball body with or without a core, and wherein the center of gravity will be at the geometrical center of the ball or so close thereto that any variation will be negibible.

The layer 13 of non-vulcanized rubber after vulcanization will be subjected to tension and

theoretically it will stretch; but the thickness of this layer is practically so small that this stretching does not seriously affect the spherical form of the ball, though, if necessary, the shape of the mold may be made such that it will correct this situation.

The spherical ball body with inclosed core is thereupon tumbled or buffed and provided with a cover 15 of gutta-percha or any other appropriate material to produce the finished ball shown in Fig. 9.

It will, of course, be understood that the exterior design of the cover may be conventional and it may be provided with dots, depressions, or any other suitable or conventional surface ornamentation or design, such as is commonly used on golf balls. It is important to note that the ball body as it comes from the mold will be spherical in form and consequently the cover may be of uniform thickness throughout its entire extent in contradistinction to that pronounced variation in thickness found in wrapped golf balls as heretofore made. Consequently, said cover will be of uniform strength throughout and will uniformly transmit impact received at any point in its surface to the inclosed ball body. It will be also noted from Fig. 9 that, when the respective sections are vulcanized together, the sections become substantially homogeneous throughout. Consequently, it is possible to make a ball which will be geometrically spherical and which will have balanced radial and circumferential stresses throughout, as hereinbefore explained.

In the foregoing description of the method, the sectors 1 have been referred to as having straight line conical faces. It is possible, however, to make these faces other than of straight line conical form and I have shown in Fig. 10 sectors wherein the faces 16 are somewhat convex-concave. When such faces are employed, the method is carried on as hereinbefore described, but the said faces of the respective sectors may not come into face abutting relation throughout, but may leave, at the conclusion of compression in the molds, concavities 17 which are filled with the unvulcanized rubber or other adhesive which is to be used to secure the sections together, but the concavities should be closed at the outer circumference of the sphere so as to entrap the binding material shown at 18 which may be thereupon vulcanized to produce a proper bond between the sectors at the joint as will be readily understood. The finished ball is substantially the same as the preferred form of ball hereinbefore described.

The molding dies, which I have hereinbefore described, may have smooth inner surfaces or cavities of substantially semi-spherical form. I find in some cases, however, when operating with dies of this kind, that there is a tendency to trap air within the cavities during the compression of the sectors and if this trapped air is not permitted to escape, it has the tendency to produce a deformed finished ball body. Therefore, in practice, I preferably provide appropriate means for venting the cavities to permit of the escape of this air. This venting may be accomplished in any one of several different ways, but, for the purpose of illustration, I have shown in Figures 5–8, the mold cavities 12 as provided on their inner faces with venting channels 22 through which the air can escape for the purposes stated. The venting is preferably employed with molds of the character shown in Figures 5–8, but is not necessary with molds of the character shown in Figures 11 and 12.

In the foregoing description the molds 10 and 11 (Fig. 5) are described as having semispherical cavities 12, 12. In modified form especially for producing balls with very high stresses, these molds might be built as shown in Figures 11 and 12, with the central portions 19—19 of the mold adapted to compress the sectors similar to 1, 1 of Figure 5, independently of the outer portions 20, 20 of the mold. When said sectors are compressed this way, they will assume the form 21, 21. After this operation, the molds 20, 20 complete the forming operation as shown in Figure 12 and the ball assumes the finished form substantially as described above. This method permits of the introduction of still higher stresses in the body of the ball if this is desired.

In the foregoing detailed description, I have set forth the invention in its preferred practical form and have described in detail the invention with respect to the making of a golf ball to which the present invention is particularly appropriate. It is possible, however, to make other balls or ball bodies than golf balls according to the present invention, and the invention is to be understood as not limited to a golf ball alone. This disclosure which I have made is of the preferred practical forms of the invention, but the invention is to be understood as fully commensurate with the appended claims.

Having thus fully described the invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of making a ball, which comprises the steps of applying external pressure to pre-formed solid elastic sectors of substantially conical shape and of predetermined radius to force said sectors collectively into a ball body of substantially spherical form and of lesser radius than said pre-formed sectors, and securing juxtaposed faces of the respective sectors to one another while the external pressure is maintained.

2. The method of making a ball which comprises the steps of externally compressing preformed solid elastic sectors of substantially conical shape and of predetermined radius to radially compress and circumferentially expand the sectors sufficiently to produce a spherical ball body of smaller radius, with the radial faces of the sectors in substantial contact with one another, securing said faces to one another while thus compressed, and thereafter relieving the externally applied pressure to permit the radial and circumferential molecular stresses of the resulting ball body to come into substantially balanced condition.

3. The method of making a ball which comprises the steps of externally compressing preformed solid elastic sectors of substantially conical shape and of predetermined radius about an interposed core to radially compress and circumferentially expand the sectors about the core sufficiently to produce a spherical ball body of smaller radius, with the radial faces of the sectors in substantial contact with one another, securing said faces to one another while thus compressed, and thereafter relieving the externally applied pressure to permit the radial and circumferential molecular stresses of the resulting ball body to come into substantially balanced condition.

4. The method of making a ball body, which comprises radially compressing pre-formed solid rubber sectors of substantially conical shape and of predetermined radius to radially compress and circumferentially expand the sectors sufficiently to

produce a spherical ball body of smaller radius, with the radial faces of the sectors in substantial contact with one another, and vulcanizing said radial faces to one another while the external pressure is maintained.

5. The method of making a ball body, which comprises radially compressing pre-formed solid rubber sectors of substantially conical shape and of predetermined radius about an interposed core to radially compress and circumferentially expand the sectors about the core sufficiently to produce a spherical ball body of smaller radius, with the radial faces of the sectors in substantial contact with one another, and vulcanizing said radial faces to one another while the external pressure is maintained.

6. The method of making a ball, which comprises radially compressing, through the application of external force, pre-formed solid rubber sectors of substantially conical shape and of predetermined radius, vulcanized sufficiently to impart substantially full elasticity to the rubber, increasing such compression until the radial faces of said sectors come into substantial contact with one another to form a ball body of lesser radius, and vulcanizing said faces together while the external pressure is maintained.

7. The method of making a ball, which comprises radially compressing, through the application of external force, pre-formed solid rubber sectors of predetermined radius, vulcanized sufficiently to impart substantially full elasticity to the rubber and while a quantity of unvulcanized rubber is present upon the radial faces of the sectors, increasing such compression until the radial faces of said sectors come into substantial contact with one another to form a ball body of lesser radius, and thereupon vulcanizing the unvulcanized rubber between said faces while the external pressure is maintained.

8. The method of making a ball body, which comprises compressing, through the application of external pressure, solid elastic sectors of substantially conical shape and of predetermined radius into a ball body of spherical form and lesser radius, and uniting all juxtaposed parts of the respective sectors to one another while under such external pressure.

9. The method of making a ball, which comprises the following steps in the order stated; first, pre-forming solid rubber sectors of predetermined radius; then vulcanizing said sectors; then applying unvulcanized rubber to the radial faces of said sectors; then assembling said sectors on a common center; then applying external pressure to the assembly to radially compress said sectors with resulting circumferential expansion of the sectors until they collectively assume a substantially spherical form of smaller diameter with the radial faces of the sectors in substantial contact with one another, then vulcanizing the said unvulcanized rubber, while said spherical form is retained, then cooling the product, and thereafter relieving the same of externally applied pressure to permit the resulting radial and circumferential stresses of the resulting ball body to come into substantially balanced condition.

10. The method of making a ball, which comprises the following steps in the order stated; first, pre-forming solid rubber sectors of predetermined radius; then vulcanizing said sectors; then applying unvulcanized rubber to the radial faces of said sectors; then assembling said sectors on a common center; then applying external pressure to the assembly to radially compress said sectors with resulting circumferential expansion of the sectors until they collectively assume a substantially spherical form of smaller diameter with the radial faces of the sectors in substantial contact with one another; then vulcanizing the said unvulcanized rubber, while said spherical form is retained; then cooling the product, and thereafter relieving the same of externally applied pressure to permit the resulting radial and circumferential stresses of the resulting ball body to come into substantially balanced condition; thereafter roughening the surface of the resulting ball body, and applying a suitable cover thereto.

11. The method of making a ball, which comprises the following steps in the order stated; first, pre-forming solid rubber sectors of predetermined radius; then vulcanizing said sectors; then applying unvulcanized rubber to the radial faces of said sectors; then assembling said sectors on a common center; then applying external pressure to the assembly to radially compress said sectors about an interposed solid core with resulting circumferential expansion of the sectors until they collectively assume a substantially spherical form of smaller diameter with the radial faces of the sectors in substantial contact with one another, then vulcanizing the said unvulcanized rubber, while said spherical form is retained, then cooling the product, and thereafter relieving the same of externally applied pressure to permit the resulting radial and circumferential stresses of the resulting ball body to come into substantially balanced condition.

12. In the method of making a ball body, the step which consists in collectively compressing into spherical form two pre-formed elastic blanks, each of which is of substantially the form of a spherical sector of substantially conical shape and has an unstressed volume substantially equal to the volume of the stressed semisphere of the resulting ball body.

13. The method of making a ball body which comprises radially compressing pre-formed solid elastic sectors of predetermined radius within dies to radially compress and circumferentially expand the sectors sufficiently to produce a spherical ball body of smaller radius with the radial faces of the sectors in substantial contact with one another, venting the dies to preclude the entrapment of air during the compression of said sectors, and securing the radial faces of the sectors to one another while the external pressure is maintained.

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