

Sept. 14, 1965

J. G. HENDRICKS

3,206,201

BOWLING BALL STRUCTURES AND THEIR MANUFACTURE

Filed Oct. 2, 1961

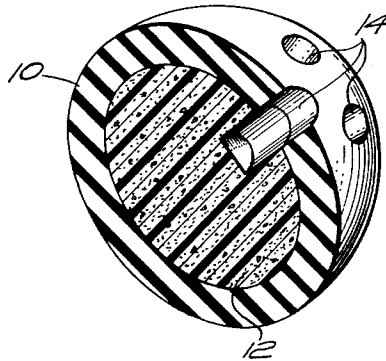
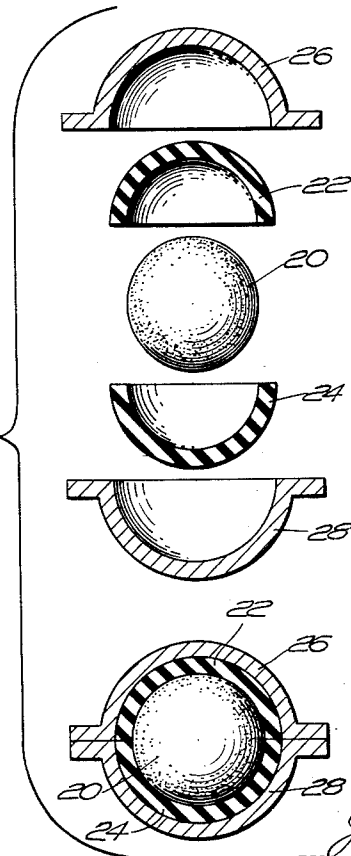


FIG. 1

FIG. 2



INVENTOR
John L. Hendricks
BY *Morse & Altman*
ATTORNEYS

1

3,206,201

BOWLING BALL STRUCTURES AND THEIR MANUFACTURE

John G. Hendricks, Weston, Mass., assignor to Stowe-Woodward, Inc., Newton, Mass., a corporation of Massachusetts

Filed Oct. 2, 1961, Ser. No. 142,235

17 Claims. (Cl. 273—63)

The present invention relates to bowling balls and, more particularly, to bowling ball structures and their manufacture.

Typically, the diameters and weights of bowling balls are governed by accepted regulations. For example, in the game of tenpins, the circumference of the ball must be 27 inches but the weight of the ball may range from 10 to 16 lbs. and a 9 lb. ball may be desired. Generally, bowling balls of the type available commercially include an outer veneer and an inner core. The outer veneer presents a polished wear resistant finish. The inner core provide a mass of controlled specific gravity. It has been found that the composition of the core heretofore has lacked an ability to withstand the continuing series of shocks to which the ball is subjected during play. In consequence, particularly in the case of a ball of light weight, the core tends to separate from and to float within the veneer and the veneer tends to crack as a result of the lack of shock absorption by the core. The present invention contemplates a novel bowling ball construction of the foregoing type having outstanding shock resistance by virtue of a novel core composition that retains its original volume and maintains its adherence to the veneer with unprecedented efficacy.

Primary objects of the present invention are to provide novel structural designs and manufacturing processes for bowling balls of the foregoing type that are characterized by: a core composed of a polymerized matrix in which are dispersed discrete chips of certain relatively low specific gravity organic materials of high dimensional stability; a core composed of a polymerized matrix in which are dispersed minute gas filled cells of certain types; and a core composed of a polymerized matrix in which are dispersed chips and cells of the above types in combination. Best results are achieved when the chips are composed of wood or plastic foam and the cells are composed of a mixture of cork and, so-called, Microballoons.

Other objects of the present invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the products and processes involving the components and steps exemplified in the following detailed disclosure, the scope of which will be indicated in the appended claims. For a fuller understanding of the nature and objects of the present invention, reference should be had to the following detailed description, taken in connection with the accompanying drawing, wherein:

FIG. 1 is a partly sectional, cut-open, perspective view of a bowling ball embodying the present invention; and

FIG. 2 illustrates a sequence of steps to which selected materials are subjected in accordance with the process of the present invention.

Generally, the bowling ball illustrated and described herein as embodying the present invention comprises a veneer 10 and a core 12, into which have been drilled three finger holes 14. In the present specific example, the external periphery of the veneer, which is ground and polished, is approximately 27 inches in circumference and the overall weight of the ball ranges from 9 to 12 pounds. It will be appreciated that in the illustrated ball the core is a sphere and the veneer is a shell, both with the same geometrical center. However, to compensate for finger

2

holes and to provide top weight, the core and the veneer may be positioned to have different geometrical centers or different centers of gravity. The veneer is composed of vulcanized rubber. The core is composed of a polymerized organic matrix, in which are dispersed cellular chips of macroscopic extent and gas filled cells of microscopic extent.

In convention fashion, veneer 10 is a natural rubber such as cis-1,4-polyisoprene or a synthetic rubber such as butadiene-styrene, neoprene, butyl rubber, nitrile rubber, polysulfide rubber, chlorosulfonated polyethylene, polyurethane, cis-1,4 polybutadiene, synthetic cis-1,4 polyisoprene, adduct rubber and combinations thereof. Curing of these materials is effected at elevated temperatures by suitable chemical agents such as sulfur, selenium, tellurium, organic peroxide, nitro compounds, azo compounds and certain organic sulfur compounds such as the alkyl disulfides. Usually, the radial thickness of the veneer ranges from 1/2 to 1 1/2 inch.

Preferably, the macroscopic chips are composed of a natural cellulosic, cellular material such as wood or a synthetic solid foam having a solid external phase and a gaseous internal phase. For example, the foam in one form is a polyurethane foam such as polyurethane itself, which is prepared by reacting polyisocyanates, alkyd resins and water. The foam, in another form, is prepared by curing any of a variety of polymerizates (e.g. acrylics such as methyl methacrylate, amino resins such as urea formaldehyde, cellulose such as cellulose propionate, polyurethanes such as polyurethane, polyamides such as polyhexamethylene adipamide, polyester resins such as those produced by the esterification of polyhydric alcohols and polybasic acids, epoxy resins such as those produced by reacting epichlorohydrin with bis-phenol, ethylenes such as polyethylene, phenolics such as phenol formaldehyde, styrenes such as polystyrene and vinyls such as polyvinyl alcohol), in the presence of a blowing agent, for example, an azo containing compound that releases nitrogen when heated (e.g. the compound diamino-benzene sold by Dupont under the trade designation Unicel). The foam in another form, is prepared by the mechanical mixing of any of the polymerizates mentioned above with a gas such as nitrogen, carbon dioxide or air. Preferably the macroscopic chips, in terms of 90% of their total weight, range in maximum extent, between 1/32 and 3/4 of an inch.

The microscopic gas filled cells, for example, are: a natural material such as cork which is composed of cortical plant tissue in which dead cells are filled with air; or miniscule phenolic cells containing nitrogen of the type sold under the trademark Microballoons by Union Carbide Corporation. In particular, Microballoons are formed by subdividing into droplets a solution containing a volatile solvent having dissolved therein film forming material and a material other than the volatile solvent which furnishes a material that remains gaseous at normal temperatures, and by heating the droplets to a temperature causing volatilization of the solvent to form a self-supporting, relatively gas-imperious particle wall coincident with particle formation and conversion of the gas furnishing material into a gas that remains gaseous at normal temperatures. The amount of the gas furnished within the forming particle and which is trapped by the particle wall within its interior is sufficient to prevent collapse of the particle wall under the pressure of the surrounding atmosphere. By way of example: the film forming material is either polyvinyl alcohol or a phenol formaldehyde resin; the decomposable substance is dinitrosopentamethylene tetramine, ammonium nitrate, ammonium carbonate or ammonium bicarbonate; and the particles have an approximate average diameter of 1 to 500 microns, an approximate density of from 0.01 to 0.3 and an approximate liquid displacement of from

0.5 to 0.6. The preparation and composition of Microballoons is described in detail in U.S. Patent No. 2,797,201, issued on June 25, 1957, in the names of F. Veatch et al. for Process of Producing Hollow Particles and Resulting Product.

Preferably the polymerizable matrix of core 12 produces a somewhat resilient plastic. This matrix for example, is a phenolic resin such as phenol formaldehyde, an epoxy resin such as that produced by reacting epichlorohydrin with bisphenol or a polyester resin such as that produced by the esterification of polyhydric alcohols and polybasic acids.

The composition used in the preferred process of FIG. 2 comprises by total weight the following: resin 25-75%; incompressible chips 0 to 75% and preferably 25 to 40%; cork 0 to 75% and preferably 5 to 15%; and Microballoons 0 to 75% and preferably 5 to 15%. In the foregoing formulation, it is necessary that the total composition includes either or both incompressible chips and Microballoons. Generally, this process comprises the steps of: curing a core mixture 20 of the foregoing type at a temperature ranging from 150 to 400° F. for a period ranging from 1 to 10 hours; turning the core down to size; positioning the core between a pair of unvulcanized rubber pies 22 and 24; compressing the assemblage of core 20 and pies 22 and 24 within a mold 26, 28; and heating at a temperature ranging from 250° to 350° F. to cure the pies. It will be understood that alternatively: the core and veneer may be co-vulcanized, rather than cured in separate steps; the assemblage may be press cured or cured in open steam; instead of pies, other veneer shapes may be used, as a single-wrap sheet roughly in the form of a maltese cross; etc. Finally, the resulting bowling ball structure is ground to its final size and drilled. In the foregoing process, the use of both cork and Microballoons together produces a synergistic effect with respect to the shock resistance of the ball.

The following non-limiting examples further illustrate the present invention:

Example I

The process of FIG. 2 was performed as follows: A spherical core was prepared by mixing the following, total weight: phenolic resin—100.00 parts; hexamethylene tetramine (as a cross-linking agent)—9.77 parts; wood chips, averaging ½ inch in greatest extent and 90% by weight of the wood chips ranging in greatest extent from ⅓ to ¾ of an inch—57.00 parts; cork—42.40 parts; Microballoons—0.00 parts; odorant—2.50 parts. The total number of parts in the core according to the foregoing was 211.67, weighing approximately 5 lbs. This core was placed in an 8¼ inch diameter mold and cured first for 2 hours at 230° F. and then for 5½ hours at 300° F. The resulting core, which weighed 4.50 lbs., was turned down to a 7¾ diameter sphere, which weighed 3.875 lbs. The turned core was positioned within a pair of unvulcanized pies weighing 7.750 lbs. the total weight of the core and the unvulcanized pies being 11.625 lbs. When placed in the mold, the unvulcanized rubber overflowed in the amount of 0.190 lb. The ball then weighing 11.438 lbs., its veneer was vulcanized under heat and pressure. Finally, the veneer was turned down to a diameter of 8.581 inches, at which time the ball weighed 9.875 lbs. and was 5160 cc. in volume. A bounce test was conducted with the foregoing ball such that the ball was repetitively dropped five feet to a concrete slab. The ball was dropped 199 times under these conditions before failure.

Example II

The process of FIG. 2 was performed as follows: A spherical core was prepared by mixing the following by total weight: phenolic resin—100.00 parts; hexamethylene tetramine (as a cross-linking agent)—9.77 parts; wood chips, averaging ½ inch in greatest extent and 90% by

weight of the wood chips ranging in greatest extent from ⅓ to ¾ of an inch—57.00 parts; cork—0.00 parts; Microballoons—42.40 parts; odorant—2.50 parts. The total number of parts in the core according to the foregoing was 211.67, weighing approximately 5 lbs. This core was placed in an 8¼ inch diameter mold and cured first for 2 hours at 230° F. and then for 5½ hours at 300° F. The resulting core, which weighed 4.69 lbs., was turned down to a 7¾ diameter sphere, which weighed 4.19 lbs. The turned core was positioned within a pair of unvulcanized pies weighing 7.750 lbs., the total weight of the core and the unvulcanized pies being 11.940 lbs. When placed in the mold, the unvulcanized rubber overflowed in the amount of 1.940 lbs. The ball, then weighing 10.000 lbs., its veneer was vulcanized under heat and pressure. Finally, the veneer was turned down to a diameter of 8.580 inches, at which time the ball weighed 8.940 lbs. and was 5160 cc. in volume. A bounce test was conducted with the foregoing ball such that the ball was repetitively dropped five feet to a concrete slab. The ball was dropped 178 times under these conditions before failure.

Example III

The process of FIG. 2 was performed as follows. A spherical core was prepared by mixing the following by total weight: phenolic resin—100.00 parts; hexamethylene tetramine (as a cross-linking agent)—9.77 parts; wood chips, averaging ½ inch in greatest extent and 90% by weight of the wood chips ranging in greatest extent from ⅓ to ¾ of an inch—57.00 parts; cork—21.20 parts; Microballoons—21.20 parts; odorant—2.50 parts. The total number of parts in the core according to the foregoing was 211.67, weighing approximately 5 lbs. This core was placed in an 8¼ inch diameter mold and cured first for 2 hours at 230° F. and then for 5½ hours at 300° F. The resulting core, which weighed 4.75 lbs., was turned down to a 7¾ diameter sphere, which weighed 4.25 lbs. The turned core was positioned within a pair of unvulcanized pies weighing 7.750 lbs., the total weight of the core and the unvulcanized pies being 12.000 lbs. When placed in the mold, the unvulcanized hard rubber overflowed in the amount of 1.500 lbs. The ball, then weighing 11.438 lbs., its veneer was vulcanized under heat and pressure. Finally, the veneer was turned down to a diameter of 8.580 inches, at which time the ball weighed 9.250 lbs. and was 5160 cc. in volume. A bounce test was conducted with the foregoing ball such that the ball was repetitively dropped five feet to a concrete slab. The ball was dropped 278 times under these conditions before failure.

Example IV

Example III was repeated except that the wood chips and Microballoons were replaced by sawdust. The dimensions throughout the process were not determined. The ball here failed after a bounce test of 40 drops.

The present invention thus provides a new bowling ball structure and process giving rise to greatly increased impact resistance by virtue of a combination of macroscopic cellular organic chips and microscopic gas filled cells, dispersed in a polymeric matrix. Since certain changes may be made in the construction and process described in the foregoing specification and shown in the accompanying drawings, without departing from the scope of the present invention, it will be understood that all matter hereinabove shall be taken in an illustrative and not in a limiting sense.

What is claimed is:

1. A bowling ball comprising an external veneer and an internal core, said veneer being composed of an elastomeric material, said core including a polymerized resin matrix containing dispersed therein, a multiplicity of macroscopic organic chips and a multiplicity of microscopic gas filled cells, said resin of said matrix constituting from 25 to 75% of said core by total weight of said core,

the remainder of said core constituting at least one of said organic chips and microscopic gas filled cells in amounts ranging together from 5 to 15% by total weight of said core and being sufficient to impart shock absorbency tending to prevent separation of said veneer from said core.

2. The bowling ball of claim 1 wherein said core, by total weight, is composed of from 25 to 75% resin, from 0 to 75% organic chips, from 0 to 75% cork and from 0 to 75% phenolic spheres containing nitrogen, at least one of said organic chips and said phenolic spheres being present in substantial amounts.

3. The bowling ball of claim 1 wherein said chips are composed of wood.

4. The bowling ball of claim 1 wherein said chips are composed of a solid foam.

5. The bowling ball of claim 1 wherein said microscopic gas filled cells are constituted by cellular materials in an amount ranging from 5 to 15% by total weight of said core and including cork and phenolic spheres containing nitrogen.

6. A bowling ball comprising an external veneer and an internal core, said veneer being composed of an olefinic elastomeric material, said core including a polymerized matrix containing dispersed therein a multiplicity of organic chips, of which 90% range from $\frac{1}{32}$ to $\frac{3}{4}$ of an inch in maximum extent, cork and microscopic hollow plastic cells containing gas, said core and said veneer being bonded together, said chips, said cork and said cells being in proportions ranging together from 5 to 15% by weight of said core, by which to absorb shock in order to prevent separation between said veneer and said core.

7. The bowling ball of claim 6 wherein said core by total weight is composed of from 25 to 75% resin, from 0 to 75% chips, from 5-15% cork and from 15 to 25% plastic spheres containing gas.

8. The bowling ball of claim 6 wherein said chips are composed of wood.

9. The bowling ball of claim 6 wherein said chips are composed of solid foam.

10. A bowling ball comprising an external veneer shell and an internal core, said shell being composed of an olefinic elastomeric material, said core including a polymerized resin matrix containing dispersed therein a multiplicity of cellular organic chips of which 90% range from $\frac{1}{32}$ to $\frac{3}{4}$ of an inch in maximum extent, cork and microscopic synthetic plastic spheres containing gas, said core by total weight being composed from 25 to 75% of said resin, from 25 to 40% of said chips, from 5 to 15% of said cork and from 5 to 15% of said synthetic plastic spheres.

11. The process of producing a bowling ball construction, said process comprising the steps of mixing polymeric resin, discrete organic chips, cork and synthetic plastic spheres containing gas, curing said mixture under heat and pressure to provide a core, inserting said core within an unvulcanized rubber veneer, curing said veneer while said veneer and core are under heat and pressure, and machining said veneer down to a predetermined diameter, said resin constituting from 25% to 75% of said core by total weight of said core.

12. The process of claim 11 wherein said chips are composed of wood.

13. The process of claim 11 wherein said chips are composed of solid foam.

14. The process of claim 11 wherein said cork is present in an amount ranging from 5 to 15% of the weight of said core.

15. The process of claim wherein said synthetic plastic spheres are present in an amount ranging from 5 to 15% of the weight of said core.

16. A bowling ball comprising an external veneer shell and an internal core, said shell being composed of an olefinic elastomeric material, said core including a polymerized resin matrix containing dispersed therein a multiplicity of cellular organic chips of which 90% range from $\frac{1}{32}$ to $\frac{3}{4}$ inch in maximum extent, cork and microscopic synthetic plastic spheres containing gas, said core by total weight being composed of from 25 to 75% of said resin, from 25 to 40% of said chips from 5 to 15% of said cork and from 5 to 15% of said synthetic plastic spheres, said synthetic plastic being phenolic, said gas being nitrogen, the radial thickness of said veneer shell ranging from $\frac{1}{2}$ to $1\frac{1}{2}$ inch, said spheres having an approximate average diameter of 1 to 500 microns and an approximate density of from 0.01 to 0.3, said polymerized matrix being selected from the class consisting of phenolic, epoxy and polyester resilient plastics.

17. A process of fabricating a bowling ball, said process comprising the steps of: mixing core materials including approximately 100 parts of phenolic resin, approximately 10 parts of cross-linking agent, approximately 57 parts of wood chips, said wood chips averaging $\frac{1}{2}$ inch in greatest extent and 90% by weight of said woodchips ranging in greatest extent from $\frac{1}{32}$ to $\frac{3}{4}$ of an inch, approximately 21 parts of cork, approximately 21 parts of phenolic plastic spheres containing nitrogen, said spheres having an approximately average diameter of 1 to 500 microns and an approximate density of from 0.01 to 0.3, and approximately 2 parts of an odorant, said core materials weighting approximately 5 pounds; at least partially curing said core materials in a spherical mold, approximately $8\frac{1}{4}$ inches in diameter, at a temperature ranging from 150 to 400° F. to produce a core; coating said core with a coat of unvulcanized rubber to provide a veneer; and completing the curing of said veneer and said core under heat and pressure to produce said bowling ball.

References Cited by the Examiner

UNITED STATES PATENTS

1,504,461	8/24	Whelan	273—63
2,362,269	11/44	Hall	273—63
2,797,201	6/57	Veatch et al.	260—2.5
2,944,821	7/60	Mason.	

OTHER REFERENCES

Plastics Technical Section, April 1954, 273-Polyurethane "Polyurethane Resins," page 143.

RICHARD C. PINKHAM, *Primary Examiner*.

JAMES W. LOVE, LOUIS R. PRINCE, *Examiners*.