Feb. 1, 1966 JEAN-PIERRE ABBAT 3,232,614

BOWLING PINS

Filed March 27, 1961

FIG. 1

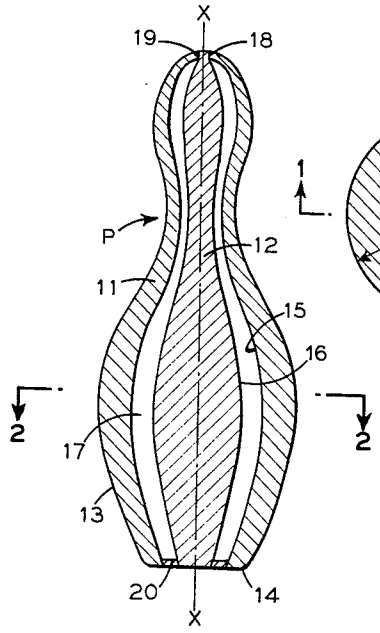


FIG. 2

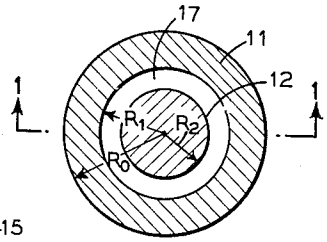


FIG. 3

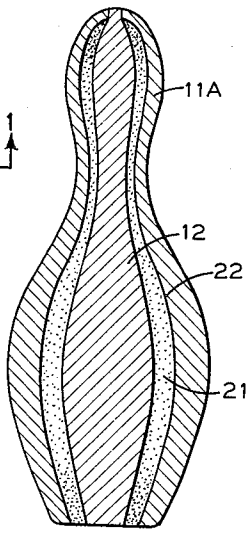


FIG. 6

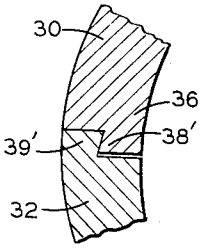


FIG. 4

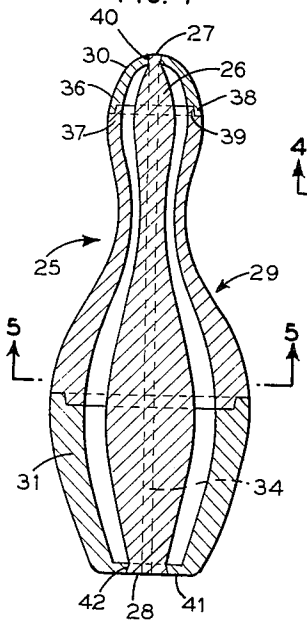
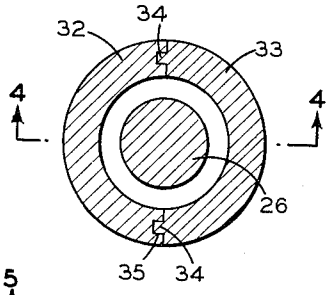


FIG. 5



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BOWLING PINS

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11 Claims. (Cl. 273—82)

This invention relates to bowling pins, and more particularly concerns bowling pins formed of non-wood materials.

Conventional bowling pins are made of sound, hard maple in one piece or of laminated construction. Such pins must meet set specifications as to weight, moisture content, height and surface configuration, to be deemed standard and acceptable for use in leagues and tournaments recognized by the American Bowling Congress (ABC).

With the progressive increase in popularity of bowling and the limited availability of acceptable maple, difficulties are being encountered in meeting the demand for wood pins. Furthermore, wood pins have a relatively limited useful life and even such normal life appears to be somewhat reduced by the hard usage encountered by the pins in relation to the automatic, mechanical pin setter which handles the same.

Wood pins, after extensive use, are refinished to extend their useful life, but such rehabilitation procedures do not materially increase the available pin supply. While attempts have been made to provide pins of non-wood materials which have a greater normal life in use; such materials have not been widely accepted inasmuch as pins made from such materials do not exhibit all the well known characteristics and properties of a wood pin.

Accordingly, an object of this invention is to provide a novel pin design which permits the use of materials highly resistant to wear, abrasion and impact; the resultant pin not only having an extended span of life, but further, faithfully reproducing the well known properties of wood pins in use, thereby making such novel pins highly acceptable by bowlers.

A further object of this invention is to provide an improved bowling pin design which permits the use of a variety of materials in the construction thereof, and allows a selection of such materials in various combinations thereof and in terms of manufacturing costs, useful life expectancy and the like, while still retaining the essential standards and specifications of a wood pin.

Still another object of this invention is to provide an improved bowling pin design which allows for precision manufacture of mass produced pins, at reduced costs; yet providing pins fully equivalent to a wood pin in respect to the essential properties thereof, which may be produced in precisely matched sets and which have a substantially increased span of life as compared to that of wood pins.

Other objects of this invention will in part be obvious and in part hereinafter pointed out.

In the drawing, FIG. 1 is a vertical sectional view of a bowling pin embodying the invention; FIG. 2 is a transverse sectional view taken on the line 2—2 of FIG. 1; FIG. 3 is a view similar to that of FIG. 1, showing a modified form of the invention; FIG. 4 is a view similar to that of FIG. 1, showing still another embodiment of the invention; FIG. 5 is a transverse sectional view taken on the line 5—5 of FIG. 4; and FIG. 6 is an enlarged, partial sectional view showing a modified form of joint between pin sections.

In designing a bowling pin to be formed of materials other than wood, the replacement pin must have an outer surface configuration which conforms precisely to the standards and specifications laid down by the ABC. Such

configuration is defined as a surface of revolution about a vertical axis with the radii measured from such axis to the surface at prescribed heights above the base of the pin, having precise values. Also, the center of gravity of the pin must be located at a predetermined point and the weight of the pin must be kept within prescribed limits.

It has been found that a bowling pin may be formed of selected materials other than wood and still show the well known and desired characteristics of a wood pin, when the novel pin comprises essentially a shell-like outer member and a core member fitted within the outer member. Furthermore, the inner surface of the outer member and the outer surface of the core member take the form of surfaces of revolution of determined configuration.

Since the outer surface of the shell-like outer member is standardized as to configuration in accordance with the specifications of the ABC, the surface configuration of the inner surface of the shell-like member and that of the outer surface of the core member is determined as a function of points in the outer surface of the shell-like member; and also taking into account the specific gravities of the materials from which the shell-like and core members are formed, as well as the specific gravity of the wood from which a conventional wood pin is formed.

The pin of the instant invention may have its outer shell-like member formed of various materials, selected on the basis of specific gravity, abrasion resistance, impact resistance and other physical properties. Thus, the shell-like outer member may be formed of metal, metal alloy, polymeric synthetics in filled or unfilled form and in solid or cellular form; including steel, aluminum, polyurethane, polypropylene, epoxy or phenolic resins. Similarly, the core member is formed of selected materials, including those enumerated above, as well as other materials having lesser degrees of resistance to abrasion, impact and the like, including plaster, hard rubber, filled papier mache, unfilled phenolic resins and the like.

By way of illustration, in FIG. 1 is shown a pin P embodying the invention. The same comprises an outer shell member **11** and a core member **12** within member **11**. The member **11** has an outer surface **13** which is a surface of revolution about the vertical axis X—X and is of standardized configuration as prescribed by the ABC. Typically, radial measurements at various height levels taken in respect to base **14** of the pin, are as follows: at 0—1.125"; at 2.25"—1.949"; at 4.5"—2.387"; at 7.25"—1.85"; at 10"—0.835"; at 11.75"—1.047"; and at 13.5"—1.273".

The inner surface **15** of shell-like member **11** and outer surface **16** of core member **12** are determined as surfaces of revolution with respect to axis X—X, in terms of surface **13** and the specific gravities of the materials of members **11**, **12** and of maple wood of the type used in making a wood pin.

Thus, where R_0 is the radius measured from axis X—X to a given point in surface **13** of member **11** at a given height above base **14**, and a known quantity based on ABC specifications and where R_1 is the radius from said axis X—X to a corresponding point in surface **15** of member **11** at the same given height above base, then $R_1=R_0k_1$, k_1 being a constant calculated in the manner later described. Accordingly, the inner surface **15** of member **11** may be completely defined to permit the formation of said member **11**.

Similarly, the outer surface **16** of member **12** may be defined by calculating R_2 values with respect to axis X—X at various heights from base **14**, from the equation

$$R_2=R_0k_2$$

k_2 being a constant calculated in the manner hereinafter described. The resultant surfaces of revolution **15**, **16** will be in opposed relation with a space **17** therebetween.

It has been found that the value of the constant k_1 may be obtained from the equation:

$$\sqrt{\left(\frac{S_1-S_0}{(S_1-S_2)E}\right)\left(1-E\sqrt{\frac{S_2(S_2-S_0)}{S_1(S_1-S_0)}}\right)}$$

where S_1 is the specific gravity of the material from which member **11** is formed; S_2 is the specific gravity of the material from which member **12** is formed; and S_0 is the specific gravity of the wood from which a conventional wood pin is formed. S_1 and S_2 are different and greater than S_0. When S_1 is greater than S_2, $E=+1$; and when S_2 is greater than S_1, $E=-1$.

Similarly, the value of the constant k_2 may be obtained from the equation:

$$\sqrt{\frac{S_1-S_0}{(S_1-S_2)E}\left(1-E\sqrt{\frac{S_1(S_2-S_0)}{S_2(S_1-S_0)}}\right)}$$

It is understood that S_0 may have values ranging from 0.60 to 0.80 which corresponds to the specific gravities of the woods acceptable for forming conventional wood pins.

The term "standardized surface configuration" or the like, as used herein, refers to the normal surface configuration of a bowling pin as the same comes within the prescribed specifications of the ABC.

In the event that the materials selected for forming members **11**, **12** are the same, or have the same specific gravity, $S_1=S_2$, then:

$$k_1=\sqrt{1-\frac{S_0}{2S_1}}$$

$$k_2=\sqrt{\frac{S_0}{2S_1}}$$

It will be apparent that with the values for k_1 and k_2 calculated in terms of the materials selected for forming members **11**, **12**, their respective surfaces may be determined. The shell and core members **11**, **12** may then be formed by appropriate operations including molding, casting, pressing or the like.

Thus, if pin P shown in FIG. 1 is to have a shell member **11** formed of polyurethane and core member **12** formed of phenolic resin, the members may be premolded of the respective materials. Member **11** has its tip formed with a small central opening **18** and core member **12** is formed at its tip with a small projection **19** receivable in opening **18**. As polyurethane member **11** is elastomeric, the same may be resiliently distended to pass core member **12** interiorly thereof for assembly therewith. A small washer **20** at base **14** of pin P is cemented in place to complete the proper assembly of members **11**, **12**.

Alternatively, the pin may be formed by successive molding operations. Thus, as shown in FIG. 3, the premolded core member **12** is used as an inner mold element for molding thereabout a light, rigid cellular mass **21**, such as foamed polyurethane. Mass **21** fills the space **17** indicated in FIG. 1. The outer surface **22** of cellular mass **21** corresponds to the predetermined inner surface of the shell member **11A** and is molded accordingly. Outer surface **22** of body **21** now provides a mold element for the shell member **11A** which is now molded about said body **21**. Body **21** is very light and does not materially affect the calculations for determining the surface configurations of core member **12** and shell member **11A**. Body **21** also maintains members **11A**, **12** in their proper relationship. Thus, shell member **11A** may be formed of a non-extensible material, by virtue of the combined molding and assembly operations described.

Also, if desired, the shell member may take the form of a plurality of premolded sections which are interfitted and assembled with the core member. As shown in FIG. 4, pin **25** comprises a core member **26** in premolded form with slightly dovetailed portions **27**, **28** at the opposite ends thereof. The shell member **29** is made up of premolded cuplike sections **30**, **31** providing the top and bottom portions of the pin respectively and a pair of mating semi-cylindrical sections **32**, **33** forming the intermediate portion of the pin.

The pin sections **32**, **33** are formed with mating tongue and groove portions **34**, **35** along their opposed vertical edges. The lower peripheral edge portion **36** of top section **30** and the upper peripheral edge portion **37** of intermediate sections **32**, **33** are interconnected as by shiplap joint portions **38**, **39**. Similar joint portions are provided to connect bottom section **31** with intermediate sections **32**, **33**.

The top shell section **30** is formed at its tip with an opening **40** complementary to tip portion **27** on core member **26** while the bottom wall **41** of the bottom shell section **31** is formed with an opening **42** complementary to projecting portion **28** on core member **26**.

The several shell sections **30**, **31**, **32** and **33** may be assembled together and with core member **26** and adhesive may be applied at the several joint lines. However, with the shell sections being formed of slightly yieldable material, the top and bottom sections **30**, **31** may be snapped into place with respect to core member **26**, locking the interenegaged portions **27**, **40** and **28**, **42** and thereby holding all the shell sections firmly together.

Other means may be used to hold the shell and core members in properly assembled relationship, as by screws, press fit portions and the like. Thus, as shown in FIG. 6, the sections **30**, **32** may be interlocked by dovetail joint portions **38'** and **39'** which are snapped together during the assembly of the several sections as described above.

Also, the cellular mass **21** may be formed in place after the members **11A** and **12** have been assembled, as by injecting a suitable polyurethane composition which will foam into place.

As various changes might be made in the embodiments of the invention herein described without departing from the spirit thereof, it is understood that all matter herein shown or described shall be deemed illustrative and not by way of limitation except as set forth in the appended claims.

What is claimed is:

1. A bowling pin comprising an outer shell member and an inner core member, interengagable means on at least one end of said members for maintaining said members with their respective vertical axes in coincidence and for preventing relative movement of said members along said axes, said shell member having outer and inner surfaces respectively describing surfaces of revolution with respect to said axes, said core member having an outer surface describing a surface of revolution with respect to said axes and in opposed relation to the inner surface of said shell member, the outer surface of said shell member being of standardized configuration, the inner surface of said shell member being such that any point in said surface shall have a radius measured from said axes which is proportioned to the radius of a corresponding point in the outer surface of said shell member measured from said axes, and the outer surface of said core member being such that any point in said outer surface shall have a radius measured from said axes which is proportioned to the radius of a corresponding point in the outer surface of said shell member measured from said axes, wherein the value of the ratio of the inner radius of the shell member to the outer radius thereof at any point between the top and bottom portions of said pin is constant and the value of the ratio of the radius of the core member to the outer radius of the shell member at said point between the top and bottom portions of said pin is constant.

2. A bowling pin as in claim **1** wherein said members are formed of materials having a specific gravity greater

than 0.60 and the specific gravities of said members are different.

3. A bowling pin as in claim 1 wherein said shell member is formed of rigid polyurethane.

4. A bowling pin as in claim 1 wherein the inner surface of the outer shell member is spaced from the outer surface of the inner core member and a cellular rigid filling is disposed between said members for maintaining said members with their vertical axes in coincidence.

5. A bowling pin as in claim 1 wherein said shell and core members are premolded elements and the shell member has an extensible opening in its wall whereby the core member may be inserted within said shell member.

6. A bowling pin as in claim 1 wherein said shell member comprises a plurality of walled sections having interengageable meeting edge portions.

7. A bowling pin as in claim 1 wherein a light rigid cellular mass is in integrated relation to said core member and said shell member is in integrated relation to said rigid cellular mass.

8. A bowling pin as in claim 1 wherein the inner surface of said outer shell member is spaced from the outer surface of said inner core member and the shell member and the core member are formed of materials having the same specific gravity and $R_1=R_0k_1$ and $R_2=R_0k_2$; k_1 being equal to

$$\sqrt{1-\frac{S_0}{2S_1}}$$

and k_2 being equal to

$$\sqrt{\frac{S_0}{2S_1}}$$

R_1 and R_2 being radii measured from the vertical axis of said members to a given point in the inner surface of said shell member and the outer surface of said core member respectively at any given height above the base of said pin, R_0 being the radius measured from said axis to the outer surface of said shell member at said given height above the base of the pin; S_1 being the specific gravity of the material from which said members are formed, and S_0 being the specific gravity of wood from which wood pins are formed.

9. A bowling pin as in claim 1 wherein said shell member comprises cup-shaped upper and lower sections and a pair of vertically split intermediate sections, said intermediate sections having interfitting joint portions on the opposed vertical edges thereof, said intermediate, upper and lower sections having interfitting joint portions on the opposed annular edges thereof.

10. A bowling pin as in claim 9 wherein said cup-shaped sections and respectively adjacent end portions of said core member have cooperative, interlocking portions for holding said shell member sections and said core member in assembled relation.

11. A bowling pin as in claim 1 wherein said shell member is formed of a rigid, abrasion resistant polymeric synthetic resinous material and said core member is formed of a molded synthetic resinous material.

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