Oct. 21, 1958 W. E. BURKHARDT, JR 2,856,679

METHOD OF RELOCATING THE FINGER HOLES IN BOWLING BALLS

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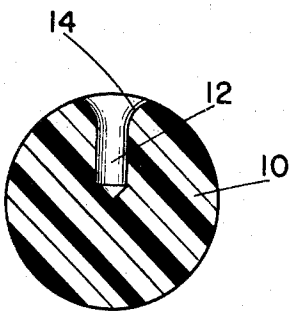


FIG 1

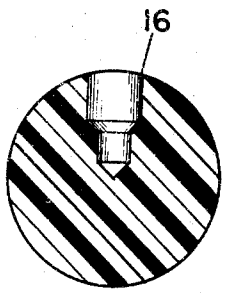


FIG 2

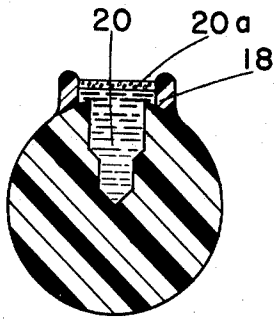


FIG 3

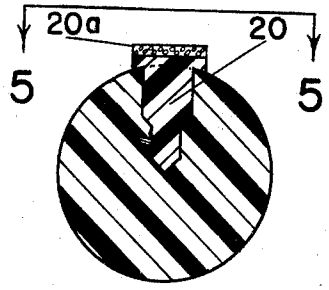


FIG 4

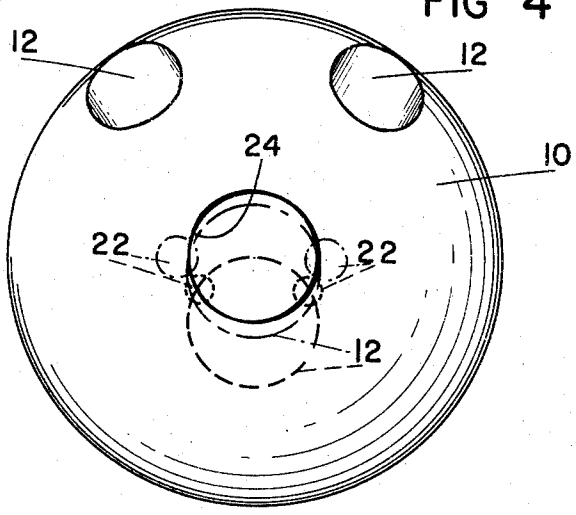


FIG 5

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METHOD OF RELOCATING THE FINGER HOLES IN BOWLING BALLS

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6 Claims. (Cl. 29—401)

The present invention relates to a method of relocating the finger or thumb holes in bowling balls.

Prior to the present invention, it has been customary to relocate the finger or thumb holes of bowling balls by enlarging the existing holes sufficiently to receive a plug capable of having a new hole entirely therein. The method comprises forming a plug of similar material on a machine, such as a lathe, and by adhesively securing the plug in the hole with pressure, the plug initially being designed to have a very tight fit therein, and the hole being vented to another finger hole to prevent the build up of pressures.

The foregoing method of repairing a bowling ball has not been satisfactory usually for the reason that the plug becomes loose in the hole, permitting slight emergence of the plug with relation to the hole which affects the balance as well as the path of the ball during motion. Furthermore, the loss of material removed to vent one hole to another affects the balance of the ball also and is not corrected in the conventional method used.

The present invention seeks to overcome these undesirable features by providing a method of relocating the finger and/or thumb holes which results in a finished product which tenaciously adheres to the parent body of the bowling ball, and therefore does not become loose; which may very easily be provided at substantially the same specific gravity as the bowling ball and fills 100% of the hole so that the balance thereof will not be adversely affected; and which is very easy and convenient to apply and work with tools to give the desired result.

In the accompanying drawing forming a part of this application, like numerals are employed to designate like parts and the steps of the method are clearly seen therein.

Figures 1–4 are vertical cross sections taken through a bowling ball and showing a number of successive steps of the method constituting the present application.

Figure 5 is a face view of the bowling ball showing the hole relocated by full line, and the original location by broken lines.

As seen in the drawings, a conventional bowling ball **10** has a number of finger holes as at **12** which extend into the body of the ball. The finger holes **12** are substantially cylindrical in shape as though they had been drilled with a conventional twist drill, but at the juncture of the cylindrical wall of the finger holes and the spherical face of the ball, they are provided with a rounded peripheral section, as at **14**, to enhance the comfort experienced while grasping the ball.

In practicing the present process, it is first necessary to remove this arcuate juncture **14**, and I therefore form a substantially right angle peripheral corner **16** by employing a conventional twist drill which is the same or larger than the diameter of the mouth of the finger hole **12** at the point where the rounded peripheral portion merges into the spherical face of the bowling ball. Then I employ a pliant material such as clay **18** to form an upstanding wall in spaced relation to the mouth of the

hole thus formed which will be temporary and removable at will.

After the wall is formed the area included within the hole and the upstanding wall is filled by tenacious fluid material **20**, which is capable of setting or hardening and curing, and which has no measurable contraction or shrinkage after hardening. This material will be subsequently described in greater detail.

After the material **20** has hardened or set up (approximately 48 hours), the wall **18** is removed. By means of a knife or other tool, or sandpaper, the excess hardened material **20** is removed to conform to the spherical configuration of the ball.

When the new finger hole location is spaced from the now filled hole, the proper sized drill is selected and disposed at the proper angle of entry and the hole is drilled. Subsequent to the drilling of the new hole a rounded edge as at **14** of Figure 1 is applied.

However, when it is desired to move the finger hole a very slight distance so that the proposed finger hole overlaps the old filled finger hole, it is necessary prior to the formation of the upstanding wall, to drill pilot holes at the points where the proposed finger hole and the original finger hole will juncture. These pilot holes are indicated by the dash-dot lines of Figure 5 and the reference numeral **22**. Then, subsequently the pilot holes and the mouth of the opening are all encircled in spaced relation by the upstanding wall and the material **20** is filled, after which the proposed finger hole **24** is drilled as previously set forth. This provides at the junctures, a greater amount of the filling material by doing away with all sharp angles, providing a greater amount of holding power and thus preventing and avoiding feather edges and thereby loosening of the material. The dotted lines are applied to show more clearly this process but probably would not apply where the center of the new hole is removed such a great distance from the center of the former one.

The present method is quite dependent upon the physical characteristics of the indurative material which is used for the fill. It is desirable first, that this material have a specific gravity substantially identical to the average specific gravity of the bowling ball; second, that it be of a material that will not shrink away from the walls of the old finger hole and thus come loose; and thirdly, by a material which is easily and conveniently worked with common wood or metal-working tools. In addition, it is desirable that the material be susceptible to coloring so that the color of the ball may be matched so that the hole change will not be noticeable.

In the practice of the present invention, I employ a material compound comprising polysulfide liquid polymer, an epoxy resin, a catalyst, a coloring material, and silica in controlled ratios. The unconverted polysulfide liquid polymer is essentially a difunctional mercaptan made from 98 mole percent of bis(2-chloroethyl) formal and 2 mole percent of trichloropropane, a crosslink agent. The polymer segments are composed of a number of formal groups linked by sulfur bonds and are terminated by mercaptan groups; side mercaptan groups occur occasionally in the chain of repeating formal units and some chain segments are crosslinked at various points. The average structure of the polysulfide liquid polymer may be represented as follows:

$$HS—(C_2H_4—O—CH_2—O—C_2H_4—S—S)_6—C_2H_4—O—CH_2—O—C_2H_4—SH$$

The polysulfide liquid polymer physically is a mobile, clear amber liquid which has been tested and found to be very stable for a period of more than three years.

The epoxy resin is used in conjunction with aliphatic

or aromatic amines as a catalyst while being co-cured with the polysulfide liquid polymer. Various amines are available which will fully cure this compound. These amines vary in activity so that room temperature cures may be accomplished with the fast acting catalysts while 180° F. temperatures are necessary with the slower acting ones. Typical amine catalysts arranged in approximate decreasing order of activity are:

(1) Tri-dimethyl-aminomethyl-phenol
$[(CH_3)_2N]_3C_6H_2OCH_3$

(2) Tetraethylenepentamine
$NH_2(CH_2CH_2NH)_3CH_2CH_2NH_2$

(3) Triethylenetetramine
$NH_2C_2H_4NHC_2H_4NHC_2H_4NH_2$

(4) Diethylenetriamine
$NH_2C_2H_2NHC_2H_4NH_2$

(5) Dimethylaminopropylamine
$(CH_3)_2N(CH_2)_3NH_2$

(6) Dimethyl aminomethyl phenol
$(CH_3)_2NC_6H_4OCH_3$

(7) Diethylaminopropylamine
$(CH_3CH_2)_2N(CH_2)_3NH_2$

(8) Benzyldimethylamine
$C_6H_5CH_2N(CH_3)_2$

(9) Piperidine
$C_5H_{11}N$

(10) Diethylamine
$(C_2H_5)_2NH$

(11) Dimethylaminopropionitrile
$(CH_3)_2NCH_2CH_2CN$

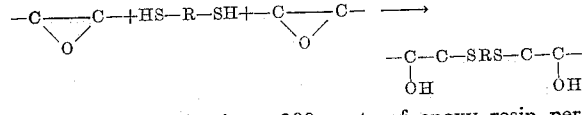
(12) 2-ethyl-hexoic acid salt of tri-dimethyl aminomethyl phenol
$[(CH_3)_2N]_3C_6H_2OCH_3CH_3(CH_2)_3CHC_2H_5COOH$

(13) Acetic acid salt of tri-dimethyl aminomethyl phenol
$[(CH_3)_2N]_3C_6H_2OCH_3CH_3COOH$

(14) M-phenylenediamine
$C_6H_4(NH_2)_2$

(15) Pyridine
(C_5H_5N)

The first five listed amines are relatively fast acting and the material will harden and cure at room temperatures while the subsequent amines are more practical for use when heat in varying degrees and periods of time is applied. An additional reaction, which probably proceeds according to the following generalized equation, occurs:



In these combinations, 300 parts of epoxy resin per 100 parts of polysulfide liquid polymer have been used in conjunction with up to 10 parts of an aliphatic or aromatic amine activator per 100 parts of epoxy resin.

Other ratios of epoxy resin to the liquid polymer are useful to the practice of this invention but this has been determined to be the most effective and useful. Depending on the relative proportions of the ingredients in the compounds, the time required for curing or conversion to a high polymer may vary from several minutes to several days at room temperature. At the ratios set forth the time required for curing is seven days at normal room temperature but material is set or hard and more easily worked after 48 hours. Higher temperatures will accelerate the cure but are not recommended because of adverse effect on the parent material of the bowling ball.

By conventional means the average specific gravity of the ball is determined and then the specific gravity of the fill material is adjusted by the addition of silica until the fill material approximates the specific gravity of the ball.

It is known that the epoxy resin has a specific gravity of 1.2, while the polysulfide liquid polymer has a specific gravity of 1.27. The amine catalyst has a specific gravity of 1.0. Where weight in air is w and weight in water is w', the specific gravity of a bowling ball is determined by the following formula:

$$\frac{w}{w-w'}=SG$$

As a specific example, a bowling ball found to have a specific gravity of 1.338 may be provided with a filling material compounded as follows:

42.0 ml. Epoxy resin	×1.2	Sp. Gr.=	50.40 gm.
14.0 ml. Liquid polymer	×1.27	Sp. Gr.=	17.78 gm.
4.2 ml. Amine catalyst	×1.0	Sp. Gr.=	4.20 gm.
9.0 cc. Carbon black	× .115	Sp. Gr.=	1.035 gm.
5.0 cc. Silica	× .750	Sp. Gr.=	3.75 gm.
60.2 ml. or cc.			77.165 gm.

95% 60.2=57.19 77.165/57.19=1.349 gm./cc. or Sp. Gr.

It will thus be seen that by varying the amount of silica included in the compound, the specific gravity may be varied in accordance with the specific gravity of the bowling ball.

Under actual operating conditions it has been found that the compound so made, is very tenacious and adheres to the walls of the filled finger hole to such an extent that during the hardening or setting stage there is a maximum of 5% shrinkage; the shrinkage is from the top inwardly of the hole. There is no measurable shrinkage during the remaining five days curing time and the compound when cured is not removed from the sides of the bowling ball.

When a subsequent hole is drilled the shaving does not separate at the juncture of the bowling ball and the cured material filling the hole, and in fact, when the ends of the shaving, having a joint between the bowling ball material and the hole filling material, are pulled the shaving seldom separates at the joint, but separates either in the hole filling compound or in the bowling ball material.

Since the shrinkage after hardening is so infinitesimal that I have been unable to measure it, the material does not shrink from the walls of the hole filled, with age.

It is to be noted that the provision of the upstanding wall in spaced encircling relation to the mouth of the hole, is for two purposes; one, to provide sufficient material above the peripheral configuration of the ball to compensate for the shrinkage during curing which causes a pit or depression to form in the outer face of the compound cured; and the other is to provide sufficient material so that the small air bubbles in the compound may rise and not interfere with the smooth finish when the material is removed and finished to the spherical configuration. These air bubbles are indicated by the layer **20***a*, shown in Figures 3 and 4. It assists in accelerating the movement of these air bubbles to the top if the bowling ball is vibrated after the compound is poured into the area previously described. This may be accomplished by a mechanical vibrator or one may employ a soft rubber mallet or similar tool to strike the ball a number of light taps, causing vibration and effecting the raising of the air bubbles. Obviously a better product results when such air bubbles are completely removed although it is possible to practice the invention without this step where great accuracy and balance is not of great importance.

Having thus described the present invention I claim as new, and desire to secure by Letters Patent of the United States the following:

1. The method of relocating a finger hole in a bowling ball, comprising forming a substantially right angle peripheral corner at the mouth of the finger hole to be relocated; drilling pilot holes at the junctures of the proposed finger hole wall and the original finger hole, and filling the area included within the hole and the upstanding wall with an initially fluid indurative tenacious material capable of maintaining its lateral volume while curing and having a specific gravity identical to the average specific gravity of the ball; effecting curing of the mate-

rial; subsequent to the material having cured, finishing the ball to the original spherical configuration and subsequently reforming the finger hole at the predetermined location.

2. The method of relocating a finger hole in a bowling ball, comprising forming a substantially right angle peripheral corner at the mouth of the finger hole to be relocated; surrounding the mouth of said opening in spaced relation with a temporary upstanding wall, filling the area included within the hole and the upstanding wall with a fluid compound containing by volume three parts of epoxy resin, one part of polysulfide liquid polymer, one-tenth of one part of an amine catalyst, and sufficient coloring material and silica to result in the desired color and specific gravity; effecting curing of the compound; subsequent to the compound having cured, removing the upstanding wall and the excess cured material to conform to the spherical configuration of the ball; and reforming the finger hole at the predetermined location by boring.

3. The method of relocating a finger hole in a bowling ball, comprising forming a substantially right angle peripheral corner at the mouth of the finger hole to be relocated; surrounding the mouth of said opening in spaced relation with the temporary upstanding wall; filling the area included within the hole and the upstanding wall with an initially fluid tenacious indurative material capable of maintaining its lateral volume while curing and having a specific gravity substantially identical to the average specific gravity of the ball; vibrating the filled material to effect removal of air bubbles from the material in the hole; effecting curing of the material; subsequent to the material having cured, removing the upstanding wall and the excess cured material to conform to the spherical configuration of the ball; and reforming the finger hole at the predetermined location.

4. The method of relocating a finger hole in a bowling ball comprising forming a substantially right angle peripheral corner at the mouth of the finger hole to be relocated; surrounding the mouth of said opening in spaced relation with a temporary upstanding wall; filling the area included within the hole and the upstanding wall with a fluid compound containing epoxy resin, polysulfide liquid polymer, an amine catalyst, and silica in suitable proportions to result in an initially fluid indurative tenacious material capable of maintaining its lateral volume while curing and having a specific gravity substantially identical to the average specific gravity of the ball; effecting curing of the compound; removing the upstanding wall and the excess cured material to conform to the spherical configuration of the ball; and reforming the finger hole at the predetermined location.

5. The method of relocating a finger hole in a bowling ball comprising forming a substantially right angle peripheral corner at the mouth of the finger hole to be relocated; providing means for limiting the flow of a fluid compound to a desired area including that of said finger hole; filling the said area with a fluid compound containing epoxy resin, polysulfide liquid polymer, an amine catalyst, and silica in suitable proportions to result in an initially fluid indurative tenacious material capable of maintaining its lateral volume while curing; and having a specific gravity substantially identical to the average specific gravity of the ball; effecting curing of the compound; causing the cured material to conform to the spherical configuration of the ball; and reforming the finger hole at the predetermined location.

6. The method of relocating a finger hole in a bowling ball comprising forming a peripheral corner of substantially not more than 90° at the mouth of the finger hole to be relocated; providing means for limiting the flow of a fluid compound to a desired area including that of said finger hole; filling the said area with an initially fluid indurative tenacious material capable of maintaining its lateral volume while curing, and having a specific gravity substantially identical to the average specific gravity of the ball; effecting curing of the compound; causing the cured material to conform to the spherical configuration of the ball; and reforming the finger hole at the predetermined location.

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