Jan. 31, 1967 F. E. SATCHELL ETAL 3,301,560

BOWLING PIN WITH SOUND CONTROLLING MEANS

Original Filed Nov. 20, 1959 2 Sheets-Sheet 1

Fig. 1.

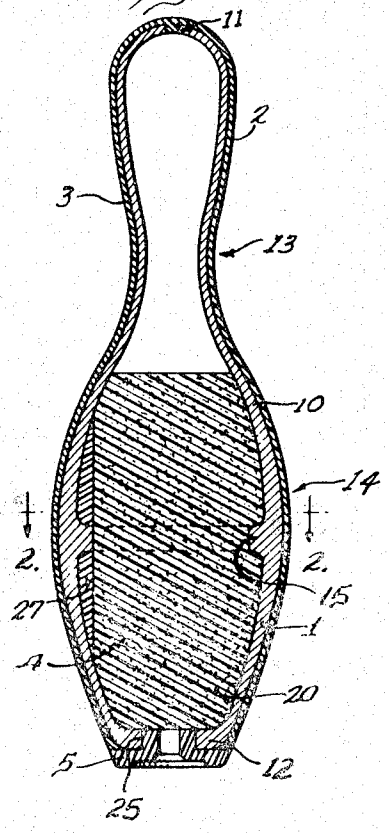


Fig. 2.

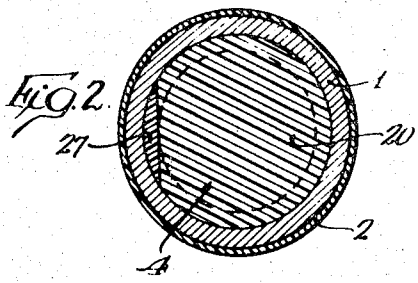


Fig. 3.

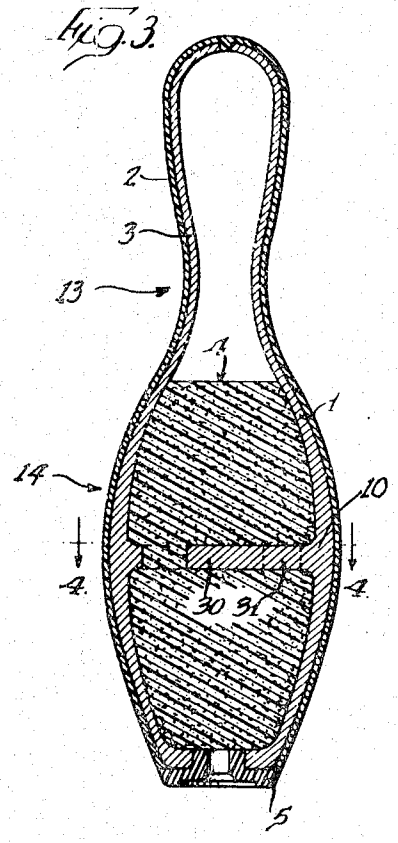
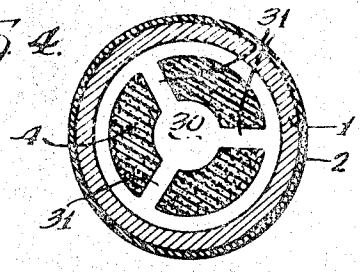


Fig. 4.



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Fig. 5.

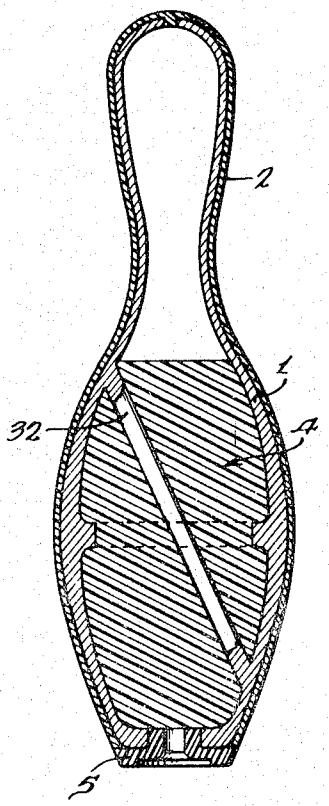


Fig. 6.

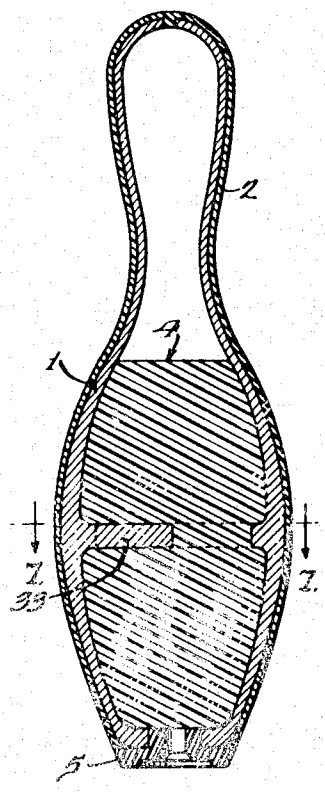


Fig. 8.

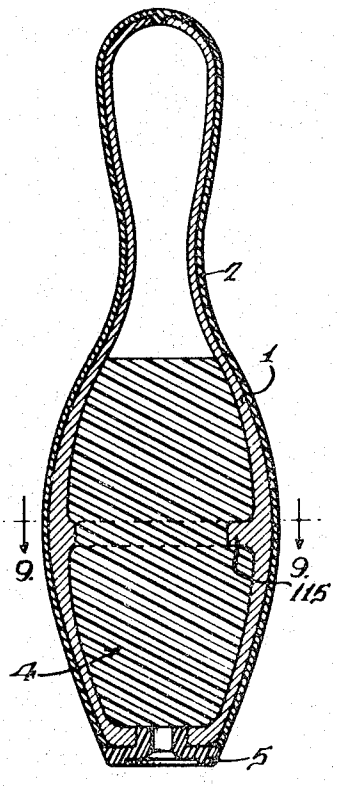


Fig. 7.

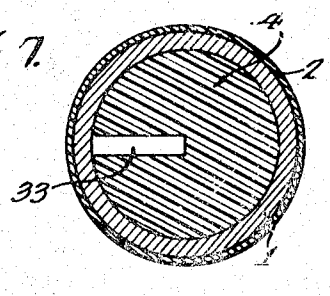
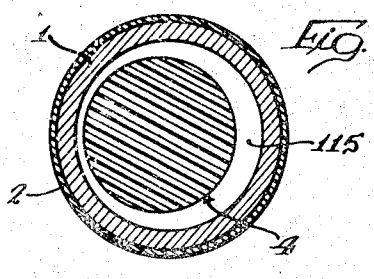


Fig. 9.



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BOWLING PIN WITH SOUND CONTROLLING MEANS

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Original application Nov. 20, 1959, Ser. No. 854,515, now Patent No. 3,138,380, dated June 23, 1964. Divided and this application Oct. 8, 1963, Ser. No. 314,652

4 Claims. (Cl. 273—82)

This application is a division of our co-pending application, Serial No. 854,515, filed November 20, 1959, now Patent No. 3,138,380, granted June 23, 1964, which was a continuation-in-part of our copending application, Serial No. 798,182, filed March 9, 1959, now abandoned.

This invention relates to a bowling pin, and more particularly to a bowling pin having a core of lightweight metal in which the pin possesses satisfactory weight, durability, action and sound properties.

Prior attempts to provide a metallic bowling pin have not proved commercially feasible because of inability of the pin to satisfy the necessary weight and durability characteristics as well as to closely approach a conventional wood bowling pin in action and sound.

An object of this invention is to provide a new and improved bowling pin having a lightweight metal hollow core with sound controlling means internally of the core, and an exterior coating on said core resulting in a pin having the action and sound generally similar to that of the wood bowling pin now commonly used in bowling alleys.

Another object of the invention is to provide a bowling pin having a lightweight metal hollow core and an exterior coating in which sound controlling means are disposed internally of the core and embody structural additions to the interior of the core wall which tend to quickly dissipate certain objectionable vibrations of the pin core.

Further objects and advantages will become apparent from the following detailed description taken in connection with the accompanying drawings in which:

FIG. 1 is a vertical section of a first embodiment of a bowling pin;

FIG. 2 is a plan section of the pin shown in FIG. 1 and taken generally along the line 2—2 in FIG. 1;

FIG. 3 is a vertical section of a second embodiment of a bowling pin;

FIG. 4 is a plan section of the bowling pin shown in FIG. 3 and taken generally along the line 4—4 in FIG. 3;

FIG. 5 is a vertical section of a third embodiment of a bowling pin;

FIG. 6 is a vertical section of a fourth embodiment of a bowling pin;

FIG. 7 is a plan section of the bowling pin shown in FIG. 6 and taken generally along the line 7—7 in FIG. 6;

FIG. 8 is a vertical section of a fifth embodiment of a bowling pin; and

FIG. 9 is a plan section of the bowling pin shown in FIG. 8 taken generally along the line 9—9 in FIG. 8.

While this invention is susceptible of embodiment in many different forms, there are shown in the drawings and will herein be described in detail several embodiments of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiments illustrated. The scope of the invention will be pointed out in the appended claims.

A bowling pin, as shown in FIG. 1, generally comprises a hollow core 1 having a resilient coating 2 secured to the exterior thereof with an adhesive 3. The hollow core 1 has sound controlling means 4 including foam material 20 disposed within the cavity within the hollow core 1. In order to complete the pin, a pin bottom 5 is secured to the base of the hollow core 1. A tenpin is disclosed herein, but the invention disclosed herein is applicable to other bowling pins such as duckpins, candlepins and Canadian fivepins.

The durability of the bowling pin is fundamentally determined by the core 1, which is composed of strong, lightweight metal alloy, primarily magnesium, with the durability increased by the resilient coating 2. In addition to the magnesium, other metals are present in the alloy and include small amounts of aluminum and zinc.

In the embodiment illustrated, the core 1 has a core wall 10 with an exterior shape closely corresponding to that of a bowling pin, but of a lesser size than a pin in order to permit additions to the exterior thereof to obtain the final bowling pin size. In the embodiment of a bowling tenpin, as shown in FIG. 1, thickness of the core wall 10 varies between a head end 11 of the core and a base 12.

The present rules of the American Bowling Congress provide that a bowling pin must weigh not less than 2 lbs. 14 ozs., nor more than 3 lbs. 10 ozs. In an actual embodiment of a pin having a total weight of 3 lbs. 4 ozs., the core 1 has a weight of approximately 2 lbs. 3 ozs. Thus, the core weight, with some variation therein, would consitute 60 to 90 percent of the total pin weight within the ABC limits. In an actual embodiment shown in FIG. 1, which has been found to provide a satisfactory core, the head end 11 has a core wall thickness of .140 inch, while the neck area 13 has a core wall thickness of .175 inch with the core wall at the belly area 14 of the core having a thickness of .375 inch and the wall gradually increasing in thickness from the neck area 13 to the belly area 14. The core wall then decreases in thickness from the belly area to the base with a core wall thickness of .185 inch generally near the base, and the base itself having a thickness of .35 inch. The thickness of the core base 12 is sufficient to prevent cracking across the base.

In order to increase the core's durability, a large rib 15 is positioned on the interior of the core wall 10 in the belly area 14 and preferably cast integrally therewith to rigidize the core and decrease the possibility of core denting in the thinner areas adjacent the belly area 14 by in effect decreasing the span across which the impact can work upon the core wall.

A metal core is louder when impacted than the conventional wood pin. In order to have the final pin with a metal core approach the sound characteristics of a wood pin, the core has the coating 2 and sound controlling means 4 associated therewith.

There are two modes of vibration of the pin core 1 which may be taken into account in producing the proper sound of the pin upon impact. One of these modes of vibration is the flexural mode, which is the vibration produced along the longitudinal axis of the core extending from the head 11 to the base 12 thereof with the head 11 and base 12 moving in a common phase and the center of the pin moving in opposite phase. The head 11 and neck part 13 of the core are largely responsible for this vibration. The other vibration is the bell mode, which is a vibration in a plane parallel to the base 12 of the core across the belly area 14 of the core. This is caused by the belly area of the core wall being distorted to an elliptical shape on impact. The vibrating belly area of the core wall forms ellipses alternately at right angles to each

other to produce the bell mode sound. Other vibrations occur at different angles to the aforementioned ellipses but are not as important to the basic sound audible to a person.

Each of the vibrations may be considered from the standpoint of the resonant frequency determining the pitch of the resultant sound as well as the Q factor, with the Q factor being the ratio of the energy stored per cycle to the energy dissipated per cycle. A rapid decay rate results in a low Q factor, and a sound with a high Q factor lasts longer than a sound with a low Q factor.

In order for the bowling pin to have a sound corresponding to that of a wood pin, as stated previously, the hollow core **1** and its vibrations upon impact are modified by the pin coating **2**, and sound controlling means within the core.

Generally, the bell mode of vibration must be minimized and the flexural mode must control the sound of the pin because it has been found that with a wooden pin, the bell mode of vibration is so mall as to be negligible. The minimization of the bell mode of vibration by the sound controlling means thus results in a pin having a sound determined primarily by the flexural mode and closely approximating that of a wood pin. It has been found that the Q ratio of flexural mode to bell mode should be at least three with the bell mode minimized.

The coating **2** also has an effect on the two modes of vibration, and it has been found that a substantially thick coating causes the pin to have a sound more nearly approaching that of a wood pin than a relatively thin coating. Localized thickening of the coating in the belly area by means such as a rubber band functions to reduce the impact noise of the pin.

The coating **2** has the basic function of cushioning the core **1** and also contributes to the factors of sound, as mentioned above, and action of the pin. This coating, in the embodiment shown in the drawings, has a thickness of one-eighth inch at the belly area of the pin, and provides approximately twelve ounces of weight to the finished pin. The coating results in a final external pin contour meeting ABC requirements. The coating may be plastisol or nylon material, and preferably is an ethocel gel lacquer coating. Prior to the coating, the surface of the core is treated with cleaning solutions, including a solution of sodium dichromate and nitric acid. After the core surface is dry, an adhesive is applied thereto. As an example, the adhesive may be a synthetic rubber based mixture. After adhesive application, an active ethyl cellulose is applied and the ethyl cellulose gel lacquer is applied as a final step by a series of dip coatings.

The coating also tends to overcome the high moment of inertia of the pin about the vertical axis thereof since the relatively thick coating, which is somewhat resilient in character, will be deformed upon impact by either a ball or a pin to provide a greater contact area and thus result in more rotation being given to the pin on an off center impact.

It has been found that the coating also functions to reduce the rebound characteristic of the pin to that encountered with a wood pin when the pin of this invention is impacted by a medium speed ball.

The pin bottom **5** is to provide a durable and nondestructive base to the pin. Its high physical requirements result from the fact that a pin struck by a ball flies through the air with the base of the pin leading the way. Hence, many secondary impacts of the pin are pin bottom impacts to other objects such as the kick-backs or other pins. The bottom is made from a material of high physical properties such as nylon to withstand the abuse encountered. Another material that is satisfactory is a polycarbonate. The pin bottom **5** is threadably attached to the base **12** of the core, as indicated at **25**.

The composite pin has a center of gravity generally the same as for a wood pin with resultant similar actions upon impact.

In the embodiments disclosed, sound controlling means are provided which decrease the bell Q factor by breaking up the symmetry of vibration operating principally in four quadrants to quickly dissipate the sound and also make it harder for the mode to operate by a rigidizing effect on the core.

In FIGS. 1 and 2, the hollow core **1** has a flexible foam **20** within the core cavity and a slug **27** bonded against the core wall interior. The slug **27** extends both above and below the strengthening rib **15** of the core and, as shown in FIG. 2, spans a fraction of the interior periphery of the core **1** and is of a material consisting primarily of synthetic resins having terminal epoxide groups.

In the embodiment of FIGS. 3 and 4, the sound controlling means comprises a centered web bracing structure including a center plug **30** centrally disposed on the longitudinal axis of the core **1** and having three equally spaced apart radially extending ribs **31** which merge and are formed integrally with the interior of the core wall **1**.

In the embodiment of FIG. 5, the core **1** has a diagonal inclined rib **32** of generally round cross section spanning opposed parts of the core wall interior to dampen vibrations in the bell mode. The diagonal rib **32** as shown merges into the core wall **1** and is formed integrally therewith.

In the embodiment of FIGS. 6 and 7, a structure is shown in which the core is permitted to vibrate in the bell mode without any special rigidifying effect, but the vibration is quickly absorbed. In this construction, a center pin **33** extends inwardly from the core wall **1** and terminates at the longitudinal axis of the pin. This pin **33** is located at the belly area of the pin and extends inwardly from the strengthening rib **15**.

In the embodiment of FIGS. 8 and 9, a construction is shown which breaks up the symmetry of bell mode vibration to lessen the effect thereof. This is accomplished by having the strengthening rib **115** off center, which breaks up the symmetry of the core. The rib has its thickest part on the order of more than twice as thick as the thinnest. This off-centering of the core also creates vertical imbalance of the pin contributing to the action of the pin upon impact.

Additional durability is provided in the pin by prolonged aging of the core **1** at normal room temperatures. Further durability is obtained by cold working of the core and particularly the neck area **13** to place the outermost part of the core wall in compression to lower the stress in the metal during flexure upon pin impacts. This, as an example, can be obtained by shot peening in which the neck area **13** is impacted by round metallic shot impinging at a high velocity.

We claim:

1. A bowling pin adapted to provide a sound substantially similar to a conventional maple wood pin on impact with a bowling ball or another pin comprising: a hollow metallic core, said core having the elongated shape of a bowling pin with a neck-head portion, a belly portion and a base portion, said core further having sound determining modes of vibration, one being a bell mode caused principally by vibration of the belly of said pin and the other being a flexural mode caused principally by the neck-head and base moving in a common phase and the belly moving in opposite phase, said bell mode being undesirable in that audibly it sounds harsh and unwooden while said flexural mode is desirable in that it sounds not unlike a maple wood pin which has a similar flexural mode; a mass positioned eccentrically within said hollow core in the belly area adapted to break up the symmetry of vibration of said bell mode to quickly dissipate the sound thereof without adversely affecting the desirable vibration of said flexural mode; said belly area being devoid of other masses tending to compensate for the eccentrically positioned mass; and a resilient plastic coating encasing said core.

2. The bowling pin of claim **1** wherein said mass com-

prises a pin on the wall of said core extending generally normal thereto and terminating near the longitudinal center line of the core.

3. The bowling pin of claim 1 wherein said mass comprises a continuous rib on the core wall interior in the belly area and disposed off center with respect to the longitudinal axis of the pin by varying in radial thickness with the thickest part being on the order of more than twice as thick as the thinnest.

4. The bowling pin of claim 1 wherein said mass comprises a slug of synthetic resinous material disposed principally in the belly of the core and spanning a fraction of the interior circumferential periphery thereof.

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