

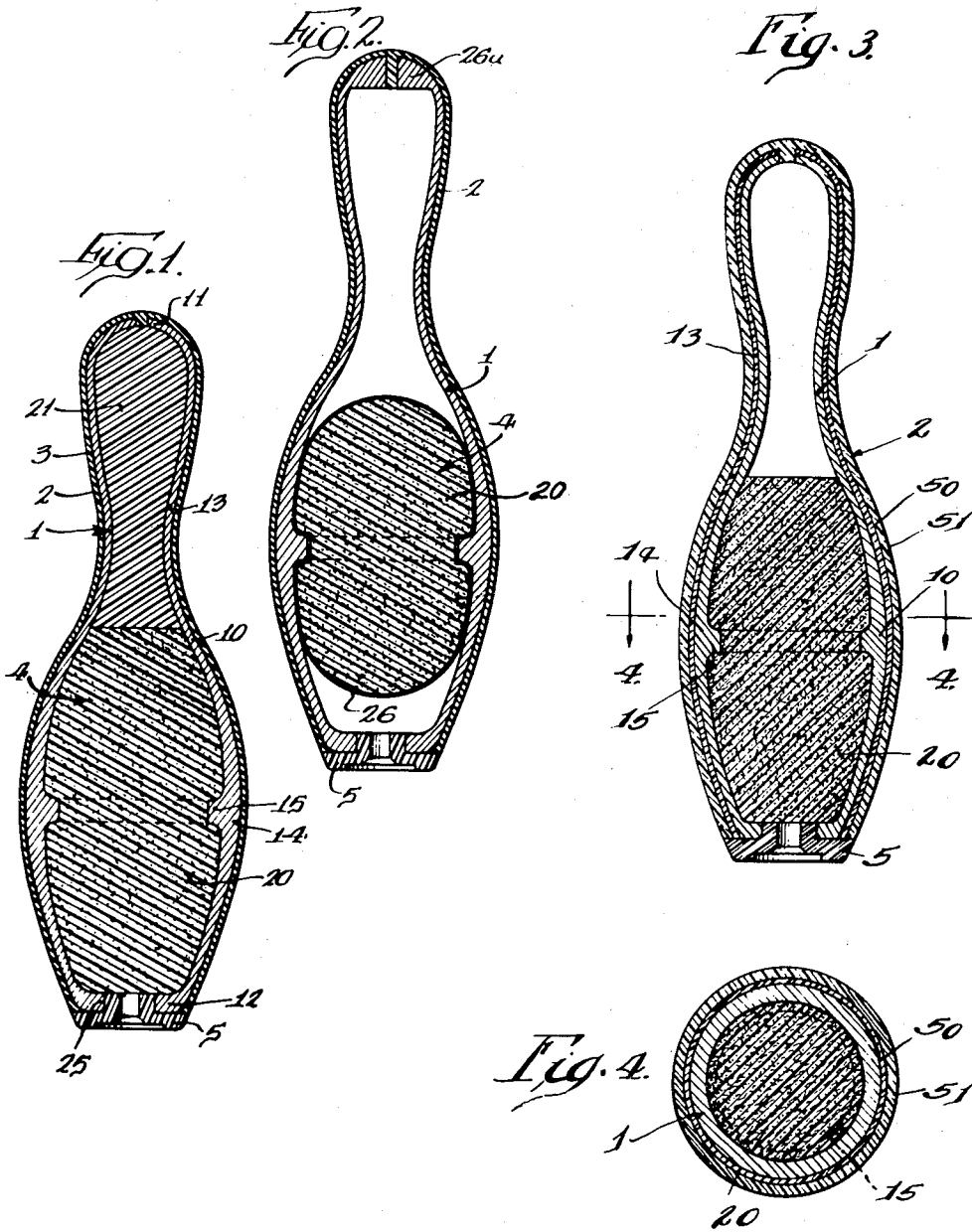
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BOWLING PIN

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BOWLING PIN

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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.

A further object of the invention is to provide a bowling pin having a hollow metallic core of lightweight metal having an external shape generally corresponding to the final bowling pin shape, said core having a relatively thick wall in the belly area of the core subjected to stress upon ball impact, the remaining areas of the core wall being of a thickness less than the wall in said belly area with local thickening thereof in the base and neck areas of the pin particularly subject to stress, a relatively thick coating encasing said core, and sound controlling means disposed within said core.

A further object of the invention is to provide a bowling pin as defined in the preceding paragraph in which the sound controlling means embodies a sound dampening material in the form of a foamable material foamed in place within the core of the pin.

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 vertical section of a second embodiment of a bowling pin;

FIG. 3 is a vertical section of still another embodiment of a bowling pin; and

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

While this invention is susceptible of embodiments 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.

This application is a continuation-in-part of our application Serial No. 798,182, filed March 9, 1959, and since abandoned.

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, indicated generally at 4, 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

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bowling pins such as duck pins, candle pins and Canadian five pins.

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 herein 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 weight 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 constitute 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

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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 4 within the core.

The sound controlling means 4 within the core, in the embodiment of FIG. 1, functions as a sound dampening structure and embodies a foam material which is foamable in place within the core. The foam material is disposed within the hollow core of the bowling pin and means are provided for locating the foam so as to eliminate a considerable part of the undesirable vibration of the bell mode. The means for locating the material may, among others, be the interior curvature of the hollow core itself, another material located, for example, in the neck of the pin to define an area of volume within the hollow core smaller than the entire volume of the core or an envelope such as a plastic ball which may encase the foam material and locate it at a place within the hollow core as will be discussed later. For example, referring to FIG. 1, the foam material includes a flexible foam 20 disposed within the hollow core from the base 12 thereof to a location above the belly area 14. This material has substantial sound dampening properties and decreases the Q factor in the bell mode of vibration to more quickly dissipate the sound produced by the bell mode vibration. As an example of the foam material, it may be a flexible polyurethane, which is a reaction product of a diisocyanate and a polyester. A more rigid foam 21 having lesser sound dampening properties is disposed within the upper end of the core, and extends within the neck area 13 into the head 11 of the pin core and functions to define a space to receive the more flexible foam 20. This rigid foam, in one embodiment, may be a rigid polyurethane foam.

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 small as to be negligible. The minimization of the bell mode of vibration by the sound controlling means 4 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

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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 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 the final component of the pin and its prime function is to provide a durable and non-destructive 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.

Another variation of sound controlling means is disclosed in FIG. 2, in which the sound controlling function of a flexible foam such as the foam 20 of FIG. 1 is arranged to provide maximum sound controlling effect with the least amount of weight addition to the pin. In FIG. 2, the flexible foam 20 is positioned within the belly area of the core 1 by being encased within a plastic ball 26. This ball thus confines the material during foaming thereof and results in the location of the foam as shown in FIG. 2. This leaves the head area of the cavity open and avoids the absorption of energy in the pin neck, when vibrated, to let the flexural mode of vibration fully operate. This embodiment also has a metal slug 26a cast integrally with the core wall at the head end of the core. This slug functions to increase the mass of the core head and lower the resonant frequency in the flexural mode to a desired value.

Another embodiment of a bowling pin is shown in FIGS. 3 and 4. This embodiment has the flexible foam 20 within the interior of the core 1 and differs from the preceding embodiments by having a thicker and more flexible coating 2. This coating contributes to both the sound and action properties of the pin by producing a sound most closely approximating that of a wood pin and giving a rebound action comparable to that of a wood pin. In order to have the over-all pin dimensions the same with the increased coating thickness, the outer dimensions of the core 1 have been reduced.

The coating 2 embodies two layers 50 and 51 with the outer layer 51 being a wear-resistant coating such as that given as a specific example in the embodiment of FIG. 1. The inner coating layer 50 is approximately half as thick as the layer 51 and is composed of a more resilient material such as a plastisol. The two layer coating provides an increased coating thickness to thus produce a softer and lower pitched sound than the coating in the other pin embodiments disclosed herein. The hardness of the coating material also has an effect on the sound as well as improving the action and scorbility of the pin.

Application of the coating having the layers 50 and 51 is accomplished by first treating the surface of the core and drying thereof as previously described. A plastisol primer is then applied to the core. As an example, this primer may be a thin film which is a combination of vinyl chloride-acetate and phenolic resins. This film is baked ten minutes at 350° F.

More specifically, this film has a ratio of phenolic

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resin to the vinyl chloride-acetate copolymer of approximately 1-5 on a weight basis.

The inner plastisol layer 50 is then applied. This layer, as an example, in the liquid state comprises a dispersion of vinyl chloride in a plasticizer which in the cured state is a plasticized vinyl chloride. Alternatively to the vinyl chloride a 95-5 copolymer of vinyl chloride-vinyl acetate can also be used. A specific example of a suitable plastisol is as follows:

	Parts by weight
(1) Diisodecyl phthalate	75-45
(2) Epoxized soyabean oil	35-10
(3) Vinyl chloride resin	100
(4) Stabilizers and antioxidants	3-5

Items 1 and 2 listed above are plasticizers and any combination thereof may be selected within the range indicated so that the total parts of plasticizer is approximately 80-85 parts by weight.

This plastisol is applied as a hot dip after heating the core to 350° F., and the coating is then cured for one half hour at 350° F.

The layer 51 is then applied similarly to the coating 2 as described in connection with FIG. 1 including the use of an adhesive and the application of a series of dip coatings of ethyl cellulose.

The hardness of the coating of the type set forth in connection with the embodiment of FIG. 1 has a Shore D hardness in the range of 65-80 and a Rockwell R hardness of +75-85. The combination coating as described in connection with the embodiment of FIGS. 3 and 4 preferably has a Shore D hardness within the range of 45-60 and a Rockwell R hardness of +5-20. It will be seen that the inner layer 50 thus reduces the hardness of the coating while suitable resistance to wear is provided by the outer coating 51.

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 prin-

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cipally 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 of sound dampening foam plastic material, means locating said mass in the hollow cavity of said core to eliminate a considerable part of the undesirable vibration of said bell mode without adversely affecting the desirable vibration of said flexural mode; and a resilient plastic coating encasing said core, said coating having a sufficient thickness to, in cooperation with said foam, substantially eliminate the remaining vibrations of said bell mode while emphasizing the wooden sounding vibration of said flexural mode.

2. The bowling pin of claim 1 wherein said sound dampening foam is principally located in the belly of said hollow core.

3. The bowling pin of claim 2 wherein said sound dampening foam is a flexible foam.

4. The bowling pin of claim 1 wherein said means is the interior curvature of the core.

5. The bowling pin of claim 1 wherein said core has an integral reinforcing rib extending into said hollow cavity and located about the belly portion.

6. The bowling pin of claim 1 wherein said core has a relatively thick wall in the belly portion.

7. The bowling pin of claim 1 wherein said means is a bag located in the hollow cavity of said core.

8. The bowling pin of claim 1 wherein said sound dampening mass is a flexible foam and said means is a rigid foam located in the neck-head portion of said core.

9. The bowling pin of claim 1 wherein said coating is formed of plural layers with an inner layer being of a resilient material and the outer layer being of a harder wear resistant material.

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