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BOWLING PIN

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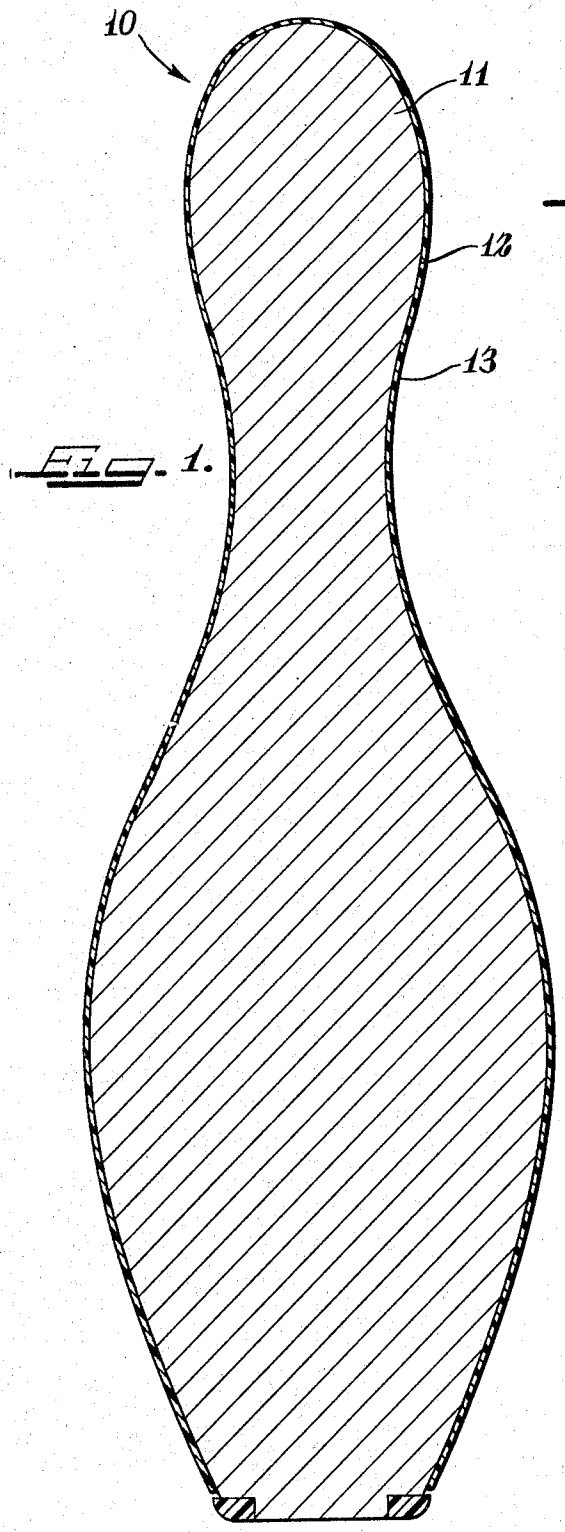

Fig. 1.

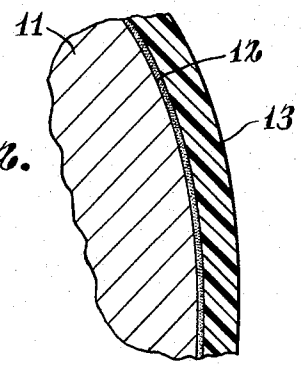

Fig. 2.

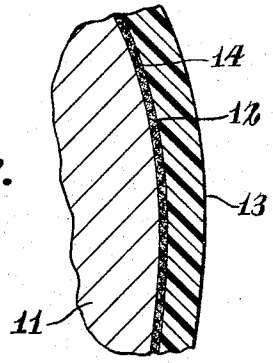

Fig. 3.

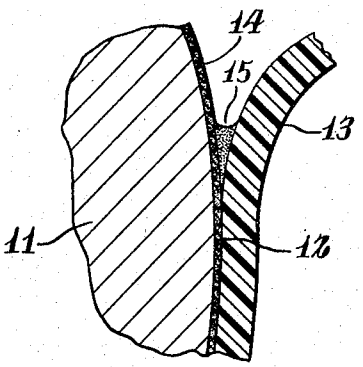

Fig. 4.

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BOWLING PIN

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This invention relates to bowling pins and more particularly to protection of bowling pins against impact by a bowling ball.

It is a general object of this invention to provide new and useful bowling pins of the character described.

It is also an object of this invention to provide new and useful protection of bowling pins and their cores against impact of a bowling ball.

Another object of this invention is to provide extended life in a new and useful manner for bowling pins having hard cores, such as hard wood cores, and hard resilient covers or outer coatings.

Still another object is to provide such a bowling pin wherein a fluid substance is disposed between the outer coating and the core. It is further an object of this invention to provide such a pin wherein a flexible structure, such as a web, is included, preferably embedded in the fluid substance.

Still another object of this invention is to provide a new and useful bowling pin having a hard core, an outer resilient or flexible hard cover and a tacky material adhering to the core and binding the cover to the core in an impact resistant bond.

Other objects will be apparent from the following descriptions and the drawings in which:

FIGURE 1 is a vertical section of an embodiment of the bowling pin of this invention;

FIGURE 2 is an enlarged partial section through one form of the embodiment of FIGURE 1;

FIGURE 3 is an enlarged partial section through another form of the embodiment of FIGURE 1 including a web embedded in the fluid or tacky material; and

FIGURE 4 is an enlarged partial section corresponding to that of FIGURE 3 during the peeling of the outer cover or coating from the pin to illustrate a preferred form of tacky material.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail an embodiment of the invention and a modification thereof with the understanding that the present disclosure is to be construed as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated.

Turning first to the drawings, FIGURE 1 shows an embodiment exemplifying the bowling pin which is provided in accordance herewith. In the illustrated example, the bowling pin indicated generally by reference numeral **10** includes a hard core **11**, preferably of hard wood such as maple, with a fluid coating **12**, e.g., a layer of a tacky composition, approximately 10 mils in thickness and having the formulation:

Ingredient:	Parts by weight
Butadiene-acrylonitrile copolymer	80–90
Phenolic resin modifier	2-8
Softener (dioctyl phthalate)	0–5

disposed over core **11**. Tacky layer **12** extends the length and over the cap of core **11** and is in turn enclosed by an outer coating **13** which may be, for example, an ethylcellulose lacquer coating wherein the lacquer is plasticized with a polyester containing castor oil or plasticized with dibutyl phthalate or other phthalate or

sebacate or the like, the plasticizer being used in a compatible amount.

The tacky layer in two forms can best be seen with reference to FIGURES 2 and 3 as a layer between the inner core **11** and outer coating **13**. Although layer **12** is shown as continuous over substantially the entire length and over the cap of core **11**, the layer **12** may be provided, if desired, over only a portion of the core surface, e.g., in the major impact areas such as the belly areas.

In the form illustrated in FIGURE 3, the tacky layer **12** embeds a flexible structure in the form of a normally tubular stretchable nylon mesh or sock **14** impregnated by layer **12**. In the illustrated form, for example, the layer may be of about 10 mil thickness and the nylon sock is preferably no greater in thickness than the total thickness of the tacky layer. In the preferred form, the nylon sock has the approximate tubular normal diameter of the neck diameter of the core, the tubular mesh being stretched from its normal tubular configuration to generally enclose and conform to the core surface. The sock may be applied to the core, for example, by stretching over the core from the cap end thereof. The sock is impregnated within the tacky material of layer **12**, being sufficiently porous or permeable for the tacky material to generally surround the individual fibers of the nylon sock mesh. The web or flexible structure **14** generally conforms to the outer configuration of the pin core, as does the tacky layer.

Returning now to the fluid or tacky coating of layer **12** in the forms of pins shown in FIGURES 2 and 3, although we do not intend to be held to any theories with respect to the present pins, the fluid or tacky coating appears to provide a migratory mass which will migrate between the core and outer cover under ball impact conditions. Thus, on impact the outer coating is free to follow the configuration of the core under stress and apparently deforms the fluid or tacky layer material while the outer coating, a hard resilient coating, is permitted to flex with the core and also to flex with respect to the core. The fluid layer serves to distribute stresses from the coating and decreases the amount of stress carried from the coating into the core. In the preferred embodiment, the fluid layer extends generally the entire length and over the cap of the core so that the stresses may be distributed more widely by the tacky layer.

Under impact of a bowling ball, especially where a hard wood core is used, after repeated impacts the wood core and plastic coating change in contour at different rates. For example, a greater appreciable amount of permanent densification of the core results. However, in the pins of this invention, the tacky layer permits differences in rates of contour change between core and coating without development of stress in the wood.

The outer coating may follow or generally conform with the core during core densification so that densification may occur without the developing of voids at the core surface; any voids developed or failures between bonds in the present pins are much more likely to occur between the outer coating and the tacky layer rather than between the tacky layer and core. The tacky material and the web, where used, remains bonded to the wood. Further, where local irregularities or failures develop between the core and outer cover, the tacky layer is fluid and can compensate over the pin configuration for such irregularities. Should the outer coating become punctured, the portions of the outer coating adjacent the puncture remain in general conformity with the pin core and are actually retained bonded to the pin core through the tacky layer rather than pulling away from the core as may happen with conventional bonding materials.

The tacky layer provides a non-abrasive mass permit-

ting the outer coating and hard core to slide over each other without destroying each other through abrasive action and thereby functions somewhat as a lubricant. In such manner the tacky layer keeps the hard elements, i.e., the core and outer coating, from "powdering" which may normally occur in the absence of the intermediate layer due to rubbing of adjacent coatings or layers or rubbing of the coating with the bonding between layers as often occurs under conditions of bowling pin use. As fissures develop in the wood surface, the fluid adhesive substance of the tacky layer may fill such fissures and inhibit their propagation. In an advantageous form, the tacky layer is a layer of tacky elastomer such as an adhesive which is capable of adhering to a hard wood core surface and the outer coating to bind the core and coating together. Where a web or flexible structure is used within the adhesive layer, the adhesive also adheres to the web and maintains the web against the pin core. The bond between the adhesive layer and core is preferably highly resistant to impact throughout the normal life of the bowling pin. Thus, in the preferred form, the adhesive material is a noncured and noncurable adhesive such as the noncuring rubber-type adhesives which have no substantial cross-linking ability and no appreciable curing or cross-linking agents incorporated therein. Although the illustrated pin has a coating thickness of about 10 mils, the preferred pins may include the tacky layer in any thickness desired, e.g., 5 to 35 mils or more or less. The thickness of the tacky layer will, of course, depend somewhat on the material used, the amount of fluid or fluidity desired between the outer coating and inner core, and the like.

FIGURE 4 illustrates the desired property of tackiness in the layer in a preferred composition. In FIGURE 4, the outer coating **13** is being peeled away from the core **11** and tacky layer **12** and the tackiness of the material is illustrated as the legs **15** formed between the outer coating and tacky layer as the outer coating is stripped therefrom. The legs **15** form and are lengthened as the outer coating **13** is pulled further away, the legs detach from the outer coating **13** and return as a portion of the tacky layer **12**, demonstrating elasticity and some plastic memory in the tacky material. Preferably, we desire a balance between cohesive strength and adhesive strength in the tacky layer material such that any failure between the tacky layer **12** and plastic coating **13** is primarily or predominantly a failure in adhesiveness of layer **12** to layer **13**, the layer having higher cohesive strength than adhesiveness to the plastic coating. Also the preferred tacky layer material has higher adhesive strength with respect to the wood core than cohesiveness so that failures in cohesiveness of layer **12** occur rather than failure of adhesiveness of layer **12** to core **11**.

Two especially advantageous substances which have been found to provide excellent tacky layers are a high acrylonitrile copolymer (e.g., butadiene-acrylonitrile) cover base adhesive which remains tacky even after nine months of standing and a Butyl Rubber adhesive of the noncuring type. As a suitable composition, an adhesive high in acrylonitrile copolymer rubber content which includes very minor amounts of neoprene, chlorinated natural rubber, and/or a phenolformaldehyde condensate (such as is normally used as a tackifying agent in adhesive) may be used. Minor amounts of a suitable softening agent such as dioctyl phthalate may be included. Such composition has appreciably no curing agent.

Outer coating **13** is a coating or cover basically like the coating or cover material provided on a conventional wood pin core. The coating material may be applied over the tacky layer in the same manner as it would be applied over a wood core or sealed wood core or over base coats on the wood core. However, in the preferred form, the outer coating has a high shrinkage value and is contractile, normally contracting the tacky substance against the hard core surface. Thus, the outer coating may serve to exert an inward stress on the tacky layer and the shrinkage or contractibility of the outer coating further enhances its ability to follow the wood core during impact and upon densification of the wood core. The contractibility of the coating may be initially established by the use of solvents or plasticizer or both. For example, a plasticizer may be included in the lacquer material which normally causes the lacquer material to contract while or upon setting. In coating, the usual basic coating materials for coating pins may be used such as nitrocellulose, cellulose acetate butyrate, ethylcellulose, etc. Suitable plasticizers have been exemplified above and will be well known to those in the art.

The web, e.g., in the form of nylon sock **14**, is embedded in the tacky substance and functions as a framework skeleton for holding the tacky material.

The tacky material or layer remains fluid over an extended period of time. In artificial aging tests, wherein pins prepared in accordance with the present invention were subjected to oven temperatures of about 125° F. for thirty days, the tacky layer did not appreciably cure or harden but remained tacky and exhibited the properties illustrated with reference to FIGURE 4. Further, pins have been stored for over nine months under ambient conditions with the tackiness of the layer retained.

In the production of pins of the present invention, the tacky material may be applied as a layer directly to the wood core. Where a web is used, the web may be applied over the core before, during, or after the tacky material, with the web becoming suitably embedded in the tacky material. The finished coating material is then applied directly over the tacky material. All coating applications of tacky material and finished coating may be by dipping or by other methods normally used in pin coating.

As a more particular example of application of a tacky coating, a solution of fluid adhesive material was applied to a maple pin core in one or more dips to desired thickness, followed by application of ethyl-cellulose lacquer in one or more dips to desired total coating thickness.

It is known in the bowling art that after repeated and continued impact of the ball with a wood core bowling pin having a resilient cover, changes in contour are developed in the pin. Apparently, the major change results from densification of the wood core, especially in the major impact or belly area, reducing the overall diameter. Commensurate densification does not occur in the cover. The decreased core diameter relative to the cover results in stress applied to the wood of the core through the bond of the cover. The stress applied to the wood is apparently spread evenly around the entire periphery of the pin. However, because the pin is weakest in the direction perpendicular to the grain of the wood, the stress results in flat grain failure or splintering in the wood at the flat grain adjacent the cover, creating a condition known in the industry as slabbing.

Although we do not wish to be held to any theories with respect to the advantages of the present bowling pins, it is believed that the tacky material **12** provided in the present pins avoids this slabbing or flat grain failure by substantially decreasing the ability of the cover under impact to transmit stress to the layers therebeneath and especially to the pin core; the stress is substantially absorbed by relocation of the tacky material. Thus, as a bowling ball impacts against the outer cover, the core may densify as in the past, but because the cover is not bonded to the tacky layer with a sufficiently strong bond to pull the tacky layer and core away as the core densifies, there is no substantial stress transmitted through the tacky layer to the pin core therebeneath, thereby substantially preventing slabbing.

We claim:

1. A bowling pin comprising a hard core, a fluid tacky layer disposed on the outer surface of said core and adhering thereto, and a hard flexible outer coating over said tacky layer and adhering thereto, said tacky layer flexibly binding said cover to said core, said tacky layer being

sufficiently cohesive to resist separation within the tacky layer under force sufficient to cause failure in adhesiveness of the tacky layer to said outer coating and being sufficiently adhesive to the core to adhere thereto under force sufficient to cause cohesive failure in the tacky layer.

2. A bowling pin comprising a hard core, a tacky adhesive layer on said core and bonded thereto by the adhesiveness of said layer and a hard resilient cover over said tacky layer and bonded to said tacky layer by the adhesiveness of said tacky layer, the bond of said cover with the tacky layer being of lower tensile strength than the bond of said tacky layer to said core whereby under normal impact of a bowling ball with the pin any separation of cover with respect to core occurs at the bond of the cover to the tacky layer in preference to the bond of the tacky layer to the core, said tacky layer being of sufficient thickness to permit flexure of the cover with respect to the core.

3. A bowling pin comprising a hard wood core, a noncurable tacky coating or layer surrounding said core and extending the length thereof and over the cap thereof for generally enclosing said core, said tacky layer comprising the major core protecting structure and being sufficiently adhesive to adhere directly to said wood core through an impact resistant bond with said wood core, the strength of said layer being insufficient to pull wood fibers from the surface of said core under a pulling force exerted on said tacky layer sufficient to move a portion of said tacky layer, and an outer flexible hard coating generally enclosing said tacky layer and bonded to said tacky layer by the adhesiveness of said tacky layer, the bond between said tacky layer and outer coating being a lower tensile bond than the bond of said tacky layer to said wood core whereby upon stripping said outer coating from the pin said tacky layer remains bonded to said wood core.

4. The bowling pin of claim 3 including a normally flexible nylon sleeve embedded in said tacky layer.

5. A bowling pin comprising a hard wood core, a noncuring, noncross-linking tacky rubber adhesive elastomer layer over said core and a hard resilient coating enclosing said tacky layer and contracting said tacky layer against said core, said tacky layer being of sufficient tackiness and thickness to permit said flexible coating to follow the contour of the outer surface of the core upon change of such contour due to densification of the core wood under bowling ball impact and said tacky layer being of sufficient fluidity to absorb impact forces by fluid movement thereof and to compensate for flexing of said outer coating with respect to said core over substantially the entire length of the bowling pin configuration.

6. A bowling pin comprising a hard wood core, a tacky fluid noncuring elastomer layer over said core and an outer coating enclosing said elastomer layer under contraction stress, said elastomer layer having sufficient fluidity and thickness to decrease the amount of stress carried into the wood core during impact of the pin by a bowling ball.

7. The bowling pin of claim 6 wherein said outer coating is a shrunk plasticized plastic coating material having sufficient plasticizer to provide the shrunk condition of said coating material.

8. A bowling pin of standard size and shape intended to be impacted by a bowling ball during a game of bowling, said pin comprising a hard core, a hard flexible outer cover over the core, and a fluid stress-absorbing adhesive layer between the core and cover and adhering the cover to the core.

9. The bowling pin of claim 8 wherein said adhesive layer is a layer of Butyl Rubber adhesive.

10. The bowling pin of claim 8 wherein said adhesive layer is a copolymer of acrylonitrile and butadiene.

11. The bowling pin of claim 8 including a fabric embedded in said adhesive layer and retaining the fluid adhesive against substantial flowage.

12. The bowling pin of claim 11 wherein said fabric is a stretched mesh sleeve.

13. The bowling pin of claim 11 in which the thickness of said fabric is less than the thickness of said adhesive layer.

14. The bowling pin of claim 8 wherein said cover encloses said adhesive layer under contraction stress.

15. The bowling pin of claim 14 wherein said cover comprises a shrunk plasticized plastic coating material.

16. The bowling pin of claim 14 wherein said cover comprises a desolventized plastic coating material.

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