

Aug. 27, 1957

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2,804,399

METHOD FOR COATING WOOD AND PRODUCTS THEREOF

Filed Feb. 8, 1956

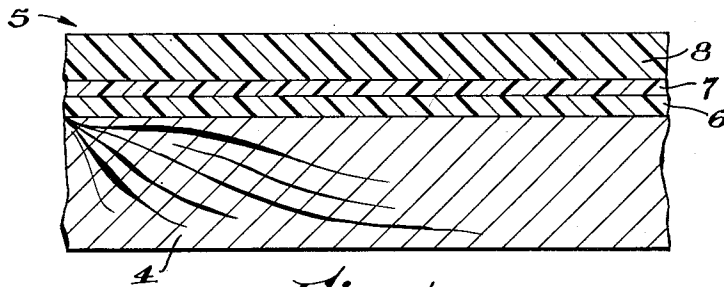


Fig. 1



Fig. 2

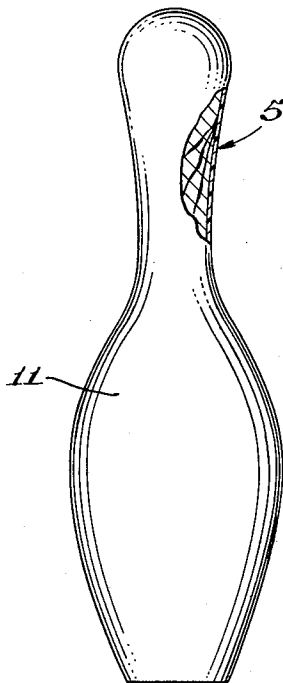


Fig. 3

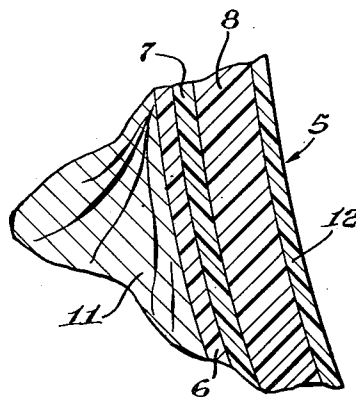


Fig. 4

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METHOD FOR COATING WOOD AND PRODUCTS THEREOF

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Application February 8, 1956, Serial No. 564,185

13 Claims. (Cl. 117—73)

This invention relates to a method for coating wooden surfaces and articles to protect them against damage from impact and deterioration. More particularly, this invention relates to a method for providing wood with a tough and effective protective covering by utilizing a tightly-adhering multicomponent coating system which comprises ethyl cellulose. The invention has specific reference to a method for protectively coating wooden implements and other paraphernalia employed in various athletic and recreational pursuits and sporting contests, such as baseball bats and bowling pins, which frequently are subjected to severe concussive impact. It is also concerned with the sundry coated wooden products which advantageously are obtainable with improved physical attributes by the practice of the coating method.

As is well known, wooden surfaces are propense to check, pit, dent, chip and undergo grain separation or splintering, particularly when they are subject to physical shock or impact from or with other objects. Individual articles fashioned from wood are especially susceptible to being shattered, splintered and even fractured or completely broken from such causes. The embrittlement of wooden surfaces and articles due to dehydration, or its swelling and increase in weight upon moisture absorption, often aggravates this susceptibility. Such comportment is an extremely undesirable and defective characteristic of wood. Among the several serious consequences for which it is responsible is oftentimes an abbreviated useful life span for many articles and implements of wood.

Baseball bats, for example, are commonly victim to a very high incidence of breakage in use. Their breakage may be induced by the impact which is occasioned whenever a baseball is hit by a batsman during the strike of the bat, especially if the angle of incidence at which the ball contacts the bat is not squarely or sufficiently parallel with or edgewise to the grain to utilize its natural optimum strength or if the locus of contact is too remote from the center of percussion of the bat, as when the ball impinges on or near the handle or tapered grip portion of the bat. It may also occur as the result of casting the bat upon the ground or otherwise causing it to be jarred. Besides actual fracture or splintering, bat breakage comprehends other conditions rendering the bat useless or unsatisfactory for additional employment. This includes checking, pitting, denting, chipping, grain separation and the like.

The breakage of baseball bats entails considerable expense by way of replacement on behalf of participants and sponsors of the sport. Furthermore, baseball bats are ordinarily manufactured from better quality grades of such types of wood as ash or hickory which are becoming increasingly scarce materials among the Nation's available resources and whose conservation is a matter of great practical concern. In addition, the breakage in use of baseball bats is a known proximate cause of injury to both competitors in and spectators of exhibitions of the sport.

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While attempts have been made to produce baseball bats having greater strength and a reduced susceptibility for breakage, completely satisfactory results have not been realized. As an illustration, baseball bats having a laminated construction are usually heavier than is desirable and despite their greater strength, have not enjoyed a widespread popularity. They also are unattractive in that their cost is excessive in comparison to conventional bats.

Analogous annotation is applicable to such wooden articles as bowling pins and alleys, polo and croquet mallets, hockey sticks, cricket bats, arrows and javelins, tool handles, wooden propellers and fans, skis, toboggans, boat hulls and other like and related wooden surfaces and articles which are subject to damaging impact and other abusive conditions. It would be advantageous for reasons of economy, conservation and safety to achieve an improved and superior resistance to breakage and damage for such articles.

It is an object of the present invention to provide a tough, dense, impact-absorbing and shock-cushioning coating for wooden surfaces and articles to imbue them with superior resistance to breakage and with minimized propensity for physical deterioration under abusive conditions of employment. It is a further object to provide a coating for wood having, in addition to such desiderata, a tightly and tenaciously adhering nature. It is a related objective for the coating to be economical and procurable from readily obtainable and relatively inexpensive materials. It is a particular object of the invention to provide such a salutary coating for various wooden sports and recreational equipment and apparatus including baseball bats and bowling pins and to secure greater endurance and extended useful life spans for such equipment. It is an additional object to provide a coating of this nature without detracting from or altering the normally acceptable utilitarian features and indicia of the coated wooden surfaces and articles. Various other objects and advantages of the invention are apparent throughout the following description and specification.

According to the invention, wooden surfaces and articles may advantageously be protectively covered with a multicomponent coating system which comprises first applying at least one priming layer and preferably more of a polyvinyl acetate latex to the bare surface of the wood; then applying at least one intermediate layer of a nitrocellulose coating composition over the applied priming layer of polyvinyl acetate latex; and subsequently applying at least one enveloping layer of an ethyl cellulose coating composition over the applied intermediate nitrocellulose layer. Each of the layers of the multicomponent coating may be applied by any suitable technique, including brushing, spraying or dipping. However, whenever it may be feasible, it is usually advantageous for the subsequent ethyl cellulose layer to be derived by dip coating in a gel lacquer formulation. Each applied layer is preferably permitted to dry thoroughly before application is made of the succeeding layer. Coated wooden surfaces and articles according to the invention have a composite, multicomponent, impact-resisting and shock-cushioning protective coating comprised of superimposed enveloping layers of polyvinyl acetate, nitrocellulose and ethyl cellulose. Such surfaces and articles have a greatly enhanced resistance to breakage and are less susceptible to damage or deterioration than when they are in an uncoated state.

Most good, commercially-available grades of polyvinyl acetate latex may be utilized for the priming layer or layers on the wooden surfaces or articles to be coated. It is convenient to employ the latex in the liquid form in which it is conventionally obtainable. Brush application is ordinarily suitable for the latex. As is a customary re-

quirement for the application of most coating materials, the surface should be dry, clean and free from grease, dirt, fingerprints or dust in order to obtain the most satisfactory results. It is usually advantageous to apply two or three coats of the polyvinyl acetate latex over the bare wooden surface to insure its thorough priming.

The intermediate nitrocellulose layer may similarly be obtained from various commercially-available types of good nitrocellulose lacquers from which a tough, adherent nitrocellulose coating may readily be derived. A typical suitable lacquer formulation prior to thinning may contain about 25 percent by weight of dissolved solids in common solvent mixtures for nitrocellulose of ethyl acetate, ethanol, xylene, toluene and the like. The dissolved solids may be comprised of suitable plasticizing materials for nitrocellulose in combination with the nitrocellulose resin which may be present in an amount which is in the neighborhood of about 70 percent by weight of the weight of the dissolved solids. The nitrocellulose resin may, for example, have a viscosity of 25-35 seconds, as determined by a standard falling ball method in a tube which is essentially similar to ASTM Test No. D301-33. Brush applications of the nitrocellulose lacquer also are usually suitable in most instances. The polyvinyl acetate and nitrocellulose layers provide good anchorage and suitable conditions of receptivity for the subsequent ethyl cellulose layer.

For most wooden articles the subsequent impact-absorbing layer may frequently be most advantageously derived from an ethyl cellulose gel lacquer composition which is applied by means of dip coating over the intermediate nitrocellulose layer. An ethyl cellulose gel lacquer, as is conventionally understood, is a formulation that is particularly adapted for hot dip application in order to obtain relatively thick coatings with minimum application effort. Frequently a coating having a 5 to 20 mil and greater thickness can be obtained readily from a single dip of the relatively cooler article in the hot gel lacquer composition. The gel lacquer may advantageously be formulated with an ethyl cellulose having an ethoxyl content, usually-designated "medium," in the range from about 45 to about 46.5 percent by weight which contains an average of between about 2.25 and 2.35 etherified ethyl substituents per glucose unit. It may have a viscosity between about 10 and 200 centipoises, as determined in a solution of about 5 percent by weight of the ethyl cellulose in a solvent mixture consisting of about 80 parts by volume of toluene and about 20 parts by volume of ethanol. It is frequently beneficial to employ a cellulose ether having a viscosity between about 50 and 100 centipoises. If desired, light stabilizers and the like can be incorporated in the cellulose ether to inhibit its discoloration on exposure to light and weathering.

Ethyl cellulose gel lacquers can be prepared with a variety of known solvents for dissolving the cellulose ether at an elevated temperature. Beneficially, however, the medium grade of ethyl cellulose gel lacquers which are advantageously employed in the practice of the present invention may be prepared with a solvent mixture of about 50 to 60 parts by weight of xylene; about 15 to 25 parts by weight of an aliphatic petroleum hydrocarbon fraction similar to that which is available under the trade-designation "Apco Thinner" from the Anderson Prichard Oil Corporation; and about 20 to 30 parts by weight of an ethylene glycol ethyl ether similar to that which is available under the trade-designation "Dowanol 8" from The Dow Chemical Company, or that which is known as "Cellosolve" and is obtainable from Carbide and Carbon Chemicals Company. Solvents or solvent mixtures having equivalent solvent power for ethyl cellulose and which are commensurate in other characteristics may, of course, also be utilized.

It is frequently desirable to plasticize the ethyl cellulose for formulation of the gel lacquer. A variety of known plasticizers and resins are available for this purpose. Ad-

vantageously, however, an alkyd type resin composition which may be similar to those which are available under the trade-names "Paraplex RG-2" and "Glyptal 2557" from Rohm and Haas Company and General Electric Company, respectively, or a hydrocarbon resin such as the poly alpha methyl styrene having a viscosity of about 900 centipoises at 60° C. which is available under the trade-designation "Dow Resin 276-V9" from The Dow Chemical Company, may be employed. Ordinarily, it is advantageous to employ not more than 50 percent by weight of the plasticizer, based on the total weight of the plasticized ethyl cellulose. The gel lacquers can be prepared with varying dissolved solids contents (which includes the weight of the ethyl cellulose and the plasticizer). While a dissolved solids content in the neighborhood of 20-30 percent by weight is normally suitable, it can be varied over wide limits within and without the mentioned range, depending on the coating thickness which is desired to be obtained in each dipping operation and the number of dips to be employed. Usually it is desirable for the complete application of the gel lacquer to be accomplished in one or two dipping operations.

Ethyl cellulose gel lacquers are best formulated to provide smooth solutions at sufficiently low temperatures (which, however, are well above room temperatures) to minimize solvent loss by evaporation. The solvent composition and its employed concentration should be capable of effecting gelation at a temperature which is about 20-25 centigrade degrees beneath the dipping temperature. The gel lacquers employed in the present invention may be prepared conveniently by dissolving the ethyl cellulose and plasticizer with suitable agitation in the solvent mixture at a temperature of about 100° C. After the gel lacquer solution has been prepared and deaerated, it may be employed for dip application of the subsequent ethyl cellulose layer in the composite coating at temperatures between about 80 and 100° C.

If desired, the ethyl cellulose gel lacquers may be prepared with cellulose ethers which have higher or lower ethoxyl contents than medium ethoxyl grades of ethyl cellulose provided that suitable adjustment is made in the solvent system employed. In addition, or alternatively, the ethyl cellulose layer on the coated article may be derived from other types of ethyl cellulose coating compositions such as conventional ethyl cellulose lacquers. In such cases several applications may be required in order to attain a layer of desirable thickness. For many purposes, such as the coating of sizeable wooden surfaces on which dip application is impracticable, the brush application of a conventional ethyl cellulose lacquer may provide a preferable technique for obtaining a suitable ethyl cellulose layer over the applied layers of polyvinyl acetate and nitrocellulose.

Usually an ethyl cellulose layer having a thickness of at least about 5 mils and, preferably, between about 15 and 50 mils is applied as the subsequent layer to the polyvinyl acetate and nitrocellulose layers in the practice of the present invention. Such a layer has sufficient thickness to permit the tough, dense, impact-absorbing and shock-cushioning properties of the ethyl cellulose portion of the multicomponent coating to protect the wooden surface or article effectively from damage due to shock and impact. It also serves to protect the wood from other deteriorating influences by providing ample impermeability as a barrier against moisture transmission so as to overcome the effects of dehydration and absorption.

While many variations may be suitable in the relative weight proportions of the layers in the multicomponent coating of the invention, it is frequently beneficial, especially on such wooden articles as baseball bats, for the relative proportions of the superimposed polyvinyl acetate latex:nitrocellulose:ethyl cellulose layers covering any given area to be roughly in the ratio of 5:1:10-25 or thereabout, respectively, on a dry-weight basis. In cer-

tain articles such as baseball bats and bowling pins, where a particular total weight must be adhered to, it may be desirable to peel or remove some of the wood from the surface of the article or to coat articles which are purposely undersized so that the weight of the coated article can nearly approximate an acceptable weight which is conventional or "normal" for the particular article.

The accompanying drawing illustrates several articles which are advantageously protectively coated in accordance with the present invention. A coated wooden surface, greatly exaggerated out of true proportion, is represented by a fragmentary sectional view in Figure 1. A baseball bat is perspectively illustrated in Figure 2 and a bowling pin, broken out partly in section, is shown in Figure 3. A fragmentary, magnified cross-sectional view of the coating layers applied on the bowling pin is shown in Figure 4.

The composite protective coating, represented generally by the reference numeral 5, on the surface of the wooden article 4 in Figure 1 is comprised of a priming layer 6 of polyvinyl acetate latex which serves both to seal the wood so that bubbling is not caused in the subsequently applied ethyl cellulose layer and to effect superior adhesion of the composite coating 5 on the article. The composite coating 5 also comprises an intermediate layer 7 of nitrocellulose, which insures an effective sealing of the wooden article and provides a bonding means between the polyvinyl acetate layer 6 and the relatively thick, subsequent impact-resisting layer 8 of ethyl cellulose. As mentioned, the polyvinyl acetate layer 6 and the nitrocellulose layer 7 may advantageously be brushed on while the ethyl cellulose layer 8 of the composite coating 5 may advantageously be derived in suitable thickness by one or two dip applications with an ethyl cellulose gel lacquer composition.

A wooden item of sports equipment, such as the baseball bat 9 depicted in Figure 2 may advantageously be provided with such an impact-resisting and shock-cushioning composite protective coating 5. Since the ethyl cellulose layer 8 is relatively slippery it may be desirable to provide a less slippery or friction gripping surface 10 on such articles as baseball bats. The friction gripping surface 10 may readily be obtained with a coating of a suitable friction-providing vinyl or neoprene-based composition such as a paint which may be similar to that obtainable under the trade-designation "1143 Neoprene Gray" from the Saran Protective Coating Company of Ferndale, Michigan.

In an analogous manner, it may be desirable to provide a relatively hard, scratch and dirt stain resisting outer covering or top coat over the ethyl cellulose layer of the composite coating in order to reduce the scratching and dirt pickup which may occur directly on the ethyl cellulose layer. This may conveniently be accomplished by application of a thin covering of a hard lacquer or like coating material such as the nitrocellulose lacquer and equivalent materials which are conventionally applied for such purposes on bowling pins. This is illustrated by the bowling pin 11 shown in Figure 3 on which a composite coating 5 is applied in accordance with the present invention. The composite coating 5, as is illustrated in greater detail by the magnified fragmentary cross-sectional view of the coating on the bowling pin in Figure 4, is superficially covered by a thin coating 12 of a conventionally-obtainable, light, hard-finish lacquer for purposes of minimizing scratching and soiling of the protectively coated article.

In a series of illustrative examples which further illustrate the practice of the invention, sixty (60) ash baseball bats, obtained in an uncoated condition from the Hanna Bat Company of Athens, Georgia, were provided with a composite coating consisting of superimposed layers of polyvinyl acetate latex, nitrocellulose and ethyl cellulose. Forty-eight (48) of the bats were adapted for

use in contests between juvenile competitors playing on organized teams such as those which participate under the auspices of the Little League, Inc. Twelve (12) of the bats were regular models intended for adult usage.

Three coats of a commercially-available polyvinyl acetate latex sold under the trade-name "Darex X-56L" by the Dewey and Almy Chemical Company were initially brushed on each bat to provide the priming layer. The intermediate nitrocellulose layer was obtained by brush application of a nitrocellulose lacquer containing about 15 percent by weight of solids comprising about 71 parts by weight of nitrocellulose resin (RS25-30 sec.), 22 parts by weight of dibutyl phthalate and 7 parts by weight of "Paraplex RG-2" plasticizer dissolved in a solvent mixture comprised of 50 parts by weight of ethyl acetate, 15 parts by weight of ethanol and 35 parts by weight of toluene.

The nitrocellulose layer was covered by an enveloping subsequent layer of ethyl cellulose derived by dip application of an ethyl cellulose gel lacquer composition. Two gel lacquer formulations were employed. Formulation "A" consisted of in the neighborhood of 21-24 percent by weight of solids comprised of 97.5 parts by weight of a medium ethoxyl value ethyl cellulose having a viscosity of about 100 centipoises, similar to that which is obtainable under the tradename "Ethocel, 100 cps. med." from The Dow Chemical Company and 2.5 parts by weight of "Paraplex RG-2" plasticizer dissolved in a solvent mixture comprised of 55 parts by weight of xylene, 20 parts by weight of "Apco Thinner" and 25 parts by weight of "Dowanol 8." Formulation "B" consisted of about 30.5 percent by weight of solids comprised of 70 parts by weight of "Ethocel, 100 cps. med." and 30 parts by weight of "Paraplex RG-2" dissolved in the same solvent mixture employed for formulation "A." Each of the bats was dip coated, without any occurrence or formation of bubbles, in the gel lacquer while the latter was being maintained at a temperature between 80 and 100° C. Pertinent data with regard to the applied multicomponent coating system is given in the following table.

Composite coating applied to baseball bats

45		“Little League” Bats.		Adult Bats	
	Length Range of Bats—Inches.....	29 to 32		34 to 35	
	Average Weight of Each Bat—grams.....	672		932	
	Average Weight of Polyvinyl Acetate Latex Layer—grams.....	27		32	
50	Average Weight of Nitrocellulose Layer—grams.....	5		6	
	Average Weight of Hard Lacquer Top Coat—grams.....	2		2	
	Average Weight of Neoprene Grip Coat—grams.....	1		1.3	
55		Gel Lacquer Formulation “A”			
		1 Coat	2 Coats	1 Coat	2 Coats
60	No. of Bats Coated.....	12	12	3	3
	Average Weight of Ethyl Cellulose Layer—grams.....	62	91	73	116
		Gel Lacquer Formulation “B”			
		1 Coat	2 Coats	1 Coat	2 Coats
65	No. of Bats Coated.....	12	12	3	3
	Average Weight of Ethyl Cellulose Layer—grams.....	49	110	62	123

As is indicated by the table, each of the bats was given a light hard top coat of scuff and dirt-resisting nitrocellulose lacquer which was sprayed over the ethyl cellulose layer of the composite coating. Also, each of the bat handles was provided with a friction grip by painting them with a neoprene paint.

All of the coated bats were exceptionally durable and resistant to breakage. All other things being equal, no appreciable difference in the hitting reaction or effect of the bats on pitched or hand-hit baseballs was discernible, particularly with respect to any increased tendency to cause pitched balls to be fouled off when struck or to be propelled greater or lesser distances than when hit by conventional uncoated bats. In addition, the coated bats produced a similar sound effect as conventional bats whenever a ball was hit with them.

Forty-five (45) of the "Little League" bats which had been coated were distributed among teams in the Little League organization in Midland, Michigan, for use during the 1955 sandlot baseball season. For purposes of comparison, one-hundred-eight (108) conventional uncoated bats of the same type were distributed to the same teams on a proportional basis with the coated, breakage-resisting bats. Equal and representative use of both types of bats in actual play was attempted to be obtained. At the end of the 1955 season 78 (or 72.2 percent) of the uncoated bats were broken by the competitors on the Little League teams while only one (or 2.2 percent) of the coated bats was broken in the course of the season. The considerable reduction in the incidence of breakage of the coated bats is outstandingly evident. Similar excellent results were obtained with the coated adult baseball bats.

Analogous advantage and benefit can also be obtained by coating such articles as bowling pins and hockey sticks in a manner similar to the foregoing.

Since certain changes and modifications can be readily entered into in the practice of the present invention without substantially departing from its intended spirit and scope, it is to be fully understood that all the foregoing description and specification be interpreted and construed as being merely illustrative of certain of the preferred embodiments of the invention which in no sense or manner is to be understood as being limited or restricted thereby excepting as set forth and defined in the appended claims.

What is claimed is:

1. Method for protectively coating wooden surfaces and articles to provide them with an increased resistance to breakage which comprises first applying a layer of polyvinyl acetate latex to the bare wooden surface; then applying a nitrocellulose layer over the polyvinyl acetate layer; and subsequently applying an ethyl cellulose layer over the polyvinyl acetate and nitrocellulose layers.

2. Method for protectively coating wooden surfaces and articles to provide them with an increased resistance to breakage which comprises first applying a layer of polyvinyl acetate latex to the bare wooden surface; then applying a nitrocellulose layer over the polyvinyl acetate layer; and subsequently applying an ethyl cellulose layer over the polyvinyl acetate and nitrocellulose layers by dip application of an ethyl cellulose gel lacquer formulation.

3. The method of claim 2 wherein the applied ethyl cellulose layer has a thickness of at least about 5 mils.

4. The method of claim 2 wherein the applied ethyl cellulose layer has a thickness between about 15 and 50 mils.

5. The method of claim 2 wherein the ethyl cellulose gel lacquer formulation from which the subsequently applied ethyl cellulose layer is derived is formulated with an ethyl cellulose having an ethoxyl content between about 45 and 46.5 percent by weight and a viscosity between about 10 and 200 centipoises, as determined in a 5 percent by weight solution thereof in an 80:20 mixture, by volume, of toluene and ethanol.

6. The method of claim 4 wherein the ethyl cellulose has a viscosity between about 50 and 100 centipoises.

7. The method of claim 2 and including the additional step of covering the subsequent ethyl cellulose layer with a thin scuff and dirt-resisting top coat of a hard finish lacquer coating material.

8. A breakage-resisting wooden article having a composite, multicomponent, protective coating on its surface comprise of sequentially superimposed layers of first polyvinyl acetate; then nitrocellulose; and finally ethyl cellulose.

9. A breakage-resisting wooden article having a composite, multicomponent, protective coating on its surface comprised of sequentially superimposed layers of first polyvinyl acetate; then nitrocellulose, and finally a layer of ethyl cellulose having a thickness of at least about 5 mils.

10. A coated article in accordance with claim 9 wherein the thickness of the ethyl cellulose layer is between about 15 and 50 mils.

11. A coated article in accordance with claim 9 wherein the relative weight proportions of the polyvinyl acetate: nitrocellulose:ethyl cellulose layers over any given area is approximately in the ratio of 5:1:10-25, respectively, on a dry-weight basis.

12. A coated article in accordance with claim 9 and including an additional thin top coat over the ethyl cellulose layer of a scuff and dirt-resisting hard finish lacquer coating material.

13. A coated baseball bat in accordance with claim 9 having an additional coating of a friction-providing material on its gripping surface.

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