

[54] **METHOD OF FABRICATING A HOLLOW BAT AND PRODUCT THEREOF**[75] Inventor: **Richard C. Wilson**, Arcadia, Calif.[73] Assignee: **Aluminum Company of America**, Pittsburgh, Pa.[22] Filed: **Mar. 8, 1971**[21] Appl. No.: **121,824**

[52] U.S. Cl.29/421, 29/516, 273/68, 273/72

[51] Int. Cl.**B23p 17/00**

[58] Field of Search29/421, 421 M, 516; 273/72, 81 R, 68; 138/89

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1,499,128	6/1924	Shroyer, Jr.	273/72
3,230,574	1/1966	Kershaw	29/516 X
3,299,933	1/1967	Akashi	151/7
3,360,264	12/1967	Lamkin et al.	273/68 X
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FOREIGN PATENTS OR APPLICATIONS

982,694 2/1965 Great Britain.....29/527.4

Primary Examiner—Charles W. Lanham*Assistant Examiner*—V. A. DiPalma*Attorney*—Arnold B. Silverman[57] **ABSTRACT**

A method of making a hollow bat including providing a hollow bat body having a handle portion at one end and a barrel portion at the other with at least one end terminating in an opening. Providing an end plug having a transverse end wall and a generally cylindrical

depending body portion having at least one annular groove therein. Deforming the end plug or the end portion of the bat body defining the open end to establish an interlocking joint between the bat body and end plug. The bat body has a radially inwardly directed flange at the opening defining end of the bat in circumferential engagement with the annular groove of the end plug.

In one form of the method the open end of the hollow bat is provided with a radially inwardly directed flange at the open end. The end plug is composed of resiliently compressible material and is positioned in axial alignment with the bat body at a position spaced from the flange. Relative axial closing movement is established between the plug and the bat body in order to compress the resilient plug radially and establish entry of the plug into the bat body. Movement is terminated when the radial bat flange is seated in the annular groove.

In another form of the method the end plug is positioned partially within the open end of the bat and the joint is effected by reforming the annular free edge of the open end radially inwardly to establish an inwardly directed flange in the bat body in circumferential engagement with the annular groove. The bat body may be composed of an electrically conductive material and the flange formation effected by a magnetic field generated by means not physically contacting the bat body.

A hollow metal bat body having a handle at one end and a barrel portion at the other end. An end plug having a transverse end wall and depending generally cylindrical body portion provided with an outwardly open annular recess. The body portion disposed within one end of the hollow metal bat and the open end within which said plug is disposed terminates in a radially inwardly directed flange which has its free end disposed within the annular recess.

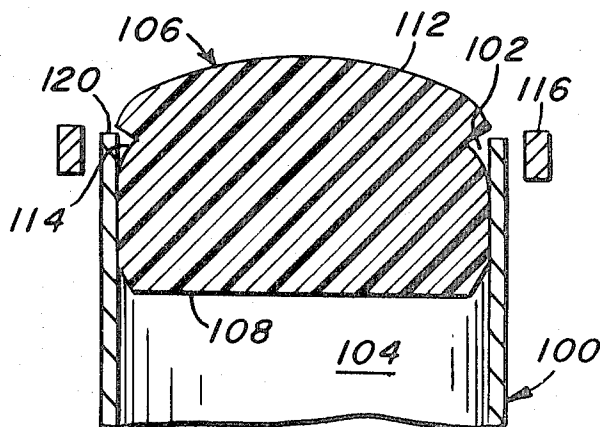
4 Claims, 9 Drawing Figures

FIG. 1.

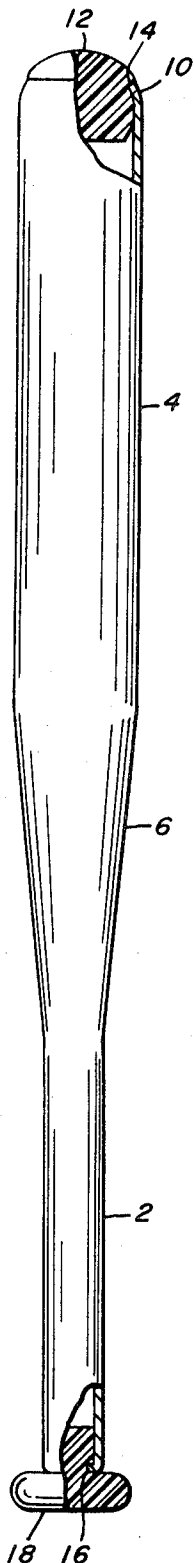


FIG. 2.

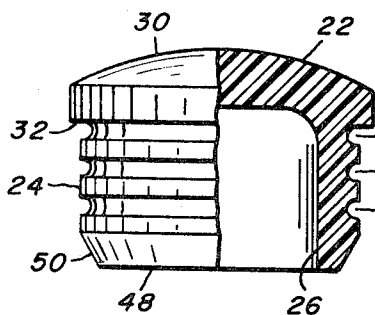


FIG. 3.

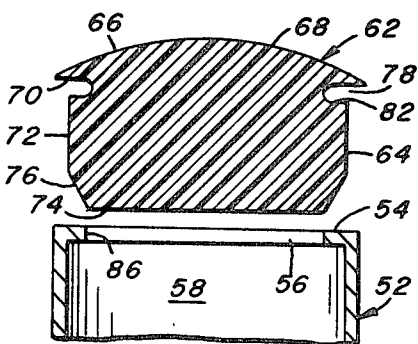


FIG. 4.

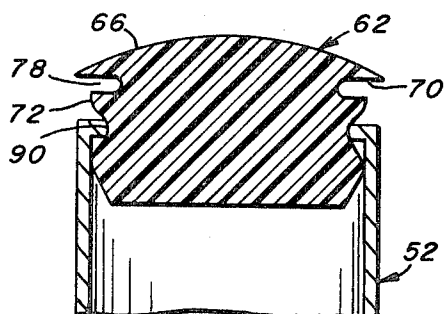


FIG. 5.

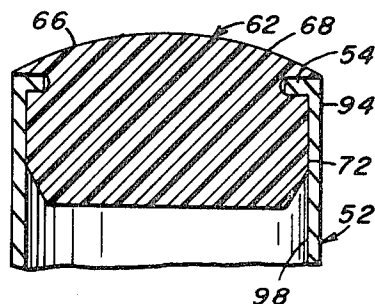


FIG. 7.

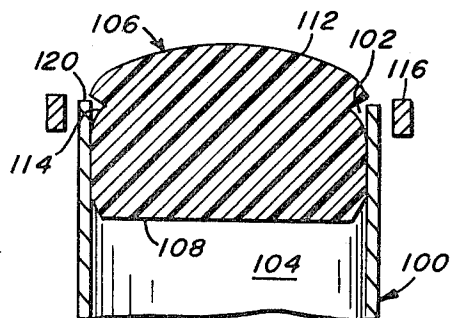


FIG. 8.

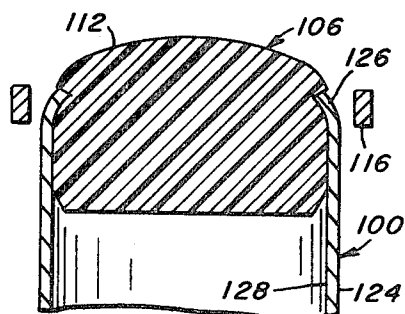


FIG. 6.

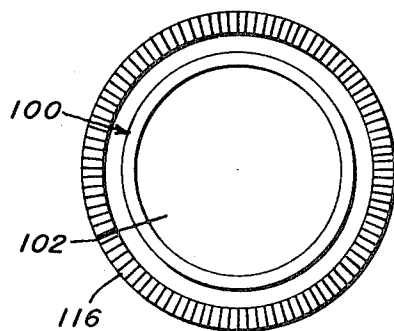
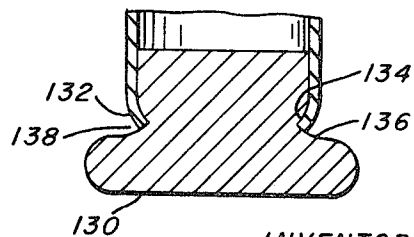


FIG. 9.



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METHOD OF FABRICATING A HOLLOW BAT AND PRODUCT THEREOF

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a method of manufacturing a hollow ball bat and the product resulting therefrom. More specifically, the invention relates to a method of effecting an intimate, effective mechanical joint below a hollow substantially rigid bat and the resultant bat structure.

2. Description of the Prior Art

It has been known to provide various forms of substantially rigid hollow bat structures composed of various materials, including metal. These bats have frequently been formed with ends which are closed by integral means or separately secured metal plugs which are joined to the bat by various means, such as welding. See U. S. Pat. Nos. 1,499,128, 514,420 and 1,603,904. Among the problems encountered with such structures have been the need to either somewhat awkwardly provide for an integral end closure or to employ cumbersome and frequently expensive joining techniques to secure a separate end portion to the bat. In addition, such structures frequently provided objectionable noise and vibration characteristics which were undesirable.

It has been known to provide a hollow metal bat having an end plug composed of a rubberous material and adapted to serve as a sound deadening means secured within the bat and by means of an adhesive such as epoxy resin. See U. S. Pat. No. 3,479,030.

As a bat is subjected to severe mechanical shock as a result of impact during normal use, adhesives may not provide sufficient permanent joinder between the bat and end plug. As a result, undesired relative axial separating movement may not effectively be avoided over a period of prolonged usage. In addition, the use of adhesives presents the likelihood of possible uneven distribution thereof and the lack of circumferential uniformity of the joint strength. Finally, the need to expend funds for this additional adhesive material and for the handling and application thereof is encountered.

With respect to bats having a decorative or protective finish, any mechanical joint formation must be effected in a manner which avoids damaging contact between the exterior bat surface and forming dies.

There remains, therefore, a need for a method of securing an end plug within a bat in order to effect maximum mechanical retention even under exposure to extreme mechanical shock while presenting desired vibration and sound dampening properties.

SUMMARY OF THE INVENTION

The above described problems have been solved by the method and product of this invention.

The method of this invention includes providing a hollow bat body having a handle portion at one end and a barrel portion at the other, with at least one such portion terminating in an open end. The end plug is provided with a transverse end wall and a generally cylindrical body portion having at least one annular groove therein. In obtaining the joint the end plug or bat end portion defining the open end is deformed in order to establish an interlocking mechanical joint between the bat body and bat plug. The resultant joint has a radially

inwardly directed flange at the opening defining end of the ball bat in circumferential engagement with the end plug's annular groove.

In one preferred form of the invention, the radially inwardly directed flange is initially provided at the open end portion of the bat and the end plug is composed of a resiliently compressible material. The end plug is initially disposed at a position spaced outwardly from the flange defined opening and is in general axial alignment with the hollow bat body. Insertion of the plug into the bat opening is effected by establishing relative closing movement between the bat body and end plug in order to cause the radially inwardly directed bat flange to resiliently radially inwardly deform the plug. Relative axial movement between the end plug and hollow bat is terminated when the annular flange is seated within the annular groove. The annular flange may be so positioned with respect to the end plug as to cause the flange to be seated within an annular groove when the underside of the transverse end wall of the plug comes into contact with the upper surface of the inwardly directed bat flange.

In another preferred form of the invention the end plug is initially seated with its depending body portion extending into the bat opening. The annular free edge of the bat's open end is then subsequently radially inwardly reformed to establish an inwardly directed flange which is in circumferential engagement with the annular groove. The annular flange is preferably reformed by non-contacting means such as a magnetic field generating means which establishes induced eddy currents within that portion of the bat which is to be reformed into the inwardly directed flange. This establishes a radially inwardly directed force which causes inward deformation of the bat's free edge to establish the flange.

The product which results from this method has one or both ends of the bat body provided with an end plug having a transverse end wall and a cylindrical body portion. An outwardly open annular groove is provided within the body portion and a transversely inwardly directed flange of the bat body is engaged within the groove. This provides an effective mechanical joint which resists undesired relative axial movement in either direction between the end plug and bat body. The transverse wall of the end plug may have an enlarged diameter which is in overlying surface to surface contact with respect to the inwardly directed flange. The flange may be so configured as to be in surface to surface overlying relationship with respect to the adjacent periphery of the cylindrical body portion of the end plug.

It is an object of this invention to provide a method of forming a hollow metal bat which possesses an effective mechanical joint between at least one bat opening and an insert end plug.

It is another object of this invention to provide an economical method of forming such a bat structure while providing desired vibration and sound dampening characteristics.

It is another object of this invention to provide a method of effecting such a joint which avoids damage to a decorative and/or protective finish disposed on the exterior of the hollow bat body.

It is yet another object of this invention to provide a bat structure which contains an end plug effectively mechanically joined to a bat body so as to resist both

relative inward and outward axial movement of the end plug with respect to the bat.

These and other objects of the invention will be more fully understood and appreciated from the following detailed description of the invention on reference to the illustrations appended hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows an elevational view of a bat construction established by the method of this invention, with portions thereof broken away for clarity of illustration.

FIG. 2 illustrates a form of end plug contemplated by this invention, partially broken away for clarity of illustration.

FIGS. 3 through 5 illustrate the sequence of operations performed in effecting the joint by a preferred method of this invention.

FIGS. 6 and 7 illustrate the initial stage of the process employed in another preferred form of this invention.

FIG. 8 illustrates a completed structure formed employing the process initially shown in FIGS. 6 and 7.

FIG. 9 illustrates a fragmentary sectional view of a joint of this invention established at the handle end of the bat employing a modified plug.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now more specifically to FIG. 1, there is shown a ball bat having a handle portion 2 which is generally cylindrical, an enlarged barrel portion 4 which is also generally cylindrical, but of enlarged diameter with respect to handle portion 2, and a connecting interposed tapered portion 6.

The term "flange" as used herein shall refer to a radially restricted or generally radially inwardly directed portion of a hollow bat body disposed at or adjacent to an end of the bat body, including portions which are integrally reinforced as by providing a hollow bead or reentrant fold.

The barrel portion 4 has a radially inwardly directed flange 10 which defines an opening which receives end plug 12. Flange 10 is mechanically engaged within annular recess 14 of end plug 12. Handle portion 2 is provided with an open end defined by transverse inwardly directed flange 16 which is engaged within a recess in end plug 18. End plug 18 is provided with a generally knob-shaped configuration having an outer portion of enlarged diameter with respect to the diameter of handle 2.

Referring now to FIG. 2, there is shown an end plug which is provided with a transverse end wall 22 and a depending generally cylindrical body portion 24. The end plug, in the form shown, is composed of a compressively resilient material. The plug is provided with a generally cylindrical bore 26. The transverse end wall 22 has a generally upwardly domed upper surface 30 and an annular generally flat undersurface 32. In the form shown, a generally vertical annular connecting surface 34 is provided. The depending body portion has several outwardly open annular grooves 40, 42, 44. The depending body portion 24 has a maximum diameter which is less than the maximum diameter of transverse end wall 22. The depending body portion 24 has a generally flat annular lower surface 48 and an angularly disposed pilot surface 50 which serves as a guide surface in introducing the end plug into a bat opening.

Referring now more specifically to FIGS. 3 through 5, one form of the method will now be considered in detail. In FIG. 3 there is shown a generally cylindrical portion of a bat body 52 which terminates in a radially inwardly directed flange 54, which is preferably circumferentially continuous and in the form shown is generally perpendicular to the adjacent portion of the bat body 52. Flange 54 defines a generally circular opening 56 in the bat end which provides a restricted or throat opening to the hollow bat interior 58.

A modified form of end plug 62 is illustrated in FIG. 3. This plug 62 is preferably composed of a substantially homogeneous resiliently compressive material, such as rubber, polyvinyl or polyethylene, for example. Plug 62 has a depending body portion 64 of generally solid section and a transverse end wall 66 which has a diameter greater than the body portion 64. The transverse end wall has an upwardly domed upper surface 68 and an annular substantially flat undersurface 70 which merges with surface 68 at the outer extremity of transverse end wall 66. The outer peripheral transverse end wall 66 is feathered to a relatively thin edge as compared with transverse wall 22 of FIG. 2 which has annular connecting surface 34.

Body portion 64 has a generally cylindrical peripheral surface 72, a bottom surface 74 and a connecting angularly disposed pilot surface 76. The depending body portion is also provided with an outwardly open annular recess 78 which is disposed in immediately underlying position with respect to transverse end wall undersurface 70. In the form shown, the transverse end wall undersurface 70 cooperates with lower annular surface 82 to define annular recess 78. If desired, the annular recess may be disposed at a position spaced downwardly from the transverse end wall 66, but it should preferably be disposed closely adjacent thereto.

As is shown in FIG. 3, in initiating the practice of this form of the invention, the end plug 62 is positioned initially in axial alignment with the hollow bat body 52 and is spaced outwardly therefrom. For convenience of reference the term "deforming" or words of similar import as used herein shall refer to resilient radial compressive deformation when the term is employed with respect to an end plug structure. (The term "deforming" or words of similar import shall refer to permanent deformation when the reference is to deformation of a portion of the hollow bat body). In effecting a joint between the ball bat body portion 52 and end plug 62, relative closing movement in an axial direction is established between the bat body portion 52 and plug 62. The inner most portion 86 of flange 54 will define an opening having a smaller diameter than peripheral surface 72 of plug 62. As the relative closing movement is continued, flange 54 will generally initially contact either bottom surface 74 or pilot surface 76, with the latter contact being preferred. Continued axial relative closing movement will result in radial circumferential compression of the plug 62.

Referring now to FIG. 4, it is seen that the end plug 62 has been introduced partially into generally cylindrical bat body 52 and that transverse resilient compressive deformation of the end plug has occurred within an annular sector 90. As application of the relative closing force is continued, compressed annular sector 90 will migrate upwardly within peripheral surface 72 until such time as the flange is seated within outwardly open

annular recess 78. At this point the final joint will have been established, as is shown in FIG. 5.

It will be noted that, in the form shown, undersurface 70 of transverse end wall 66 is in overlying surface to surface contact with flange 54 and preferably covers substantially all or at least a major portion of this flange surface. This surface to surface contact provides an aesthetically pleasing bat end configuration which has a smooth surface transition between upper surface 68 of end plug 62 and the outer surface 94 of cylindrical bat body 52.

Referring once again to FIG. 5, another advantage of the transverse end wall 66 having an enlarged diameter with respect to the opening defined by flange 54 will be considered. Either through increased thickness of this wall such as is provided between height of vertical wall 34 in FIG. 2 and/or the diameter of the transverse wall such as shown in FIGS. 3 through 5 a surface to surface engagement between the transverse end wall and the inwardly directed flange serves to resist undesired excessive travel of the end plug into the hollow bat interior. Thus, when the annular recess is positioned immediately underlying the transverse end wall or closely adjacent thereto, the end wall 66 serves as an automatic stop which resists undesired excessive entry of the plug into the hollow bat interior during bat manufacture. In addition, it serves as an additional restraint against such undesired movement during bat usage when axially applied loads might be applied to the end plug.

It is also noted that in the form shown, peripheral surface 72 of end plug 62 is in circumferential frictional engagement with interior surface 98 of hollow bat body 52. This serves to provide increased frictional resistance to undesired relative movement of the bat end plug 62 with respect to the bat body 52. Finally, the compressive material functions as a seal to resist entry of moisture and other foreign material into the hollow bat material with the potential risk of undesirable corrosion resulting therefrom.

In another preferred form the method of this invention, as is shown in FIGS. 6 through 8, provides a plug which is first inserted within the bat end and the bat flange is subsequently formed. One of the advantages of the method of this invention is that it will generally be desirable to provide a decorative and/or protective finish to the exterior surface of the bat material, as by painting, anodizing or other finishing techniques. This finish must be protected from impairment during end plug joiner. One advantageous method of accomplishing this is to reform the bat to establish the flange by means which are not in physical contact with the bat. In the form of the invention shown in FIGS. 6 through 8, the tubular hollow bat portion 100 initially is provided with an opening 102 which is substantially equal to the diameter of the hollow portion 104 disposed immediately adjacent opening 102. An end plug 106, which preferably has at least the outer portion thereof composed of a material adapted to provide vibrations and noise dampening characteristics, is partially disposed within opening 102. If desired, plug 106 may have a substantially rigid stiffening interior element which will serve to increase the resistance to axial displacement and may provide a saving in the amount of the outer material required for the plug. Alternatively, the plug may be composed entirely of a substantially rigid material as plug deformation is not required in this method of effecting the joint. In the form shown, the

plug has a generally flat bottom surface, a generally cylindrical peripheral lower sector 108, an upwardly domed upper sector 112 and an outwardly open annular recess 114. In the form shown in FIGS. 7 and 8, the upper sector 112 has a diameter which is equal to or slightly smaller than the diameter of bottom portion 108.

Referring to FIG. 6, there is illustrated an electrical coil 116 which is adapted to serve as a magnetic field generating means. It is disposed in circumferential surrounding position with respect to that portion of the bat body 100 which is to be radially inwardly deformed to establish the desired mechanical joint. It is preferred to provide a conventional source of a magnetic field such as equipment which is adapted to function in intermittent or pulsed fashion to provide pulses of magnetic energy of sufficient magnitude that eddy currents will be induced within the portion of the bat which is to be deformed. A suitable piece of equipment for this purpose is manufactured by Maxwell Laboratories, Inc. and sold under the trademark "Magneform". See also U. S. Pat. Nos. 3,088,200 and 2,976,907.

One preferred electrically conductive bat body material for purposes of this embodiment of the invention is aluminum and more specifically an aluminum-zinc alloy such as 7005 and 7075. In effecting this deformation by means of the magnetically forming equipment, the coil is positioned circumferentially in spaced relationship around that axial zone of the hollow bat which is to be reformed inwardly. If desired, in addition to the primary field generating coil, a field shaper such as that provided by the Magneform machine may be employed to distort the magnetic field and concentrate the energy within certain regions. It is believed that deformation is effected by the magnetic field establishing the induced eddy current with a resultant force causing initial radially inward movement of the metal. This initial movement causes the deformed part to travel only a short distance, but does establish a large amount of kinetic energy which subsequently performs the next of the working operations. During this operation, the end plug sector adjacent the metal being formed functions as a die element to assist in controlling the inward deformation. Thus, as is shown in FIGS. 7 and 8, after the pulsed magnetic field is established the resultant force causes radially inwardly directed deformation of end portion 120 of bat body 100 and causes the same to be mechanically received within annular recess 114 to establish an effective interlocking joint between hollow bat body portion 100 and end plug 106. The flange 126 has a curved surface which is in overlying surface to surface contact with the underlying plug periphery and preferably has a free edge in contact with the upper annular surface which defines the upper portion of the recess. It will be appreciated that this joint has been established without any metal working tools coming into direct contact with the outer surface 124 of bat body 100. This eliminates the possibility of damaging the exterior surface 100 which may or may not be provided with a special decorative or protective finish. It is noted that this joint may also provide a portion of upper surface 112 in overlying contact with radially inwardly directed flange 126. This also provides the aesthetical and mechanical advantages described above.

It will be noted that in the form shown lower sector 108 of end plug 106 has a diameter approximating that of inner surface 128 of bat body 100 and is preferably

in surface to surface contact therewith. This provides increased frictional resistance to undesired relative axial movement between the bat body 100 and end plug 106. While for purposes of illustration the orientation of flanges 54 and 126 has been shown to be substantially perpendicular or curved inwardly with respect to the adjacent portion of the bat body, respectively, and these are preferred, it will be appreciated that the flange may have other configurations. The flange might, for example, be disposed angularly in either direction of a perpendicular should this be desired. A corresponding change in the configuration of recess 114 should be made, if such flange shapes are desired.

Referring now to FIG. 9, a handle joint established in accordance with the method of FIGS. 6 through 8 is illustrated. In the form shown, the end plug 130 has transverse end wall 136 which has a knob-like configuration. While the end plug 130 is shown as being composed of metal of solid section, it may be made from other suitable materials and constructions of materials. A plug having a hollow metal configuration may be provided, for example. The radially inwardly directed flange 132 is engaged within annular recess 138 and has its inner surface in surface to surface contact with surface 134 of the end plug 130. The free end of the flange 132 is in engagement with recess defining surface 136. Intimate mechanical joiner which prevents undesired relative axial movement between the end plug 130 and bat body is, therefore, established in a substantially identical manner as has been described above, even though the plug has a somewhat different configuration.

Referring now in further detail to the end product produced by this process, such as is shown in FIGS. 5 and 8, other structural features will be noted. As a result of the interlock between flanges 54, 126 within recesses 78 and 114, respectively, an effective mechanical joint resisting either inward or outward relative axial displacement of the end plugs 62, 106 with respect to the bat bodies 52, 100 is provided. The end plug is provided with at least one outwardly open annular recess which is preferably disposed immediately underlying or closely adjacent to the transverse end wall of the plug. In one preferred form, the undersurface of the transverse wall is preferably in circumferential overlying surface to surface contact with the bat flange. In another preferred form, the flange is in surface to surface overlying contact with respect to the underlying lower recess defining surface and may have a portion in contact with the upper recess defining surface. In the form of insert plug adapted for barrel insertion, the transverse end wall preferably has a diameter which is not greater than the outer diameter of the hollow bat section, but is greater than the diameter of the opening defined by flanges 54, 126, respectively. If desired, the color of the plug material may be so selected as to provide a matching or complementary aesthetically pleasing exterior appearance with respect to the bat finish.

While for convenience of illustration, apart from FIGS. 1 and 9, the end plug is shown as being secured to the barrel or larger diameter of the hollow bat, it will be appreciated that the method and product of this invention may be employed to provide end plugs in the handle portion of the bat body in addition to or in lieu of the plug insert in the barrel portion. When an end plug is employed in the handle portion, it generally will be desired to provide a transverse end wall which has

a greater diameter than the opening defined by the flange portion of the bat.

It will, therefore, be appreciated that the method of this invention provides a means for establishing a joint between an opening in a hollow bat and an end plug, which joint effectively provides mechanical resistance to undesired relative axial movement of the end plug with respect to the bat body. The joint is effected in such a fashion as to avoid any damage to the surface finish of the hollow bat body. In addition, the resultant bat structure may be provided with desired properties of vibration and sound deadening. In addition to eliminating the need for the use of adhesives in effecting the permanent mechanical joint, the awkward handling of adhesive materials and the possible lack of circumferentially uniform strength of joint are eliminated. The structure also provides an effective seal to resist entry of moisture and other undesired foreign matter into the hollow bat interior. Finally, the bat is adapted to withstand the severe mechanical shock to which it will be subjected in ordinary use without structural impairment of the joint. It is also adapted to withstand certain types of abuses which one would normally encounter in the handling of such products.

For convenience of reference, the specific form of bat body illustrated has a handle portion 2 of substantially uniform diameter, a barrel portion 4 of substantially uniform diameter and an intermediate tapered section 6. It will be appreciated, however, that the method of this invention as well as the product may advantageously be practiced with respect to bats having various configurations including those having a handle and/or barrel portion which is entirely or partially tapered. Any reference herein to a "generally cylindrical body portion" or words of similar import is intended to include such structures.

Whereas particular embodiments of this invention have been described above for purposes of illustration, it will be apparent to those skilled in the art that numerous variations of the details may be made without departing from the invention as defined in the appended claims.

I claim:

1. A method of making a hollow ball bat comprising providing a hollow metal bat body having a handle portion at one end and a generally cylindrical barrel portion at the other with at least one said portion terminating in an end portion defining an open end, providing an end plug having a transverse end wall and a generally cylindrical depending body having at least one annular groove therein, providing magnetic field generating means, positioning said depending body of said end plug in said open end of said bat body, positioning said magnetic field generating means around said open end of said bat body, and generating a magnetic field by said magnetic field generating means to induce eddy currents within said end of said bat body within which said end plug is disposed to create circumferential radially inwardly directed deformation of said bat body end to establish inwardly directed flange in said bat body in engagement with said annular recess in said end plug.

2. The method of claim 1 including

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said magnetic field generating means including a continuous circular magnetic field generating loop of slightly larger diameter than the portion of said bat body to be deformed,
 said end plug is composed at least in part of a resiliently compressible material, 5
 said annular recess being defined by an upper recess defining surface and a lower recess defining surface,
 said annular recess being disposed closely adjacent to said transverse end wall, 10
 inserting said end plug in said barrel portion of said bat, and
 subsequently deforming said bat end by generating a magnetic field within said loop to establish said 15

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joint to provide surface to surface contact between the underside of said inwardly directed flange and at least one of said annular recess defining surfaces.
 3. The method of claim 1 including
 said end plug having a knob shaped transverse end wall,
 inserting said plug into said handle end of said bat, and
 reforming said handle end to establish said joint.
 4. The method of claim 2 including
 said transverse end wall having a transverse diameter not greater than the transverse diameter of said depending body portion.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,735,473 Dated May 29, 1973

Inventor(s) Richard C. Wilson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Abstract, line 4	Change "plub" to --plug--.
Col. 1, line 10	Change "below" to --between--.
Col. 1, line 22	Change "have" to --has--.
Col. 2, line 49	Change "configured" to --configured--.
Col. 4, line 52	Change "inner most" to --innermost--.
Col. 5, line 59	Change "vibrations" to --vibration--.
Col. 6, line 1	After "surfaces" insert --108--.
Col. 6, line 2	After "sector" delete "108".
Col. 7, line 2	Change "undersired" to --undesired--.

Signed and sealed this 25th day of December 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents