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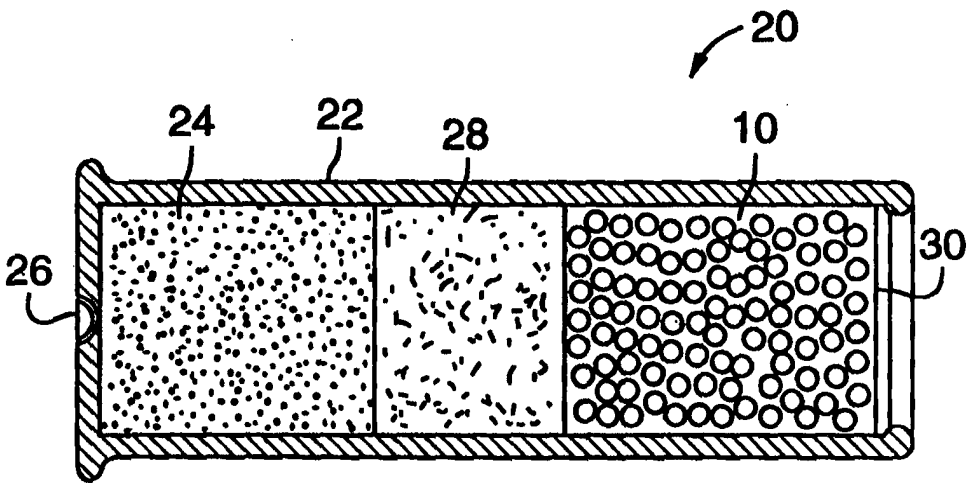

(57) Abstract

A sporting device and method utilize a material including heavy metal ore concentrate particles in a potting compound as a non-toxic substitute for lead or other poisonous metal.

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HIGH-DENSITY SPORTING DEVICES AND METHODS

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention is directed to high-density sporting devices and method for making same.

DESCRIPTION OF THE BACKGROUND ART

Because of the poisonous characteristics of lead, there have been various proposals for non-toxic substitutes for lead in sporting devices such as bullets, shotgun pellets, fishing devices such as lures, jigs, sinkers and the like, and other sporting devices such as underwater diver's weights.

There remains a need in the art for non-toxic substitutes for lead in sporting devices.

SUMMARY OF THE INVENTION

In accordance with the present invention, a sporting device is formed from a material comprising heavy metal ore concentrate particles and a potting compound.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross-sectional view of a shotshell in accordance with one embodiment of the invention.

Fig. 2 is a cross-sectional view of a shotgun slug in accordance with one embodiment of the invention.

Figs. 3 and 4 are cross-sectional views of bullets in accordance with embodiments of the invention.

Fig. 5 is an elevational view in partial cross-section of a rifle cartridge in accordance with the present invention.

Fig. 6 is an elevational view of a fishing lure in accordance with one embodiment of the present invention.

Fig. 7 is an elevational view of a fishing sinker in accordance with one embodiment of the invention.

Fig. 8 is an elevational view of a diving weight in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The inventive sporting devices include hunting devices selected from the group consisting of bullets and shotgun pellets, fishing devices such as lures, jigs, sinkers and the like, and other sporting devices such as underwater diver's weights. The invention replaces lead for use in such devices, and avoids the problem of lead contamination of the environment when such devices are used.

Devices in accordance with the present invention are manufactured utilizing a particulate, non-toxic, heavy metal ore concentrate containing 50-90% by weight non-toxic heavy metal, such as tungsten, molybdenum, bismuth, manganese, iron or the like. For example, a primarily or predominantly tungsten-containing ore concentrate can be a high-density tungsten-containing ore concentrate containing at least 50% or more by weight tungsten, preferably about 60% by weight or more tungsten, more preferably about 70% by weight or more tungsten, and most preferably about 75% by weight or more tungsten. The invention can be equally applicable to other suitable heavy metal ore concentrates.

In preferred embodiments, the heavy metal ore concentrate is substantially non-toxic, *i.e.*, non-poisonous to animals and the environment, *i.e.*, is substantially free of toxic materials.

In particularly preferred embodiments, the heavy metal ore concentrate is utilized in powered or granular form, and held together by a substantially non-toxic, non-poisonous potting compound, binder or adhesive, preferably a non-toxic acrylic binder.

Compositions from which inventive sporting devices in accordance with the present invention are made include potting compound or binder within the range of from about 1-40% of the composition by weight. In preferred embodiments, the composition contains less than 30% by weight potting compound or binder, more preferably less than about 20% by weight potting compound or binder, even more preferably less than about 10% by weight potting compound or binder, and most preferably about 5% by weight potting compound or binder.

In particularly preferred embodiments, the heavy metal ore concentrate particles are mixed with the potting compound or binder, and formed into granules. The

granules then can be melted and formed into high-density sporting devices such as shotgun pellets 10 (shown in Fig. 1), bullets 12a, 12b, 12c, 12d (shown in Figs. 2-5), fishing devices 14, 16 (shown in Figs. 6 and 7) or diving weights 18 (shown in Fig. 8). Shotgun pellets, bullets and fishing sinkers can be formed by punching out of a sheet made from melted granules containing the heavy metal ore concentrate and binder or potting compound. Alternatively, the sporting devices can be formed by injection molding, die casting, punching out of rope, mold casting, spin molding or the like.

The invention is also applicable to shotgun shells comprising a casing, a propellant such as gunpowder contained within the casing, an igniting device such as a cap for igniting the propellant, and non-toxic wildlife shot formed of a plurality of pellets in accordance with the present invention.

Shotgun pellets in accordance with the present invention can be any useful size, for example, BBB to "dust" size (BBB, BB, B, 1-7, 7½, 8-12 and "dust" size) or 000-T (000, 00, 0, 1-4, FF, F, TT and T). A shotgun shell 20 in accordance with the present invention is shown in Fig. 1, and includes pellets 10, case 22, propellant 24, primer cap 26, wadding 28 and closure 30.

The invention is further applicable to a firearm cartridge comprising a casing, a propellant such as gunpowder contained within the casing, an igniting device such as a cap for igniting the propellant, and a firearm bullet, at least a principal portion of the bullet being formed from a heavy metal ore concentrate and potting compound or binder in accordance with the present invention. A firearm cartridge in accordance with the invention is shown in Fig. 5, and includes bullet 12d, case 32, propellant 34 and primer cap 36.

Bullets in accordance with the invention can range in size from about .22 caliber up to 10 gauge slugs for shotguns. Fig. 2 shows a one-piece shotgun slug 12a according to one embodiment.

The present invention also is applicable to so-called "clad" or "jacketed" bullets, such as are illustrated in Figs. 3 and 4. These jacketed bullets include one or more heavy metal-containing elements 38, 38a, and 38b.

In Fig. 3, the bullet is made up of a single, heavy metal-containing core element surrounded by a metal jacket 40 which can be of any suitable metal such as copper or copper alloy.

In Fig. 4, the bullet includes two heavy metal-containing core elements 38a, 38b which are surrounded by a metal jacket 42.

In preferred embodiments, the heavy metal-containing elements of jacketed bullets such as are show in Figs. 2 and 3 comprise at least about 50% by weight of the entire bullet, more preferably at least about 75% by weight thereof.

The present invention is also applicable to underwater fishing devices, such as fishing lures, jigs, sinkers and the like. For example, the lure shown in Fig. 6 includes a fish hook 44, an eyelet 46 for attachment to a fishing line (not shown) and a device for attracting or deceiving a fish such as the hackle 48 shown. The spherical, weight-providing element of this device contains a heavy metal ore concentrate and is lead-free.

Fig. 7 illustrates another embodiment of the present invention in the form of a heavy metal ore concentrate-containing sinker 16 which may be spherical as shown or any other suitable shape. The sinker shown has a partial slit 50 therein which may be closed around a fishing line (not shown) for attachment thereto. Alternatively, the sinker may be provided with a hole or eyelet therein for attachment to a fishing line.

One tungsten-containing ore concentrate for use in the invention is Wolfram (Wolframite) powder which is a brown (sometimes referred to as grey) sub-product of well-known tungsten refining processes. Other tungsten ore concentrates include white, yellow and blue tungsten concentrates.

Wolframite is produced during known tungsten refining processes at an intermediate stage prior to producing substantially pure tungsten powder. Tungsten ore is crushed, ground down and separated from initial waste portions of the ore including rock material and the like. A further separation of tungsten-containing material may take place by gravity or by floatation to produce high-grade Wolfram (Wolframite). Wolfram (Wolframite) typically is made up of about 75% tungsten trioxide, which typically has a density of about 65% that of substantially pure refined tungsten powder.

Other ingredients may include about 20% iron, 3.5% manganese, 0.06% sulfur, 0.04% tin, and smaller amounts of other materials.

The heavy metal ore concentrate particles, e.g., Wolframite powder, then are mixed with a potting material or binder such as nylon, acetal, ethylene vinyl acetate (EVA), high-density polyethelene (HDPE), polyolefinelastomers, polypropylene, santroprene, and the like. The potting compound or binder forms a matrix for holding the heavy metal ore concentrate particles. The mixture is formed into granules which then can be processed into shotgun pellets, bullets, fishing devices, diving weights, or any other device requiring a material of high strength, density and durability, by injection molding, die casting, pressing, swaging or any other suitable method.

In preferred embodiments, compositions for forming the inventive devices comprise about 60-99% of the heavy metal ore concentrate, more preferably greater than 70% of the heavy metal ore concentrate, still more preferably greater than 80%, even more preferably greater than 90%, and most preferably about 95% of the heavy metal ore concentrate.

In alternative embodiments, one or more additional ingredients can be added, such as additional metal(s), e.g., iron, tungsten, manganese and the like.

In particularly preferred embodiments, compositions for forming devices of the present invention have a density substantially the same as that of lead.

Claims:

1. A sporting device formed from a material comprising heavy metal ore concentrate particles and a potting compound.

2. The sporting device of claim 1 wherein the heavy metal ore concentrate contains about 50-90% by weight of a metal selected from the group consisting of tungsten, molybdenum, bismuth, manganese, iron and mixtures thereof.

3. The sporting device of claim 1 wherein the heavy metal ore concentrate is a primarily tungsten-containing ore concentrate containing at least 50% by weight tungsten.

4. The sporting device of claim 3, comprising about 1-40% said potting compound.

5. The sporting device of claim 4 wherein said potting compound is a non-toxic acrylic binder.

6. The sporting device of claim 1, selected from the group consisting of shotgun pellets, bullets, fishing devices and diving weights.

7. The sporting device of claim 3, wherein said sporting device is selected from the group consisting of shotgun pellets and bullets.

8. The sporting device of claim 7, wherein said sporting device comprises shotgun pellets, and further comprises a shotgun shell including a casing, a propellant, and an igniting device.

9. The sporting device of claim 7, wherein said sporting device comprises a bullet, and further comprising a firearm cartridge including a casing, a propellant contained within the casing, and an igniting device.

10. The sporting device of claim 1, wherein said heavy metal ore concentrate comprises wolframite.

11. A method of making a sporting device, comprising forming a material including heavy metal ore concentrate particles and a potting compound into a sporting device as defined in claim 1.

12. The method of claim 11 wherein the heavy metal ore concentrate contains about 50-90% by weight of a metal selected from the group consisting of tungsten, molybdenum, bismuth, manganese, iron and mixtures thereof.

13. The method of claim 11 wherein the heavy metal ore concentrate is a primarily tungsten-containing ore concentrate containing at least 50% by weight tungsten.

14. The method of claim 13, comprising about 1-40% said potting compound.

15. The sporting device of claim 4 wherein said potting compound is a non-toxic acrylic binder.

16. The method of claim 11, wherein said sporting device is selected from the group consisting of shotgun pellets, bullets, fishing devices and diving weights.

17. The method of claim 13, wherein said sporting device is selected from the group consisting of shotgun pellets and bullets.

18. The sporting device of claim 17, wherein said sporting device comprises shotgun pellets, and further comprises a shotgun shell including a casing, a propellant, and an igniting device.

19. The sporting device of claim 17, wherein said sporting device comprises a bullet, and further comprises a firearm cartridge including a casing, a propellant contained within the casing, and an igniting device.

20. The method of claim 11, wherein said heavy metal ore concentrate comprises wolframite.

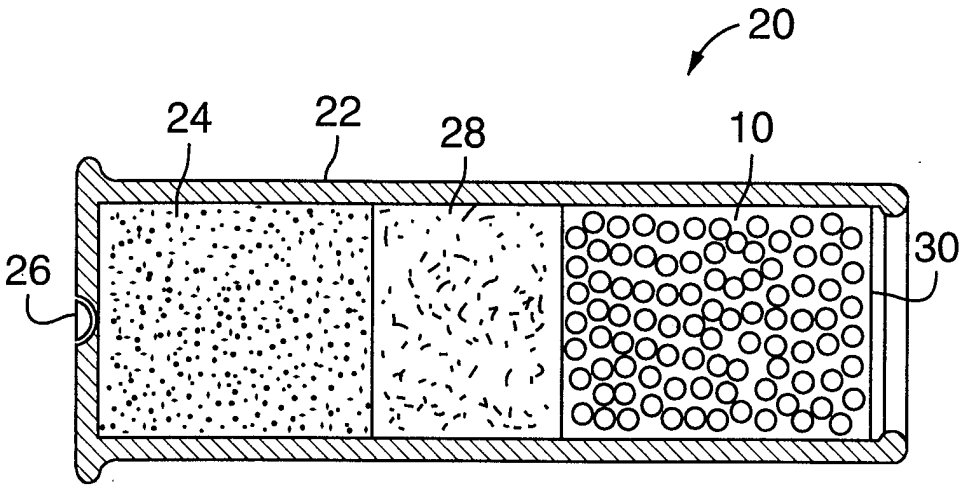

FIG.1

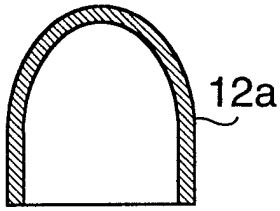

FIG.2

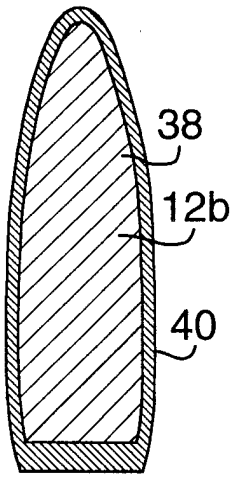

FIG.3

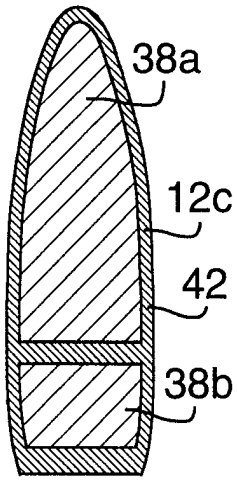

FIG.4

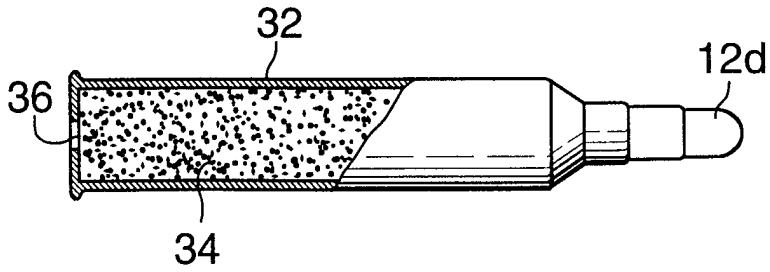

FIG.5

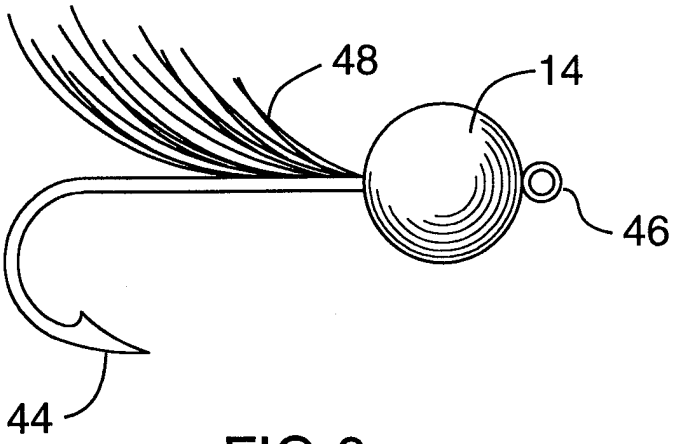

FIG.6

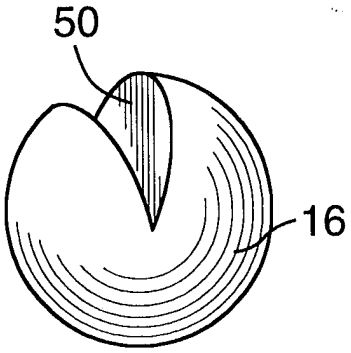

FIG.7

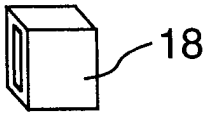

FIG.8