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(54) **BICYCLE CRANK AND METHOD FOR MANUFACTURING THE SAME**

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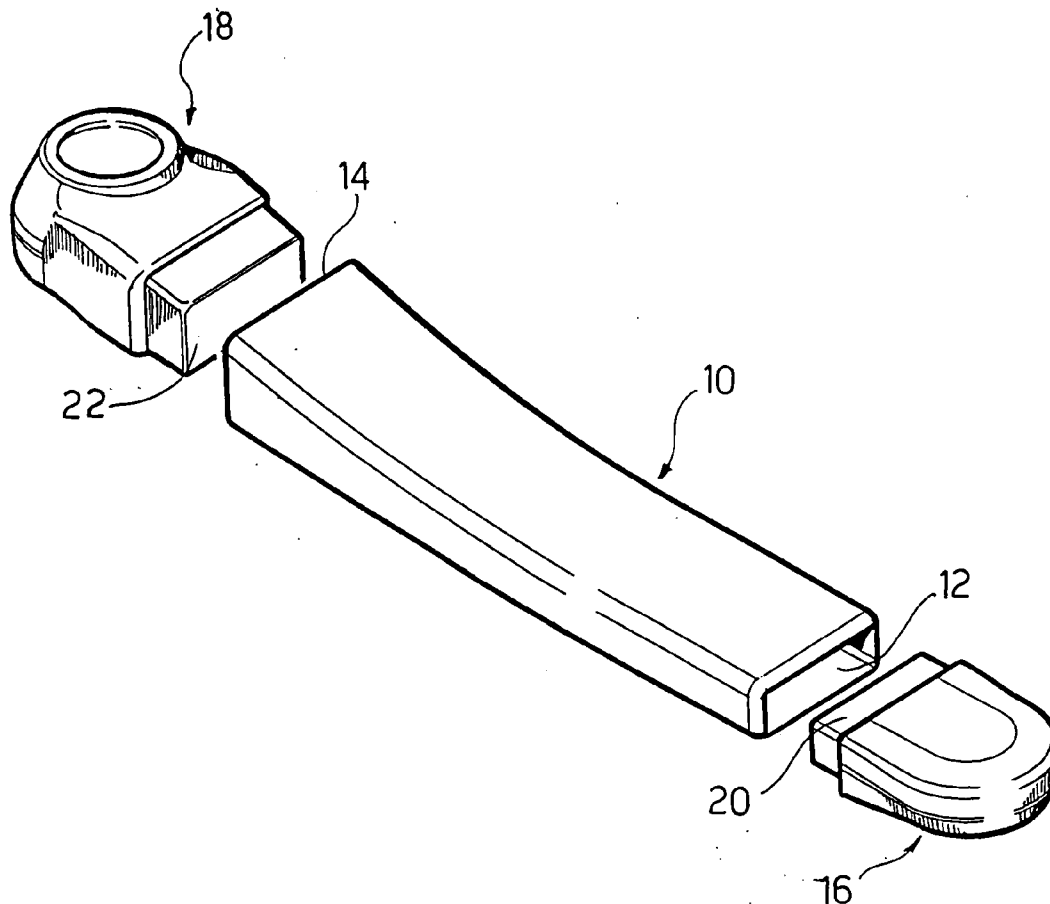
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(57) **ABSTRACT**

A bicycle crank and a method of making a bicycle crank is provided. The bicycle crank has an elongated core with first and second ends, first and second inserts arranged on the ends of the core, and a high-resistance fibre coating incorporated in a plastic material matrix which forms a casing incorporating the core and the inserts. The core is a rigid element and each insert is equipped with a connecting portion inserted into a respective end of the core to establish a shape coupling therewith.



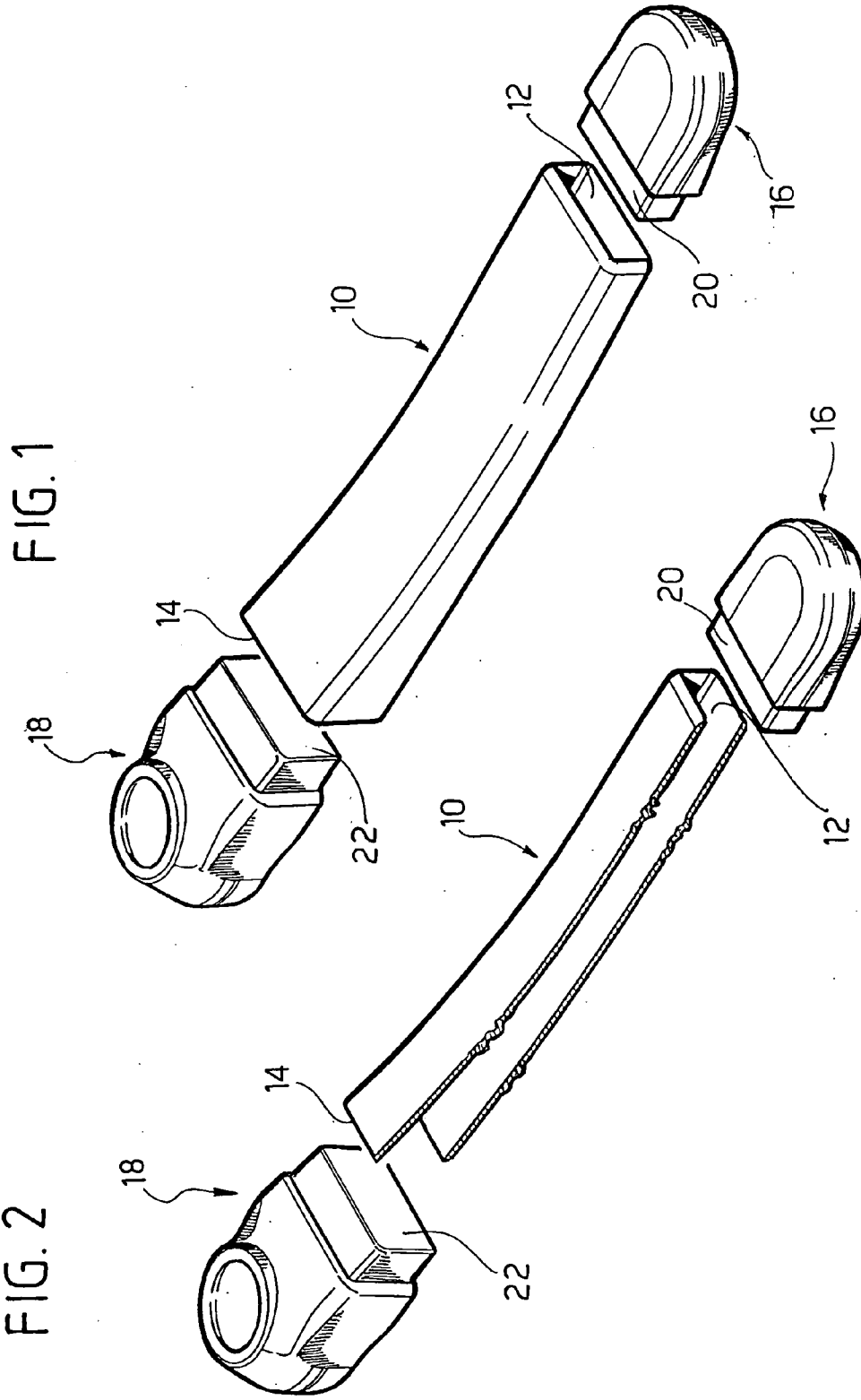


FIG. 3

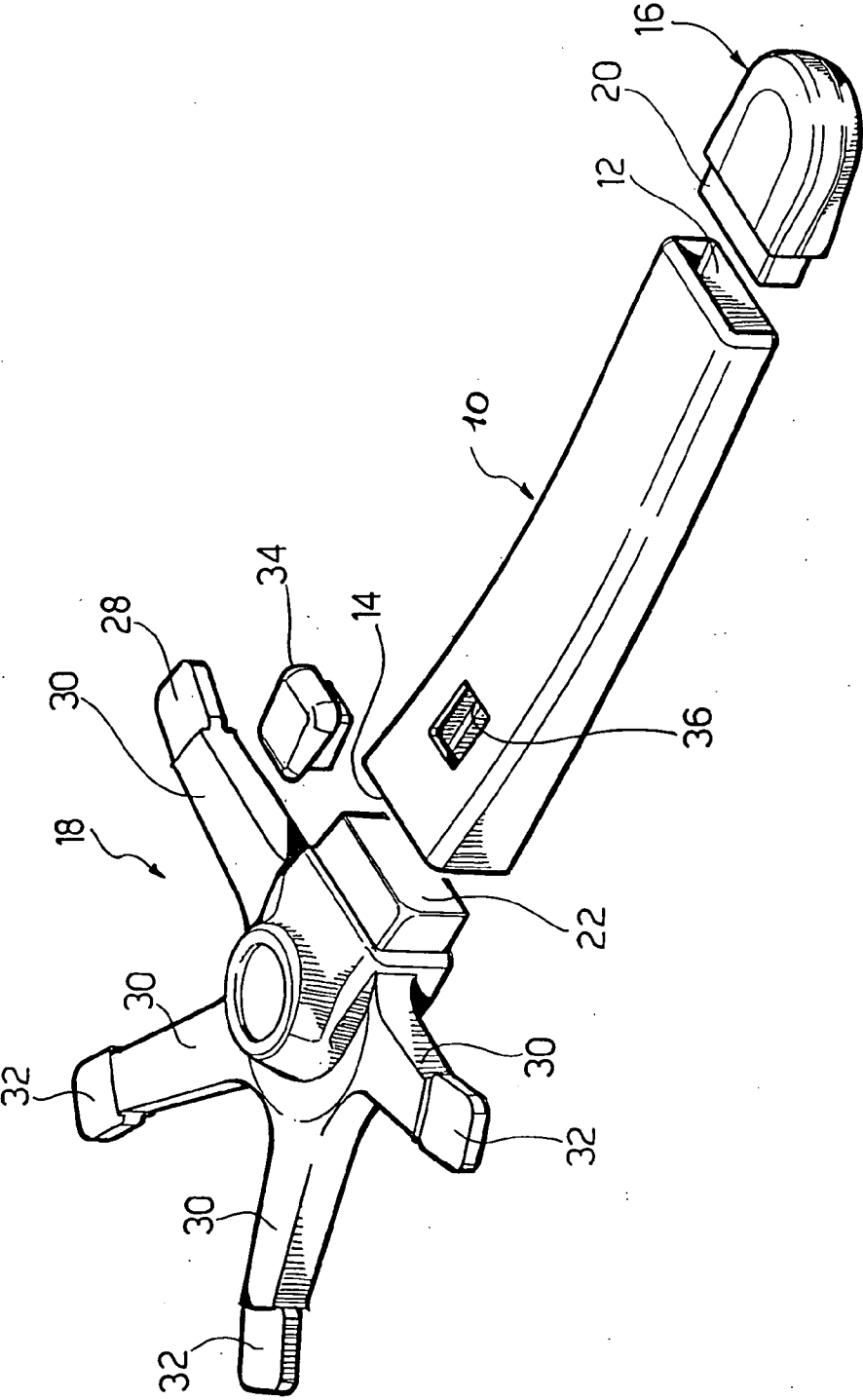


FIG. 6

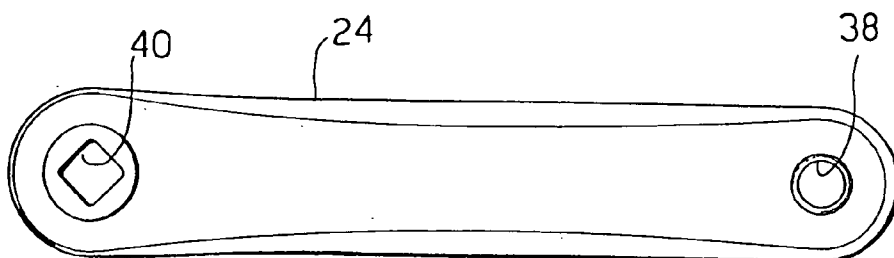


FIG. 4

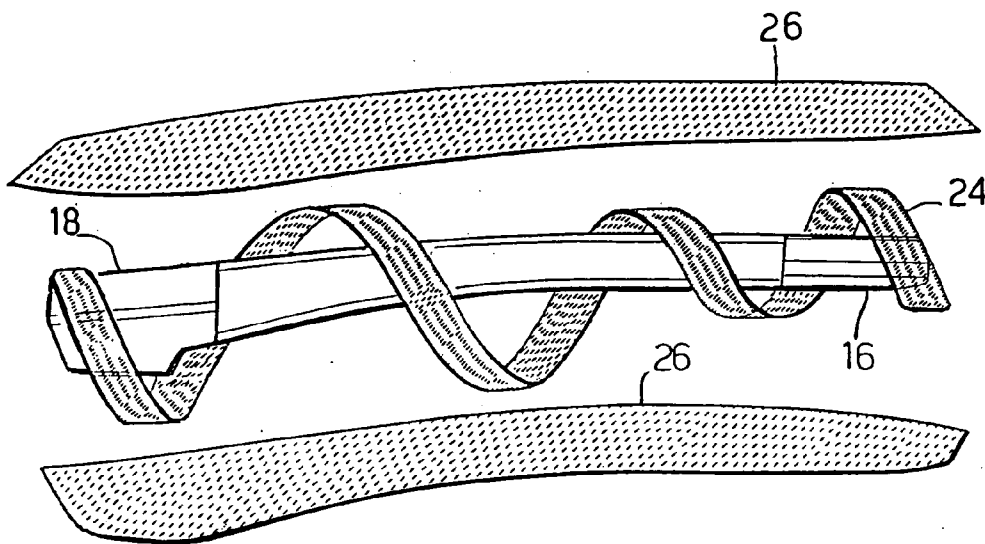
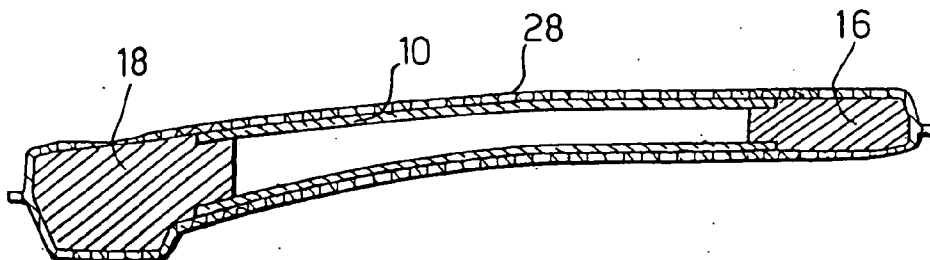


FIG. 5



BICYCLE CRANK AND METHOD FOR MANUFACTURING THE SAME

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation of U.S. patent application Ser. No. 10/174,754, filed on Jun. 19, 2002 which is incorporated by reference as if fully set forth.

BACKGROUND

[0002] This invention relates to a bicycle crank and a method for manufacturing said crank.

[0003] More precisely, this invention relates to a bicycle crank comprising:

[0004] an elongated core with a first and a second end,

[0005] a first and a second insert arranged on the ends of said core, and

[0006] a high-resistance fibre coating incorporated in a plastic material matrix.

[0007] U.S. Pat. No. 6,202,506 describes a bicycle crank of the type specified above, wherein the inserts are foamed into a rigid plastic material forming the core of the crank. Said U.S. Pat. No. 6,202,506 describes a procedure for manufacturing a crank comprising the following steps: introducing into a mould one layer of fabric soaked in synthetic resin providing a partially open fibre-reinforced plastic casing, inserting a pair of inserts in the partially open casing, foaming the inserts with high-resistance foam, sealing the fibre-reinforced plastic material casing with at least one layer of fibre fabric soaked in plastic material, and hardening the fibre-reinforced plastic material and said foam.

[0008] U.S. Pat. No. 4,811,626 describes a bicycle crank formed by three separate elements: a crank arm and two end-pieces. The crank arm consists of an element of composite material formed by overmoulding of a synthetic resin on a tubular core of reinforced fibres such as carbon fibres or aramid fibres. The two end-pieces have respective connecting elements which are forcibly engaged within the corresponding end of the tubular element which forms the crank arm. The crank described in this document is not provided with a high-resistance casing and the end-pieces and the crank arm may consequently come apart.

SUMMARY

[0009] The object of the present invention is to provide a light, resistant crank and a method for making said crank, which does not require foaming the inserts in the mould.

[0010] According to the present invention, this object is attained by means of a crank and a manufacturing method which characteristics are described in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] This invention will be better explained by the following detailed descriptions with reference to the accompanying figures as non-limiting example, wherein:

[0012] **FIG. 1** is a perspective exploded view illustrating the components of a left crank according to this invention,

[0013] **FIG. 2** is a perspective view similar to **FIG. 1** illustrating a longitudinal cross-section of the core,

[0014] **FIG. 3** is a perspective exploded view illustrating the components of a right crank according to this invention,

[0015] **FIG. 4** schematically illustrates the lamination phase employing layers of carbon fibre for manufacturing a crank according to this invention,

[0016] **FIG. 5** is a longitudinal cross-section view of a crank according to this invention at the end of the lamination and carbon fibre polymerisation phase, and

[0017] **FIG. 6** is a top view of a finished crank.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] With reference to **FIGS. 1 and 2**, numeral **10** indicates a tubular core made of rigid material, for example injection moulded plastic material, metallic material (aluminium alloy or similar material) or highresistance fibre reinforced plastic material, such as carbon fibres or similar. Core **10** has an elongated shape and presents two ends **12**, **14**, to which respective inserts **16**, **18** are connected, said inserts being provided with connecting portions **20**, **22** which are inserted into respective end portions **12**, **14** to establish a shape coupling with the core **10**. The inserts **16**, **18** can be made of metallic material, for example aluminium alloy, or fibre-reinforced plastic material. The inserts present holes for housing the pedal spindle and the bottom bracket spindle, respectively (not shown).

[0019] As schematically illustrated in **FIG. 4**, the arrangement comprising the core **10** and the inserts **16**, **18** is wrapped in tapes **24** and sheets **26** formed by structural high-resistance fibres incorporated in a plastic material matrix. Preferably, the tapes and the sheets **24**, **26** are made of carbon fibre fabric incorporated in a thermosetting resin. The structural fibres can be selected among carbon fibres, glass fibres, aramidic fibres, boron fibres, ceramic fibres or any combinations thereof.

[0020] The core **10** holds the inserts **16**, **18** joined in a predefined position and forms a supporting surface during lamination. The term "lamination" herein refers to the layering operations of the tapes **24** and the sheets **26** on the arrangement formed by the inserts **16**, **18** and the core **10**. This operation is used to direct the reinforcement fibres in the most suitable fashion to confer the required structural characteristics to the crank. After lamination, the crank is subjected to moulding and simultaneous heating at a temperature either equal to or higher than the polymerisation temperature of the thermosetting resin. The moulding operation is carried out in a mould and press (not shown). During moulding, the applied pressure is contrasted by the core and the inserts. During moulding, the core **10** provides a suitable contrast to the moulding pressure. This pressure compacts the plastic material matrix fabric. The presence of a rigid material core **10** implies that a high moulding pressure can be applied, to the advantage of compacting the layers of fibre in the plastic material matrix.

[0021] After moulding, the plastic material matrix is hardened. The crank removed from the mould appears as shown schematically in **FIG. 5**, with a homogenous carbon fibre casing **28** enclosing the core **10** and the inserts **16**, **18**. The

casing **28** has high-resistance structural characteristics and is capable of transferring the stress to which the crank is subjected during use from one insert to the other.

[0022] The procedure described above with reference to the left crank is used similarly for manufacturing the right crank, as shown in **FIG. 3**. In this case, the insert **18** for connecting the bottom bracket is equipped with a set of integral metallic spokes **30**. In the form of embodiment shown in **FIG. 3**, the insert **18** has four spokes **30**, which ends **32** form points for fastening a pair of chain wheels (not shown). A fifth fastening point is obtained by means of a third metallic insert **34** housed in a recess **36** formed in the core **10**. The crank shown in **FIG. 3** is subjected to lamination and polymerisation in the mould similarly as described above.

[0023] Both in the case of the left crank and in the case of the right crank, the inserts are subjected to mechanical machining to form a threaded hole **38** for connecting a pedal spindle and a square hole **40** for connecting a bottom bracket spindle after polymerisation in mould.

[0024] The solution according to this invention attains the objective of providing a crank which weight is lighter than traditional cranks while providing the same rigidity. The system according to this invention can be used to very easily vary the shape and the dimensions of the crank, by replacing the tubular core and intervening on the moulds, to vary the length of the crank and the so-called Q-Factor (i.e., the distance between the external surface of the crank and the median plane of the frame), for example, for double and triple chain wheel versions.

[0025] As already said, the main purpose of the elongated rigid core **10** is that of providing a form and a supporting surface to the structural fibres. The core **10**, therefore, does not present, substantially, any structural resistance, or presents a limited structural resistance. With the term limited structural resistance it is intended that the great part of the structural resistance to the crank is given by the casing **28**, which presents a high-resistance and is capable of transferring the great part of the force and of the torque between the inserts **16** and **18** during the use of the crank.

[0026] Naturally, numerous changes can be implemented to the construction and forms of embodiment of the invention herein envisaged, all comprised within the context of the concept characterising this invention, as defined by the following claims.

What is claimed is:

1. A bicycle crank comprising:
 - an elongated core having open first and second ends;
 - first and second inserts that are tapered and matingly engagable with said first and second ends, with the first insert positioned adjacent to the first end of the core and the second insert positioned adjacent the second end of the core; and
 - an outer casing comprised of a fibrous plastic material which encases the core and the inserts.
2. The bicycle crank of claim 1, further comprising a third insert arranged in an intermediate area of said crank.

3. The bicycle crank of claim 1, wherein said structural fibers are chosen from a group comprising: carbon fibers, glass fibers, aramidic fibers, boron fibers, ceramic fibers or a combination thereof.

4. The bicycle crank of claim 1, wherein said inserts are metallic.

5. The bicycle crank of claim 4, wherein said inserts are made of an aluminum alloy.

6. The bicycle crank of claim 4, wherein said inserts are made of fiber-reinforced plastic material.

7. The bicycle crank of claim 1, wherein said elongated core is rigid.

8. The bicycle crank of claim 1, wherein said elongated core provides little or no structural resistance.

9. The bicycle crank of claim 7, wherein said elongated core is made of plastic.

10. The bicycle crank of claim 7, wherein said elongated core is made of metal.

11. The bicycle crank of claim 7, wherein said elongated core is made of fiber-reinforced plastic material.

12. The bicycle crank of claim 1, wherein said elongated core comprises end portions in which said inserts are connected to establish a shape coupling.

13. A bicycle crank, comprising:

- an elongated core having open first and second ends;

- a first and a second insert arranged at the ends of said casing for connecting the bicycle crank to a pedal and to a bottom bracket spindle, wherein said first and second inserts are tapered to matingly engage said first and second ends of the core, said inserts and core are enclosed within a single structural unit casing of structural fibers incorporated in a plastic material matrix, that substantially structurally connects the said inserts to said casing.

14. The bicycle crank of claim 13, further comprising a third insert arranged in an intermediate area of said crank.

15. The bicycle crank of claim 13, wherein said structural fibers are chosen from a group comprising: carbon fibers, glass fibers, aramidic fibers, boron fibers, ceramic fibers or a combination thereof.

16. The bicycle crank of claim 13, wherein said inserts are metallic.

17. The bicycle crank of claim 16, wherein said inserts are made of an aluminum alloy.

18. The bicycle crank of claim 16, wherein said inserts are made of fiber-reinforced plastic material.

19. The bicycle crank of claim 13, wherein said elongated core is rigid.

20. The bicycle crank of claim 13, wherein said elongated core provides little or no structural resistance.

21. The bicycle crank of claim 19, wherein said elongated core is made of plastic.

22. The bicycle crank of claim 19, wherein said elongated core is made of metal.

23. The bicycle crank of claim 19, wherein said elongated core is made of fiber-reinforced plastic material.

24. The bicycle crank of claim 13, wherein said elongated core comprises end portions in which said inserts are connected to establish a shape coupling.

25. Method of manufacturing a bicycle crank, comprising the following steps:

- a) forming an elongated rigid core;

- b) applying a pair of inserts to the opposite ends of said elongated core;
- c) surrounding the core and inserts with a coating of structural fibres incorporated in a plastic material matrix; and
- d) hardening said plastic material matrix to form a high resistance rigid casing enclosing said elongated core and said inserts.

26. Method of manufacturing a bicycle crank comprising the following steps:

- a) providing an elongated core having first and second ends;

- b) positioning at least one insert adjacent to at least one end of the core;
- c) applying a fibrous structural plastic material to the core and the insert; and
- d) hardening the plastic material to form a structural casing enclosing the core and the insert to provide substantially all of the structural connection to the insert.

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