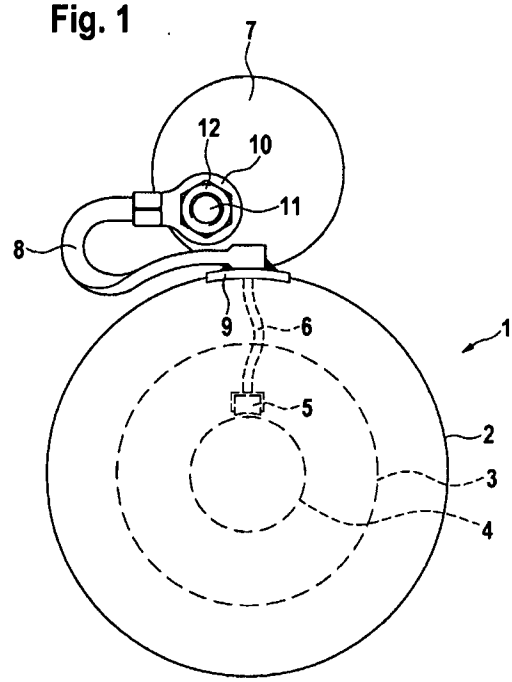
ABSTRACT

ELECTRIC MOTOR, IN PARTICULAR A STARTER MOTOR FOR AN INTERNAL COMBUSTION ENGINE

Described herein is an electric motor (1), particularly a starter motor for an internal combustion engine, where the electric motor (1) comprises an electric conductor for supplying current. The electric conductor is connected to a contact piece (9), which is in contact with a component of the electric motor (1). The electric conductor has, in a central section (13), a rectangular cross-section.

Fig. 1



I/We claim:

1. An electric motor (1), particularly a starter motor for an internal combustion engine, comprising:

   an electric conductor for supplying current, wherein the electric conductor is connected to a contact piece (9), which is in contact with a component of the electric motor (1);

   characterizing in that,

   the electric conductor has, in a central section (13), a rectangular cross-section.

2. The electric motor (1) as claimed in claim 1, wherein the electric conductor is welded with the contact piece (9) within the region of a front-side end section (14, 15), and wherein the front-side end section (14, 15) has a rectangular cross-section, but with a distinctive format as compared to the central section (13).

3. The electric motor (1) as claimed in one of the claim 1 or 2, wherein the electric conductor is implemented as a stranded wire (6).

4. The electric motor (1) as claimed in one of the claim 1, 2 or 3, wherein two front side end sections (14, 15) of the electric conductor, in each case, have the rectangular cross-section with a distinctive format as compared to the central section (13).

5. The electric motor (1) as claimed in claim 4, wherein the rectangular cross-sections of the end sections (14, 15) are produced by forming.

6. The electric motor (1) as claimed in any one of claims 1 to 5, wherein the central section (13) of the electric conductor is formed flat with a larger width (b) and smaller height (h) than that of at least one end section (14, 15).

7. The electric motor (1) as claimed in claim 6, wherein an angle (α) within a transition region of the wider central section (13) of the electric conductor to at least one narrower end section (14, 15) amounts to maximum of 75°.

8. The electric motor (1) as claimed in one of claims 1 to 7, wherein a ratio of width (b) to height (h) of the central section (13) of the electric conductor at least amounts to 3:2.

9. The electric motor (1) as claimed in one of claims 1 to 8, wherein one of the end sections (14, 15) of the electric conductor has a square cross-section.

10. The electric motor (1) as claimed in one of claims 1 to 9, wherein both the end sections (14, 15) are welded with contact elements (9, 10).

11. The electric motor as claimed in one of claims 1 to 10, wherein one of the end sections (14, 15) of the electric conductor is connected with a cable lug (10).

12. The electric motor (1) as claimed in one of claims 1 to 11, wherein the contact piece (9) is connected with a pole housing (2) of the electric motor (1) in an insulated manner.

13. The electric motor (1) as claimed in one of claims 1 to 12, wherein a conductor (6) is connected with a carbon brush (5), which lies in contact with a fixed armature commutator (4).

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To
The Controller of Patents
The Patent office at New Delhi

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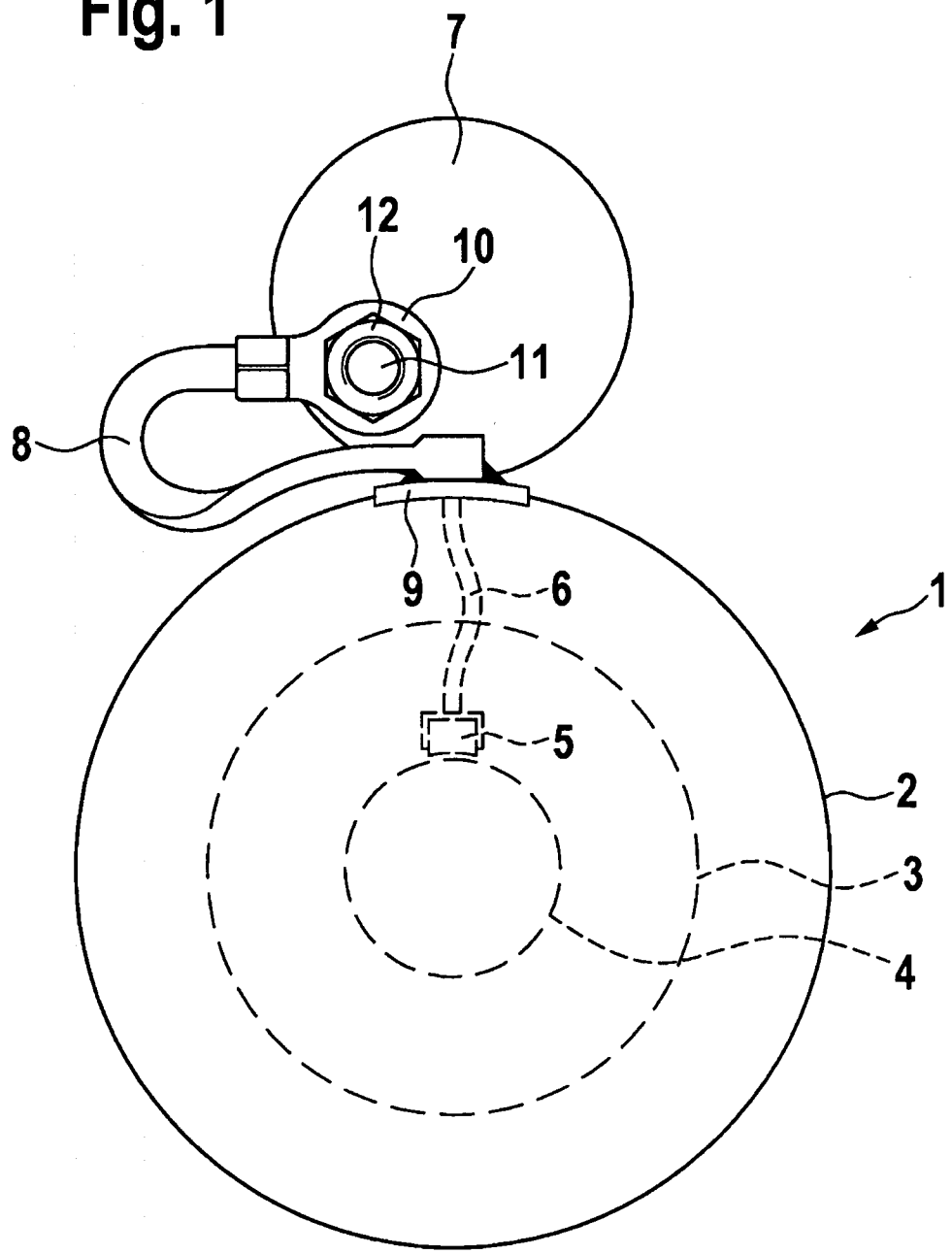
Fig. 1



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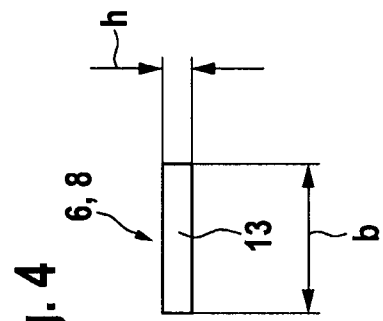

Fig. 4

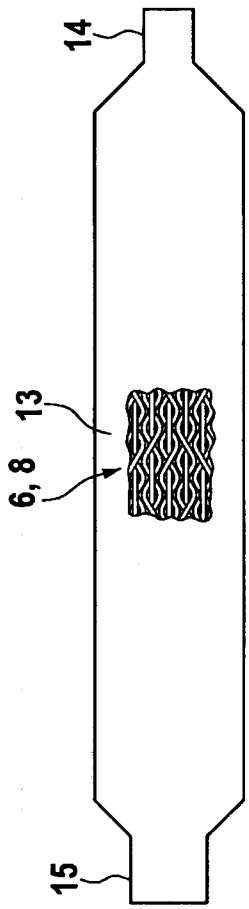

Fig. 2

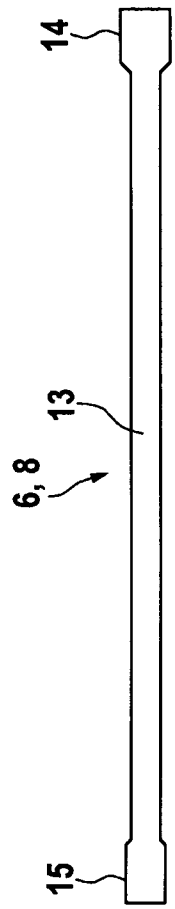

Fig. 3

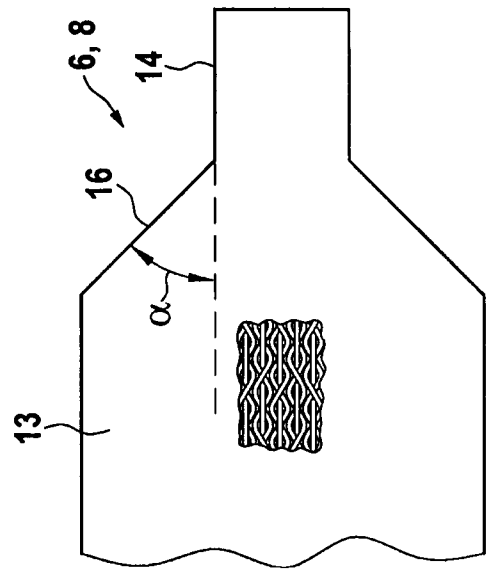

Fig. 5

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TECHNICAL FIELD

The present subject matter relates to an electric motor, particularly a starter motor for an internal combustion engine.

BACKGROUND

An electric starter motor for an internal combustion engine is described in the document DE 35 39 851 A1. For starting the internal combustion engine, an armature of the electrical starter motor is kinematically connected to a starter pinion, through which a crankshaft of the internal combustion engine is set in motion.

An electric supply for the electric starter motor usually takes place over stranded wires, which are usually made of copper and are electrically connected to carbon brushes that are in contact with a commutator. Since the carbon brushes are subjected to wear, usually a yaw mechanism is provided for compensating the wear, where the stranded wires connected with the carbon brushes are required to carry out the yaw movement of the carbon brushes. Also, due to vibrations and shocks as well as thermal effects, the stranded wires are subjected to considerable loads, which however do not lead to failure or breakage of the stranded wire over the lifetime of the starter motor.

Usually, the stranded wires connected to the carbon brushes and other stranded wires that lead from a relay to a pole housing of the starter motor, are implemented as a twisted stranded wire having a circular cross-section, where due to an installation situation, the stranded wires are required to be relatively bent in stronger manner, which leads to additional load and risk of contact with other components. There is also the risk of disengagement and related diversification of the stranded wire.

SUMMARY

This summary is provided to introduce concepts related to an electric motor, in particular a starter motor for an internal combustion engine, and the concepts are further described below in the detailed description. This summary is neither intended to identify essential features of the claimed subject matter nor is it intended for use in determining or limiting the scope of the claimed subject matter.

In one embodiment, the subject matter describes an electric motor, particularly a starter motor for an internal combustion engine, where the electric motor includes an electric conductor for supplying current. The electric conductor is connected to a contact piece, which is in contact with a component of the electric motor. The electric conductor has, in a central section, a rectangular cross-section.

BRIEF DESCRIPTION OF THE FIGURES

Further advantages and embodiments of the present subject matter are described in the description by the figures. In the figures, similar components are referenced by similar reference numerals.

Fig. 1 shows a schematic representation of an electric motor with a pole housing, in accordance with an embodiment of the present subject matter.

Fig. 2 shows a top view of a stranded wire, in accordance with an embodiment of the present subject matter.

Fig. 3 shows a side view of the stranded wire, in accordance with an embodiment of the present subject matter.

Fig. 4 shows a sectional view of the stranded wire, in accordance with an embodiment of the present subject matter.

Fig. 5 shows a detailed view in a transition region of a front side to a central section of the stranded wire, in accordance with an embodiment of the present subject matter.

DETAILED DESCRIPTION

The present subject matter is based on an object to provide an electric connection in an electric motor to run durably and robustly with good adaptation to structural conditions in the electric motor.

The object of the present subject matter is achieved with the features of claim 1. The dependent claims describe further embodiments of the present subject matter.

In the electric motor configured in accordance with the present subject matter, the electric starter motor for an internal combustion engine is embodied, which is implemented as a mechanically commutated direct current (DC) motor. The electric motor includes one or

multiple pairs of carbon brushes, which are in contact with a commutator, through which the current is conducted in an armature winding of an armature. The carbon brushes, in each case, are connected to an electrical conductor for current supply. Further, the electric conductor is provided to lead from a relay to a component of the electric motor and from a further electric conductor to the carbon brushes. In this way, the electric conductor leading from the relay to the component of the electric motor, particularly pole housing is coupled to a contact piece, from which the further conductor also leads to the carbon brushes.

According to an embodiment of the present subject matter, at least one electric conductor includes a rectangular cross-section in a central section, and is welded to the contact piece in the region of one front-side end section. The front-side end section consists of a rectangular cross-section, which has a distinctive format as compared to the central section.

According to the embodiment of the present subject matter, the electric conductor having the rectangular cross-section has greater bend-ability in contrast to the prior art, in which the electrical conductor has round cross-section, where electric conductor having the rectangular cross-section leads to a better adaptation to an installation situation. Despite the pliability and flexibility of the electric conductor, there is no risk of diversification in case of an embodiment of the electric conductor as stranded wire. Further, the electric conductor of the rectangular cross-section can be bent or twisted around different axes, without causing damage to the electric conductor.

A format in the end section of the electric conductor, through which the electric conductor is welded to the contact piece, is distinctive from the format of the rectangular-shaped central section of the electric conductor. It is particularly provided that the central section is formed flat, thus has a larger width and a smaller height than the end section welded to the contact piece. The end section has a cross-sectional geometry in accordance with the present embodiment that is favorable for the welding operation.

In one embodiment, both opposite lying front side end sections of the electric conductor are provided, in each case, with rectangular cross-sections that differ in cross-sectional geometry or a format relative to the central section, particularly formed less flat than the central section. In one implementation at least one of the end sections optionally

provide both end sections, with a square cross-section, which is convenient for the welding operation, since the required welding point is reduced, so that the electric conductor can be welded to the end-side contact element in order to save the space.

According to a further embodiment, it is provided that at least one front side end section, particularly both front side end sections, are produced by forming of the rectangular cross-section, with which the central section of the electric conductor is provided. By this forming process, starting from an electric conductor with a constant cross-section over the axial length, a compaction of the end sections with less hard rectangular cross-section is achieved, where only the cross-sectional shape changes, but the cross sectional area in the end sections is equal or at least approximately the same as the cross sectional area in the central section of the electric conductor.

In order to avoid or at least to reduce the mechanically and thermally induced voltages in the electric conductor, a transition from the wider middle section of the electric conductor to at least the narrower end section is provided at maximum angle of 75 degrees, relative to the longitudinal axis of the electric conductor. The angle particularly amounts to 60° or 45°. Thus, a relatively smooth transition between the wider central section and the narrower, front side end section is secured. Thus the damage during compaction, particularly in the form of a stiffening of the strand, can be avoided by limiting the angle in the transition region.

In order to ensure a sufficiently high flexibility of the electric conductor, a ratio of width to height of at least 3:2 is provided in the region of the center section, so that the width amounts to at least 1.5-times to the height. If necessary, a significantly higher ratio of width to height can be chosen, particularly a ratio of 4:2, 5:2, 6:2 or greater.

In another implementation, both the end sections are welded to the contact elements, such as an end section of the electric conductor with the cable lug and the opposite lying end section with the contact piece which is guided with insulation (such as insulation rubber) through the pole housing of the electric motor. In the case of a current carrying conductor, which leads the electric motor to the commutator, the conductor is connected with the carbon brush on a commutator side and is welded to the contact piece on the side lying opposite to the commutator, which is guided the pole housing in insulated manner.

Fig. 1 shows an electric motor 1, which is formed as a mechanically commutated direct current (DC) motor and is used as a starter motor for internal combustion engines. The electric motor 1 has an armature 3 rotating in a pole housing 2, at inner side of which magnets are arranged, which is provided with an energizable armature core provided with coils, where the energization of the armature core is carried out via a commutator 4, on outer side of which a carbon brush 5 is lying, which is connected to a power conductor implemented as the stranded wire 6.

The power supply to the electric motor 1 is performed from a relay 7 through the power conductor formed as a stranded wire 8, which is connected, particularly welded to a contact piece 9 on the side of the electric motor, where the power conductor is disposed on the pole housing outer side. The stranded wire 6 is connected to the contact piece 9, through which the carbon brush 5 is supplied with power. The stranded wire 8 on the other end is welded with a cable lug 10, which is stacked on a pin 11 within the relay 7 and is secured with a nut 12.

The stranded wire 8 and the stranded wire 6, each have a right-corner-shaped cross-section in a central section, and similarly a rectangular or square cross-section in their two end sections. In the following Figs. 2 to 5, the stranded wire 6 or 8 is shown in individual representation. The stranded wire 6, 8 consists of a central section 13 and front side end sections 14 and 15, through which the stranded wire 6, 8 is welded to respective contact elements. The front side end sections 14 and 15 have a cross-section that is distinctive from the cross-section of the central section 13. As shown in section view according to Fig. 4, the central section 13 is formed flat and has a relatively large width b and a small height h, where the ratio of width b to height h is at least 3:2, however, if required, the width b can be significantly greater. A front-side end section 14 has a square cross section and an opposite lying front side end section 15 of a rectangular cross section, which is formed less flat than in the central section 13 so that the ratio of width to height of the front-side end section 15 is smaller than within the central section 13.

In a side view according to Fig. 3, the abovementioned different cross-sectional geometry is represented in the flat central section 13 and slightly thicker formed end sections 14 and 15, where due to the square cross-sectional geometry, the one of the front-side end

section 14 has a greater height than the opposite lying front-side end section 15 with rectangular, non-square, cross section. Since the front side end sections 14 and 15 are produced by forming the electric conductors 6, 8, also the front side end sections 14 and 15 have the same cross-sectional area as that of the central section 13.

Fig. 5 shows a transition 16 between the one front-side end section 14 and the central section 13 in a detailed representation. Particularly, in order to avoid damage during compaction, the transition 16 has an angle α, which amounts maximum to 75°, with respect to a longitudinal axis of the electric conductor 6, 8. In the embodiment shown in Fig. 5, the angle α is of about 45°.