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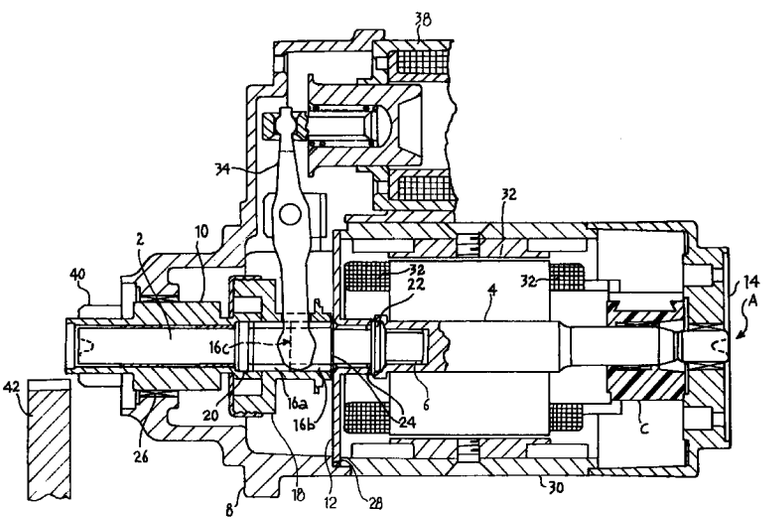
(54) A starter motor for internal combustion engines, in particular for motor vehicles

(57) A starter motor for internal combustion engines comprises a shaft (A) subdivided into two parts (2, 4) joined together by a coupling profile (6) which joins them fixedly for rotation. A stop device comprises helical teeth (16) which are able to cooperate with a shoulder ring (20) of the shaft (2) which limits the axial stroke of a free wheel (18).



EP 0 807 758 A1

Description

The present invention relates to a starter motor for an internal combustion engine, in particular for motor vehicles. More particularly, the present invention relates to a starter motor comprising a shaft separated into two portions and a pinion stop device for limiting the movement of the pinion upon engaging with a gear ring on the flywheel of the internal combustion engine.

As is known, the pinion is slidable on the starter motor shaft in such a way as to be able to mesh with the gear ring during starting. Stop means for limiting the path of the pinion are therefore necessary.

Currently the most widely utilised arrangement provides for the use of a stop ring which is fixed to one end of the shaft by means of a circlip fitted in a groove formed on the shaft itself, or by two collets which are coupled on a circlip also fixed in a groove provided at one end of the shaft.

These arrangements are however disadvantageous if utilised for starter motors with projecting pinions because it is necessary to insert both the stop ring and the circlip within the pinion and all the said components must be miniaturised; moreover it becomes impossible to check the correct assembly of the components themselves with consequent reduction in reliability.

The object of the present invention is that of providing a starter motor for an internal combustion engine which allows all the above-indicated problems to be resolved in a satisfactory manner and which is easy to assemble and has a high reliability.

According to the present invention this object is achieved by a starter motor for an internal combustion engine having the characteristics indicated in the claims which follow the present description.

Further advantages and characteristics of the present invention will become apparent during the course of the following detailed description, provided purely by way of non-limitative example, with reference to the attached drawing which is a schematic representation in transverse section of an embodiment of the starter motor which is the subject of the present invention.

In the drawing A indicates a starter motor shaft. The shaft A is subdivided into two portions, indicated 2 and 4, corresponding respectively to a coupling shaft 2 and a rotor shaft 4. As can be seen from the drawing, the coupling shaft 2 supports a pinion 10 intended, as mentioned above, to mesh with a gear ring 42 provided on a flywheel of an internal combustion engine; the rotor shaft 4 on the other hand supports a rotor comprising a plurality of rotor windings 32 of the starter motor.

The coupling shaft 2 and the rotor shaft 4 are connected together by corresponding form-fitting shaped end 6 provided at their respective facing ends, which guarantee the transmission of torque from the rotor shaft 4 to the coupling shaft 2 and further serve as supports for the rotor shaft 4.

The rotor shaft 4 is in fact supported at one end, the end opposite the coupling shaft 2, by a support 14 positioned close to a commutator C operable to supply the rotor windings 32, whilst at the end facing the coupling shaft 2 it is supported by the coupling at the shaped end 6 of the coupling shaft 2 itself. The support 14 at the commutator end of the shaft is applied to a casing 30 of the starter motor carrying an inductor winding and containing the rotor 32.

The coupling formed by the shaped end 6 also allows alignment of the coupling shaft 2 and the rotor shaft 4 with one another and with respect to a support structure 8 situated in correspondence with the coupling shaft 2. This coupling shaft 2 is in fact supported by a support structure 8 by means of a bush or bearing 26 and an intermediate support 12 as will be better explained hereinafter.

On the coupling shaft 2 are mounted the pinion 10 as mentioned above, and a free wheel hub 18 intended to cooperate with the pinion 10. Currently, the use of a pinion coupled to the shaft of the associated starter motor by means of a free wheel is widely employed.

A splined portion 16a of the coupling shaft 2 permits a coupling unit constituted by the pinion 10 and the free wheel 18 to slide axially on it.

The starter motor in fact includes, for the purpose of causing sliding of the coupling unit 10, 18, a lever 34 which acts on the free wheel 18 in an arrangement widely known in the art.

The lever 34 is actuated by means of an electromagnet 38. When, at the beginning of the starting operation, the electromagnet 38 is activated it presses the free wheel 18 and the pinion 10 towards the gear ring 42. In this way it causes meshing of a toothed end portion 40 of the pinion 10 with the gear ring 42. Almost simultaneously the electromagnet 38 closes a supply circuit to the starter motor which therefore causes starting of the internal combustion engine.

As mentioned the coupling unit 10, 18 is mounted in an axially slidable manner on a grooved portion 16a of the coupling shaft 2. More precisely a hub of the free wheel 18 has a correspondingly splined internal portion 16b which allows it to slide axially, but not to rotate, with respect to the coupling shaft 2.

The hub of the free wheel 18 is connected by means of the free wheel coupling to the pinion 10 which can rotate or translate on the coupling shaft 2. The pinion 10 can therefore slide axially in a fixed manner with the free wheel 18 and can rotate on the coupling shaft 2. In practice the rotation of the pinion 10 is however limited by the free wheel device 18 which permits the pinion 10 to rotate in the same direction but more rapidly than the hub of the free wheel 18 when it is driven to rotate by the internal combustion engine, whilst when the starter motor drives the rotation of the internal combustion engine the pinion 10 is driven to rotate fixedly by the free wheel hub 18 at the same speed of rotation as the coupling shaft 2.

The axial sliding of the hub of the free wheel 18 on the grooved portion 16a of the coupling shaft 2 is delim-

ited at one end of the intended path by an annular projection 20 formed on the coupling shaft 2 by means of a variation in diameter provided at one end of the grooved portion 16a, against which the end 16c of the grooved portion 16b of the free wheel hub 18 abuts. At the opposite end the path of the free wheel hub 18 is limited by the intermediate support 12.

The principal steps in the assembly of the starter motor according to the invention, which is rational and efficient, will now be described briefly.

In the first place the pinion 10 and the free wheel 18 constituting the coupling unit are threaded on to the coupling shaft 2 and are subsequently assembled.

On the assembly formed by the coupling shaft 2 and the coupling unit 10, 18 is mounted the intermediate support 12 which is locked in the desired position by means of a resilient stop ring or Seeger 22 with the interposition of plain or star washers 24. The assembly formed by the coupling unit 10, 18, the coupling shaft 2 and the intermediate support 12 is mounted and centred in the support structure 8 at the pinion end (10) by means of a bush or bearing 26 which supports the pinion 10 and, at the opposite end, by means of a centring recess 28 of substantially annular form provided with an abutment surface situated in the portion of the support structure 8 facing the rotor 32 and intended to function as a seat for the intermediate support 12.

The assembly of the starter motor is completed by assembling the casing 30 which axially fixes the intermediate support 12 and by inserting the rotor 32 with its shaft 4 and the support at the commutator 14 end.

The operation of the starter motor which is the subject of the present invention is as follows. When the starter motor is actuated the electromagnet 38 thrusts the free wheel 18 towards the ring gear 42 by means of the lever 34. The free wheel 18, urged by the lever 34, continues along its path towards the ring gear 42 until the toothed portion 40 of the pinion 10 is introduced between the teeth of the ring gear 42 of the internal combustion engine's flywheel. The axial path of the free wheel 18 is limited by the fact that the end 16c of the grooved portion 16b of the hub of the free wheel 18 facing towards the ring gear 42 comes up against the stop ring 20 of the coupling shaft 2.

The electromagnet 38 also simultaneously supplies the starter motor the rotor 32 of which starts to turn and, with its rotor shaft 4 drives the coupling shaft 2 to rotate by means of the coupling of the shaped end 6. The coupling shaft 2, retained in axial position by the intermediate support 12 by means of the Seeger 22 and the washers 24 drives the free wheel 18, and therefore also the pinion 10, to rotate by means of the splined coupling 16a.

From what has been just said the advantages of the starter motor according to the invention are evident, which combines a great simplicity of assembly with a good reliability of the pinion stop system.

Naturally, the principle of the invention remaining the same, the details of construction and the embodiments can be widely varied with respect to what has been described and illustrated without by this departing from the ambit of the present invention as defined in the appended Claims.

Claims

1. A starter motor for an internal combustion engine comprising a shaft (A) carrying a rotor (32) and a pinion (10) associated with a free wheel device (18), the said shaft (A) comprising a first, coupling portion (2) carrying the said pinion (10) and the said free wheel (18), and a second, rotor portion (4) carrying the said rotor (32), characterised in that the said first, coupling portion (2) and the said second, rotor portion (4) are provided at their facing ends with coupling means (6) in such a way as to be fixed for rotation together and aligned with one another.

2. A motor according to Claim 1, characterised in that the said first, coupling portion (2) includes stop means (20) and a splined portion (16a) carrying a hub of the said free wheel (18), the said hub being provided with a corresponding spline (16b) the end (16c) of which strikes against the said stop means (20) limiting its axial path.

3. A motor according to Claim 2, characterised in that the said stop means includes an annular enlargement (20) provided on the said first, coupling portion (2) at one end of the said splined portion (16a) nearer the said pinion (10).

4. A motor according to Claim 2 or Claim 3, characterised in that the said splined portion (16a) of the said first, coupling portion (2) and the said splined portion (16b) of the said hub of the said free wheel (18) are coupled in such a way that the said hub of the said free wheel (18) is fixed for rotation with and slidable on the said first, coupling portion (2).

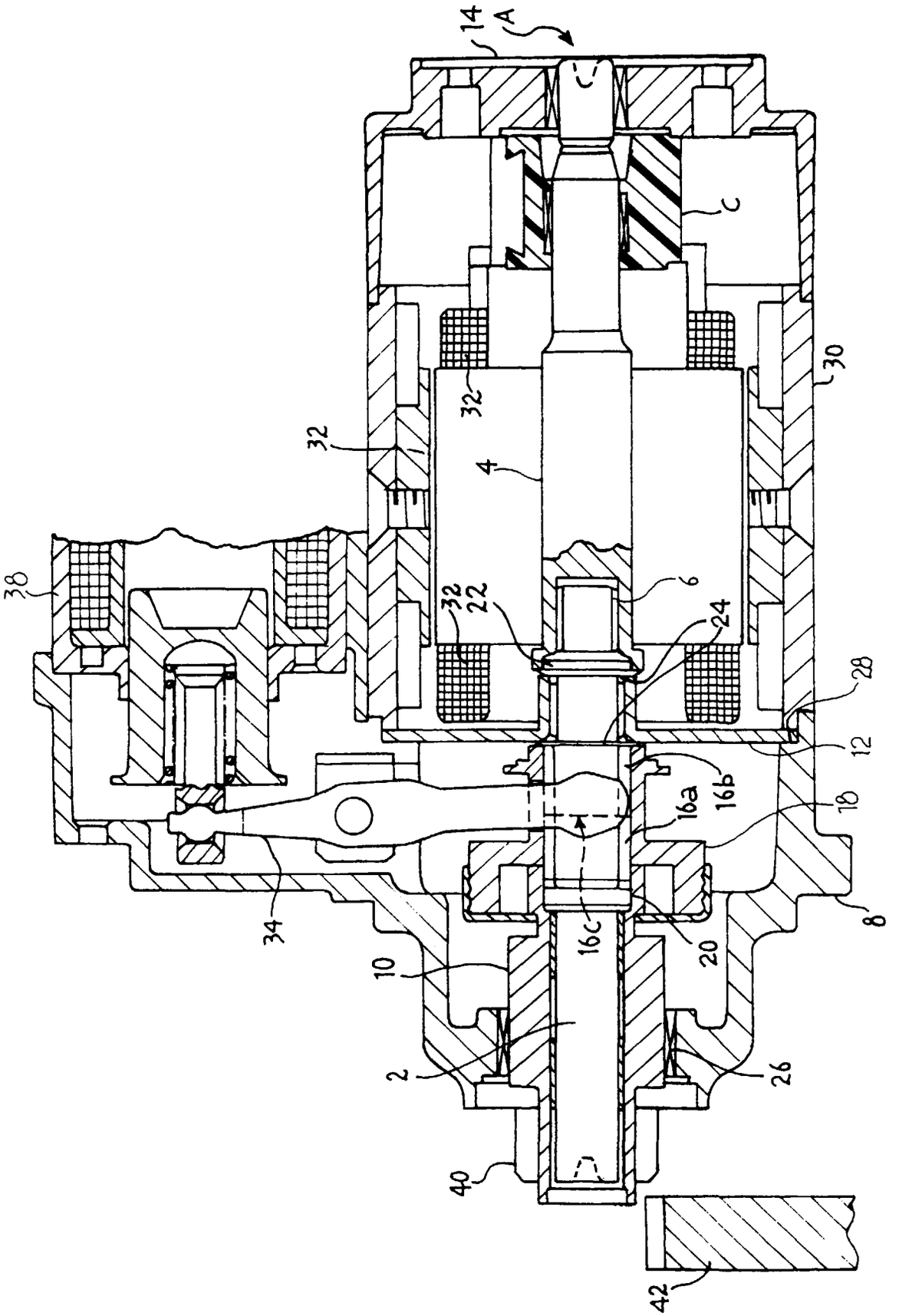
5. A motor according to any of Claims from 1 to 4, characterised in that the said coupling means (6) have complementary profiles.

6. A motor according to any of Claims from 1 to 5, characterised in that the said first, coupling portion (2) is supported by a support structure (8) at one end, nearer the said pinion (10), of the said motor.

7. A motor according to Claim 6, characterised in that the said first, coupling portion (2) is supported by the said support structure (8) by means of a bearing or bush (26) carrying the said pinion (10) and by an intermediate support (12) fitted at one end of the said support structure (8) towards the said rotor (32) and carrying a corresponding end of the said first, coupling portion (2).

8. A motor according to any of Claims from 1 to 7, characterised in that the said first, coupling portion (2) is axially tied to the said intermediate support (12) by means of a Seeger (22) and washers or rosettes (24) mounted on its end opposite the position of the said pinion (10).

9. A motor according to any of Claims from 6 to 8, characterised in that the said second rotor portion (4) is supported at one end by a support (14) situated in correspondence with a commutator (C) operable to supply the said rotor (32) and at the opposite end, towards the said pinion (10), by the said first, coupling portion (2) by means of the said coupling profiles (6).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EUROPEAN SEARCH REPORT

Application Number
EP 97 10 7131

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 347 442 A (WHITE DALE A ET AL) 31 August 1982	1,5-9	F02N15/06
A	* column 4, line 38 - column 6, line 2; figures 1,3-5 *	2,3	
X	US 4 295 069 A (GIVAN DAVID E ET AL) 13 October 1981	1,5	
Y	* column 2, line 38 - column 3, line 10; figures 1,4 *	2-4	
Y	PATENT ABSTRACTS OF JAPAN vol. 014, no. 532 (M-1051), 22 November 1990 & JP 02 224843 A (MITSUBISHI ELECTRIC CORP), 6 September 1990, * abstract *	2-4	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F02N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 August 1997	Marti Almeda, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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