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54 **Combustion engine provided with a starter and a current generator.**

57 Internal combustion engine for motor vehicles provided with at least one starter and one current generator connected to the drive shaft in order to start the engine and to generate the necessary electric energy for the engine to work, wherein the starter and the current generator are replaced by a brushless permanent magnet electric motor.

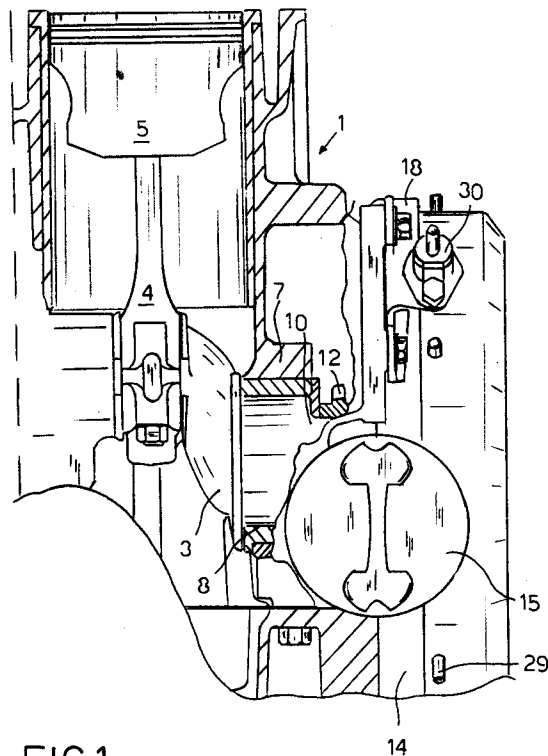


FIG.1

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This invention refers to internal combustion engines for motor vehicles provided with an electric starter and a current generator. One of the primary requirements in the designing of motor vehicles, in particular for so called "city cars", is to reduce the overall weight of the vehicle so that it can be driven using less power and therefore with less fuel consumption and less pollution.

In current vehicles, to start the combustion engine and to generate the required levels of electric energy, two power units are used, a starter and a generator, which besides the cost, also have a significant impact on the total weight of the engine, both because of their weights and because of the connection systems and the transmission of movement to and from the combustion engine.

The aim of this invention is to combine in a single electronic device the functions of the starter and of the current generator, simplifying at the same time the connection system to the combustion engine.

This and other aims are reached with an internal combustion engine according to the introduction of the first claim, characterized in that the starter and the current generator are replaced by a brushless permanent magnet electric motor in which the rotor is splined directly to the drive shaft of the combustion engine, on its distribution side.

Other characteristics and advantages will become clear from the following description which refers to the attached drawings, given by way of example only and in which:

Figure 1 is a partial cross section view of an internal combustion engine provided with an electric motor according to the invention.

Figure 2 is a cross section view of the electric motor manufactured in order to be mounted according to Figure 1.

With reference to the figures, the numeral 1 indicates an internal combustion engine (partially shown) provided with a camshaft (3), and connecting rods (4) and pistons (5). The crankshaft rotates in the engine block (7) on smooth bearings (8).

At the end (10) of the crankshaft (3), opposite to the end facing the gearbox, and therefore on the side usually called the distribution side, a gear (12) is splined, devoted to the operation of the engine distribution (camshaft). On the same side of the engine, a casing (14) is positioned around the end (10) of the camshaft (3), fixed in a known way by means of bolts (not shown), which incorporates an inlet (15) for the feeding of lubricating oil into the engine. Said casing (14) is made in the form of a circular shell, coaxially mounted to the crankshaft to form, with the windings (17) integrally mounted, the stator (18) of a brushless permanent magnet motor, in which the polarity can be inverted at any moment. A second circular shell (22) is splined,

coaxially to the casing (14), through the interposition of a seal (24), on the crankshaft (3) of the internal combustion engine (1), the shell of which rotates together with the crankshaft and carries on its periphery a series of permanent magnets (26) (facing, at work, the windings (17)) and forms the rotor (27) of the electric motor.

On the external wall of the rotor (27) small staves (29) are placed at regular intervals (as an alternative, square teeth could be machined), which, in cooperation with a sensor (30) attached to the stator (18), will determine the rotational speed of the rotor. Both components (14, 22) are cup shaped, positioned with their cavities facing each other and both components have an internal peripheral frontal rim, respectively (32) and (33), which cooperate to form, in counter rotation, a labyrinth seal for the protection of the motor (20).

The mechanism's way of working is already clear from the above. In fact it will be sufficient to control the rotational speed of the rotor, using the sensor (30), associated, if the case, to a sensor on the starter switch, to decide when to invert the polarity and to transform the electric motor (20) from a starter into a current generator.

Besides the savings in cost and weight mentioned above, there will surely be less consumption of power increased efficiency of the internal combustion engine.

Claims

1. An internal combustion engine for motor vehicles of the type provided with at least one starter and one current generator connected to the drive shaft through systems in order to start the engine and to generate the necessary electric current for the engine to work, characterized in that the starter and the current generator are replaced by a brushless permanent magnet electric motor with a rotor splined directly to the drive shaft of the engine, coaxially to it and on its distribution side.
2. An engine according to claim 1 characterized in that the stator of the electric motor is attached directly to the engine block of the internal combustion engine, coaxially to the axis of its drive shaft.
3. An engine according to claims 1 and 2 characterized in that both the stator and the rotor are circular cup-shaped casings.
4. An engine according to claims 1 and 2 characterized in that the stator is one of the casings of the engine block of the internal combustion engine.

5. An engine according to claim 3 characterized in that the rotor has staves placed at regular intervals on its external surface.

6. An engine according to claim 3 characterized in that the rotor has square teeth machined on its external surface. 5

7. An engine according to claims 5 and 6 characterized in that a sensor able to detect the passage of the staves or of the teeth is mounted on the stator. 10

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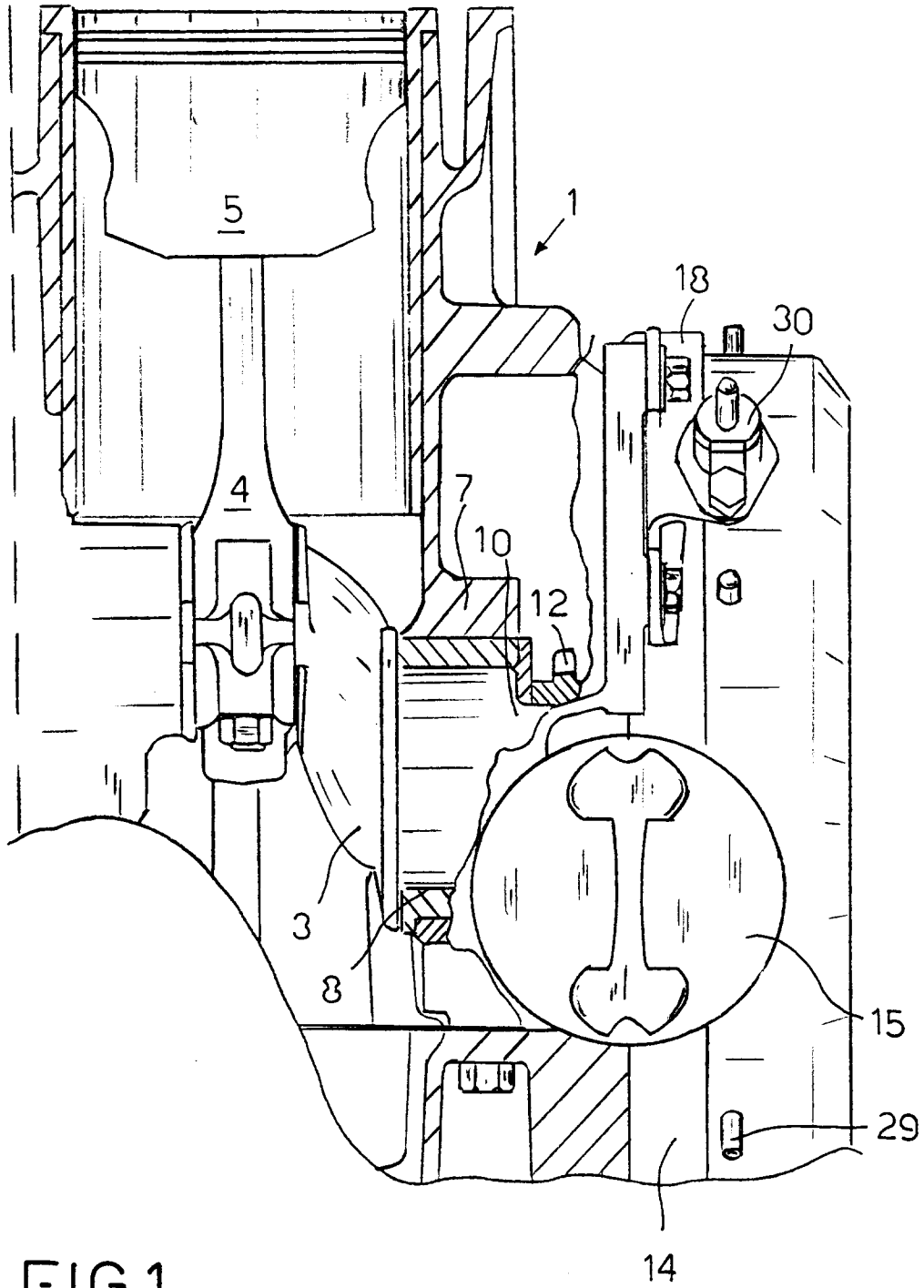
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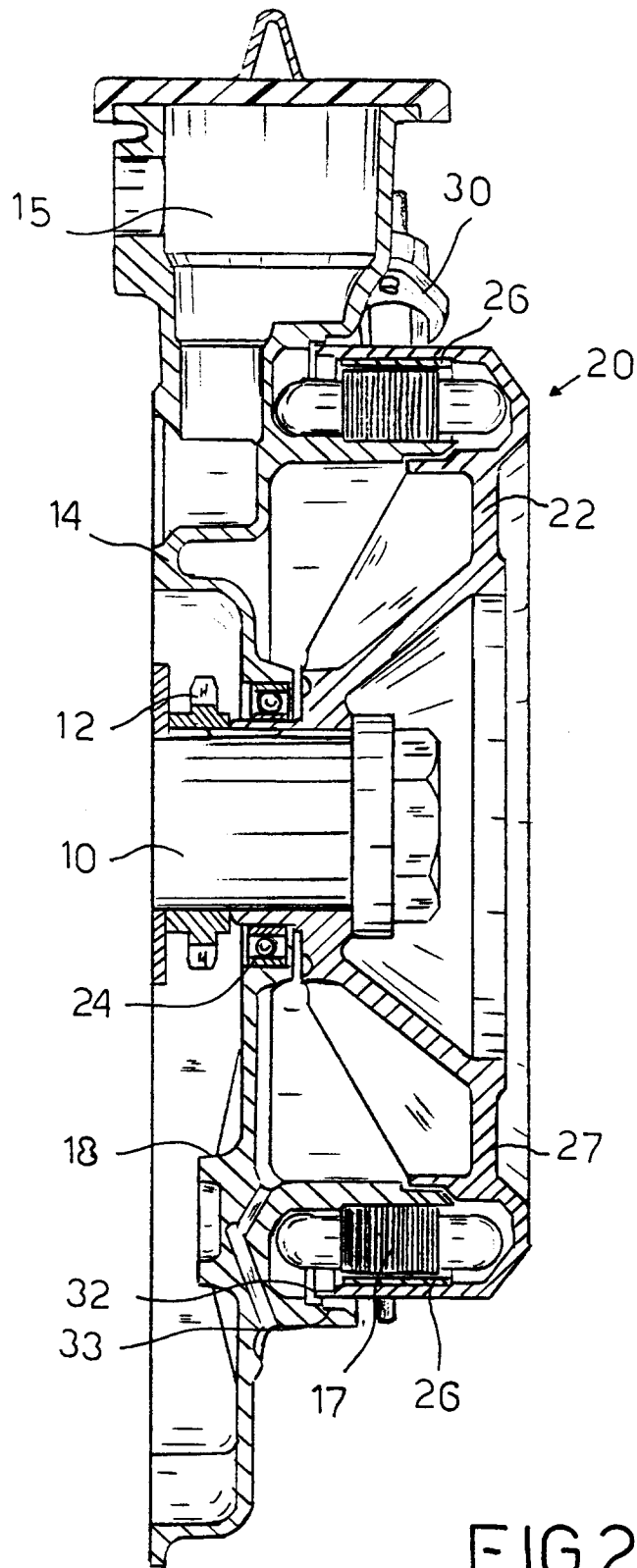
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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
Y	PATENT ABSTRACTS OF JAPAN vol. 10, no. 356 (E-459) (2412) 29 November 1986 & JP-A-61 154 464 (MAZDA MOTOR CORP.) 14 July 1986 * abstract *	1,2	F02N11/04
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A	US-A-4 918 323 (ASO) * column 4, line 36 - line 35; figure 2 *	1-4	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			F02N
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		3 June 1994	Bijn, E
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