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(54) System for detecting the rotation speed of an internal combustion engine camshaft

(57) A system (1) for detecting the rotation speed of an internal combustion engine camshaft (2), wherein a toothed timing pulley (4), fitted to the camshaft (2), carries integrally a sound wheel (10) facing a speed sensor (11) for detecting a signal generated by rotation of the sound wheel (10); according to the invention, as opposed to being a conventional toothed wheel, the sound wheel (10) is defined by a magnetic ring (13) made of a magnetized polymer material and carried by a rigid supporting ring (12) fitted integrally to the pulley (4), so as to obtain a stronger, more accurate, "cleaner" signal as compared with that of a conventional toothed sound wheel.

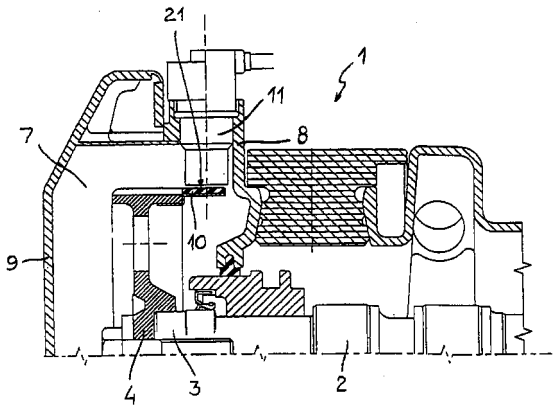

Fig. 1

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Description

[0001] The present invention relates to a system for detecting the rotation speed of an internal combustion engine camshaft, and to an integrated assembly usable in such a system and comprising a sound wheel and a timing pulley of an internal combustion engine.

[0002] Devices for detecting the relative speed of two relatively rotating members are commonly used, particularly in the car industry, and comprise a so-called "sound wheel", i.e. a ring with magnetic gaps, and a sensor for detecting the magnetic variations generated by the gaps on the sound wheel traveling past the sensor. Among the more widely used, for example, are sound wheels defined by toothed metal wheels : the sensor is located at the peripheral edge of the toothed wheel, and the alternating solids (teeth) and voids (gaps between the teeth) generate a signal corresponding to the rotation speed of the sound wheel (and, hence, of the member connected to the sound wheel with respect to the sensor). Devices of this type are widely used, for example, for detecting the rotation speed of vehicle wheels (to control, for example, intervention of braking or traction control systems).

[0003] Also known is the need, again in the car industry, to detect the rotation speed of engine camshafts, which forms the basis for various engine operation adjustments. At present, this is done using detecting devices of the type described above, featuring speed sensors and sound wheels defined by toothed metal wheels. Applying devices of this sort to an engine camshaft, however, poses several drawbacks. Firstly, to ensure a strong, accurate signal, the toothed metal wheels used as sound wheels, must be made to a high degree of precision, particularly as regards cutting the teeth, and are therefore invariably expensive. And even so, the toothed wheels traditionally used as sound wheels in this particular application are totally unsatisfactory in terms of signal strength and precision. Secondly, the best position in which to set up the detecting device is at the pulley supporting the timing belt (for connection to the drive shaft), which, as is known, must be a toothed belt to ensure precise operation of the timing system. On the other hand, the very presence of the toothed timing belt interferes with operation of the detecting device, this disturbing the signal reaching the sensor. In other words, the teeth on the belt confuse the signal generated by the toothed wheel defining the sound wheel, and so disturb the sensor reading.

[0004] It is an object of the present invention to provide a system for detecting the rotation speed of a camshaft, designed to eliminate the aforementioned drawbacks, and which, in particular, provides for a high degree of efficiency, is unaffected by interference caused by the presence of the toothed timing belt, and at the same time is extremely straightforward and cheap to produce and assemble.

[0005] According to the present invention, there is provided a system for detecting the rotation speed of an internal combustion engine camshaft, comprising a toothed timing pulley fittable to said camshaft; a sound wheel carried integrally by said pulley; and a speed sensor for detecting a signal generated by the rotation of said sound wheel, and fittable to a housing structure fixed with respect to said camshaft; the system being characterized in that said sound wheel comprises a substantially rigid supporting ring fitted integrally to said pulley; and a magnetic ring made of magnetized polymer material and carried by said supporting ring.

[0006] The invention also relates to an integrated assembly comprising a toothed timing pulley of an internal combustion engine, and a sound wheel; characterized in that said sound wheel comprises a substantially rigid supporting ring fitted integrally to said pulley; and a magnetic ring made of magnetized polymer material and carried by said supporting ring.

[0007] The invention therefore provides for a detecting system which is not only highly efficient and reliable, but also compact, cheap and easy to produce, and easy to assemble. The particular characteristics and the location of the sound wheel with respect to the timing pulley provide for obtaining a strong, highly accurate signal, far superior to that of conventional toothed wheel. Moreover, the effect on the sensor of interference generated by the toothed timing pulley and belt being located close to the sensor-sound wheel assembly is greatly reduced.

[0008] In short, substituting sound wheels of magnetic rubber for the toothed metal wheels traditionally used in this type of application has surprisingly been found to result not only in various manufacturing advantages (lower cost, simpler processing), but also in a much more efficient signal.

[0009] The invention therefore also extends to the use of a sound wheel comprising a magnetic ring made of magnetized polymer material and connecting means for connection to a timing pulley of an internal combustion engine to form systems for detecting the rotation speed of a camshaft of said engine.

[0010] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a system for detecting the rotation speed of an internal combustion engine camshaft in accordance with the present invention;

Figure 2 shows a larger-scale view if a detail of the Figure 1 detecting system;

Figures 3 and 4 show graphs of output signals from two systems for detecting the rotation speed of a camshaft, one being a known system (featuring a toothed metal sound wheel), and the other a system in accordance with the present invention.

[0011] With reference to Figures 1 and 2, number 1 indicates as a whole a system for detecting the rotation speed of a camshaft 2 of a known internal combustion

engine not described or shown in detail for the sake of simplicity. As is known, one longitudinal end 3 of camshaft 2 is fitted with a toothed pulley 4 for a known timing belt (not shown) : as is known, in fact, correct operation of the timing system requires a toothed connection between the drive shaft and camshaft.

[0012] Pulley 4, which is substantially known, has a number of teeth 6 on a radially outer lateral surface 5, and is housed inside a compartment 7 defined by a housing structure 8 integral with the engine and closed by a cover 9.

[0013] Pulley 4 is fitted integrally with a sound wheel 10, which cooperates with a sensor 11 to generate a signal indicating the rotation speed of pulley 4 (and, hence, the camshaft 2 to which pulley is fitted). In the example shown, sound wheel 10 comprises a substantially rigid supporting ring 12 fitted integrally to pulley 4; and a magnetic ring 13 made of magnetized polymer material and fitted integrally to supporting ring 12.

[0014] In the preferred, non-limiting embodiment shown in Figures 1 and 2, supporting ring 12, made for example of shaped sheet metal, has a substantially right-S-shaped radial section, and comprises a cylindrical annular connecting portion 14 for connection to pulley 4 and fitted with radial interference inside a peripheral edge 15 of pulley 4; a cylindrical collar 16 coaxial and concentric with, but offset laterally with respect to, pulley 4 and annular connecting portion 14; and a connecting portion 17 between and perpendicular to annular connecting portion 14 and collar 16. Collar 16 is located radially outwards of annular connecting portion 14 and laterally with respect to peripheral edge 15 of pulley 4.

[0015] Magnetic ring 13 is connected integrally to and evenly covers a radially outer lateral surface 18 of collar 16 : for example, the polymer material from which magnetic ring 13 is made is bonded in known manner at the curing stage to the radially outer lateral surface 18 of collar 16. The polymer material from which magnetic ring 13 is made is also magnetized in known manner so as to generate, as it rotates, a periodic signal detectable by sensor 11.

[0016] Magnetic ring 13 is cylindrical, is located with its central axis 19 coincident with the axis of rotation of pulley 4 (and therefore with the axis of camshaft 2), extends axially beyond an axial end edge 20 of pulley 4, and has a radially outer lateral surface 21 substantially flush with an envelope surface of teeth 6 of pulley 4 (i.e. the tips of teeth 6 are located at the radially outer lateral surface 21 of magnetic ring 13).

[0017] Sensor 11 (known) is housed through a wall of housing structure 8 so as to be positioned radially with respect to magnetic ring 13, and to face, from a small predetermined radial distance, the radially outer lateral surface 21 of magnetic ring 13.

[0018] Pulley 4 and sound wheel 10 therefore define, according to the invention, an integrated assembly 22 which can be preassembled easily and then fitted to the engine.

[0019] In actual use, sound wheel 10 rotates integrally with pulley 4, and therefore with camshaft 2; and the signal generated by magnetic ring 13 is detected by sensor 11 with substantially no interference from pulley 4 and/or the timing belt. The advantages of the solution according to the invention, as compared with conventional sound wheels (toothed metal wheels), are shown in the Figure 3 and 4 graphs, which show the output signals detected by a known system for detecting the rotation speed of a camshaft (Figure 3), and by a system in accordance with the invention (Figure 4). In comparable conditions (same size sound wheel, same type of sensor, etc.), the signal detected by the system according to the invention is obviously more regular, substantially undisturbed, and stronger.

[0020] Clearly, changes may be made to the system as described and illustrated herein without, however, departing from the scope of the present invention as defined in the following Claims.

Claims

1. A system (1) for detecting the rotation speed of an internal combustion engine camshaft (2), comprising a toothed timing pulley (4) fittable to said camshaft (2); a sound wheel (10) carried integrally by said pulley (4); and a speed sensor (11) for detecting a signal generated by the rotation of said sound wheel (10), and fittable to a housing structure (8) fixed with respect to said camshaft (2); the system (1) being characterized in that said sound wheel (10) comprises a substantially rigid supporting ring (12) fitted integrally to said pulley (4); and a magnetic ring (13) made of magnetized polymer material and carried by said supporting ring (12).

2. A system as claimed in Claim 1, characterized in that said magnetic ring (13) is cylindrical and positioned with a central axis (19) parallel to an axis of rotation of said pulley (4); said sensor (11) being positioned radially with respect to said magnetic ring (13) and facing, from a small predetermined radial distance, a radially outer lateral surface (21) of said magnetic ring (13).

3. A system as claimed in Claim 2, characterized in that said magnetic ring (13) projects axially from an axial end edge (20) of said pulley (4); said radially outer lateral surface (21) of said magnetic ring (13) being substantially flush with an envelope surface of the teeth (6) of said pulley (4).

4. A system as claimed in Claim 3, characterized in that said supporting ring (12) comprises a cylindrical collar (16) coaxial and concentric with said pulley (4); said magnetic ring (13) being connected

integrally to a radially outer lateral surface (18) of said collar (16).

5. A system as claimed in Claim 4, characterized in that said supporting ring (12) also comprises an annular connecting portion (14) for connection to said pulley (4) and fitted with radial interference inside a peripheral edge (15) of the pulley (4); and a connecting portion (17) between said annular connecting portion (14) and said collar (16).

6. A system as claimed in Claim 5, characterized in that said supporting ring (12) has a substantially right-S-shaped radial section; said collar (16) being located radially outwards of said annular connecting portion (14) and laterally with respect to said peripheral edge (15) of the pulley (4).

7. A system as claimed in Claim 6, characterized in that said magnetized polymer material is bonded directly, during curing, to said collar (16) of the supporting ring (12) to form said magnetic ring (13).

8. An integrated assembly (22) comprising a toothed timing pulley (4) of an internal combustion engine, and a sound wheel (10); characterized in that said sound wheel comprises a substantially rigid supporting ring (12) fitted integrally to said pulley (4); and a magnetic ring (13) made of magnetized polymer material and carried by said supporting ring (12).

9. An integrated assembly as claimed in Claim 8, characterized in that said magnetic ring (13) is cylindrical, is coaxial and concentric with respect to said pulley (4), and projects axially from an axial end edge (20) of said pulley (4); a radially outer lateral surface (21) of said magnetic ring (13) being substantially flush with an envelope surface of the teeth (6) of said pulley (4).

10. An integrated assembly as claimed in Claim 9, characterized in that said supporting ring (12) comprises a cylindrical collar (16), to a radially outer lateral surface (18) of which is connected said magnetic ring (13); an annular connecting portion (14) for connection to said pulley (4) and fitted with radial interference inside a peripheral edge (15) of the pulley (4); and a connecting portion (17) between said annular connecting portion (14) and said collar (16).

11. An integrated assembly as claimed in Claim 10, characterized in that said supporting ring (12) has a substantially right-S-shaped radial section; said collar (16) being located radially outwards of said annular connecting portion (14) and laterally with respect to said peripheral edge (15) of the pulley (4).

12. An integrated assembly as claimed in Claim 11, characterized in that said magnetized polymer material is bonded directly, during curing, to said collar (16) of said supporting ring (12) to form said magnetic ring (13).

13. Use of a sound wheel (10) comprising a magnetic ring (13) made of magnetized polymer material and connecting means (14) for connection to a timing pulley (4) of an internal combustion engine to form systems for detecting the rotation speed of a camshaft (2) of said engine.

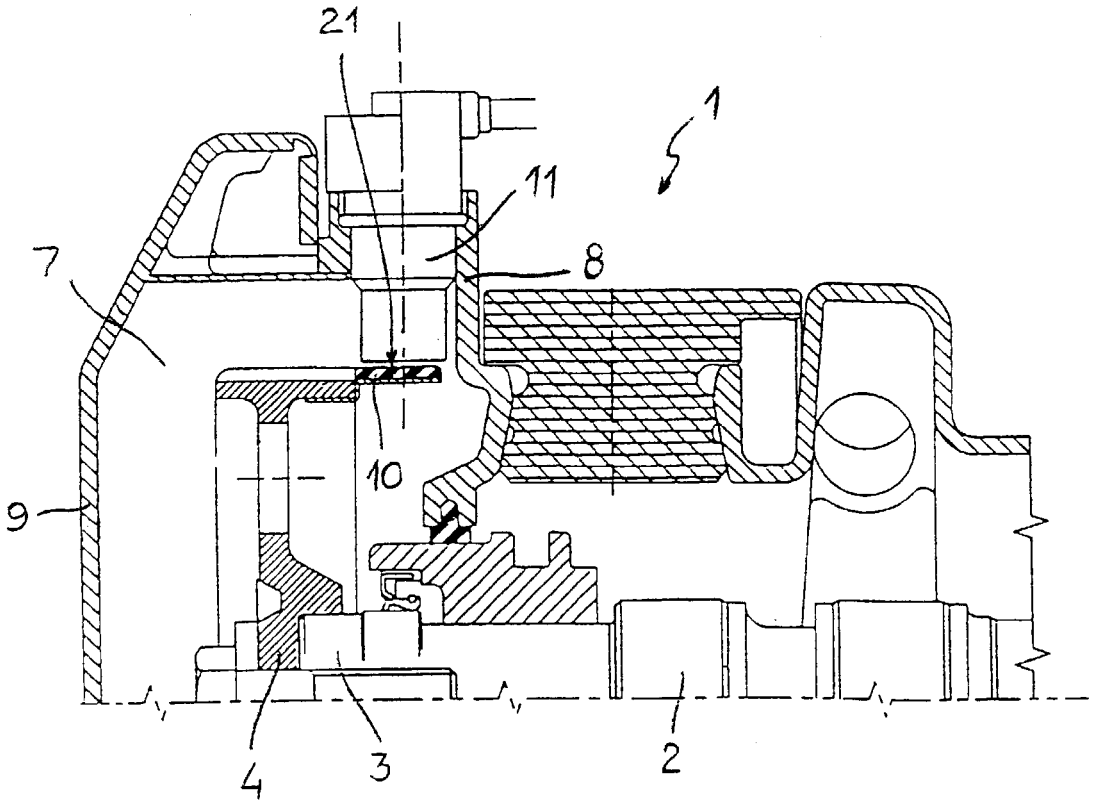

Fig. 1

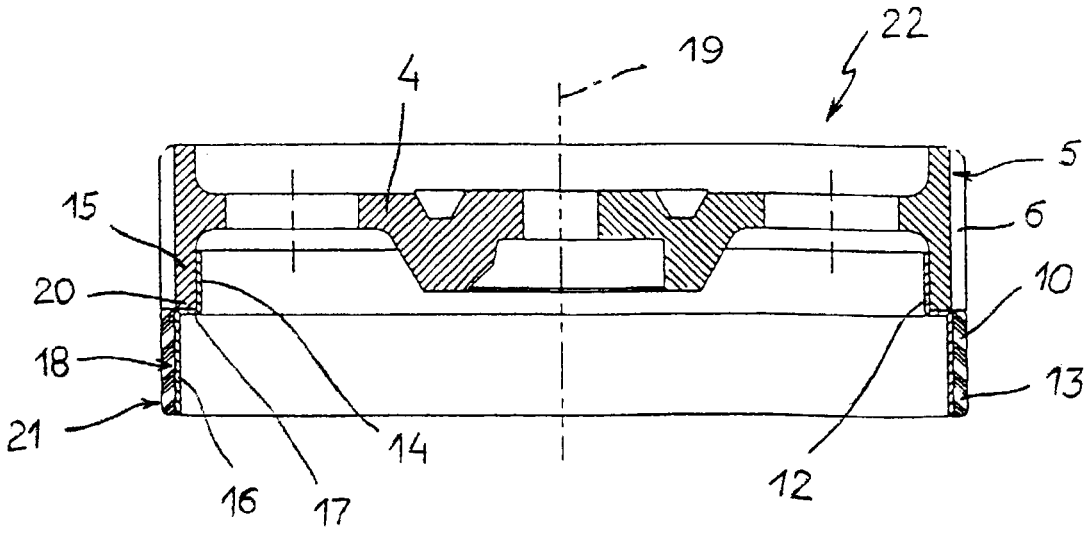

Fig. 2

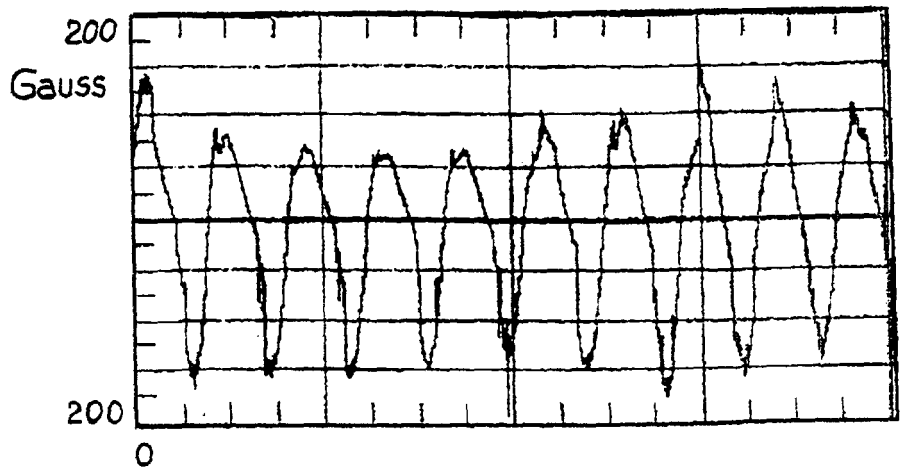

Fig. 3

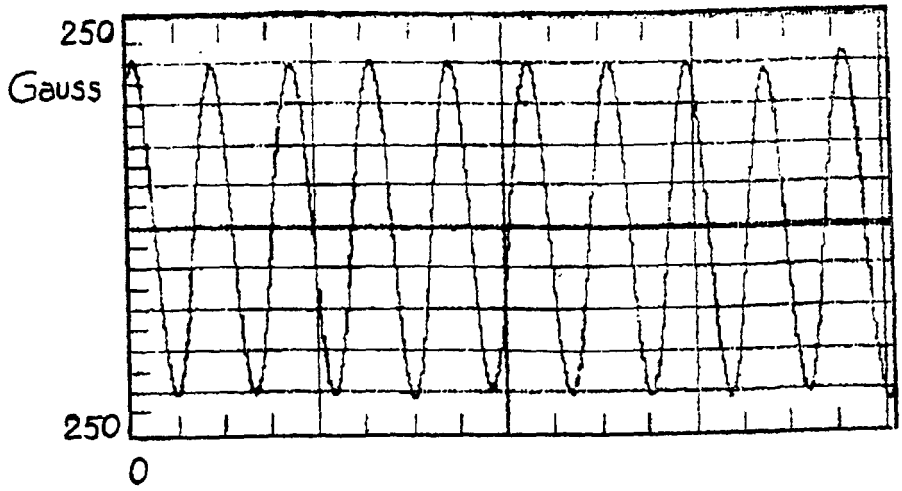

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 00 12 1777

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F01L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 January 2001	Klinger, T

CATEGORY OF CITED DOCUMENTS

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