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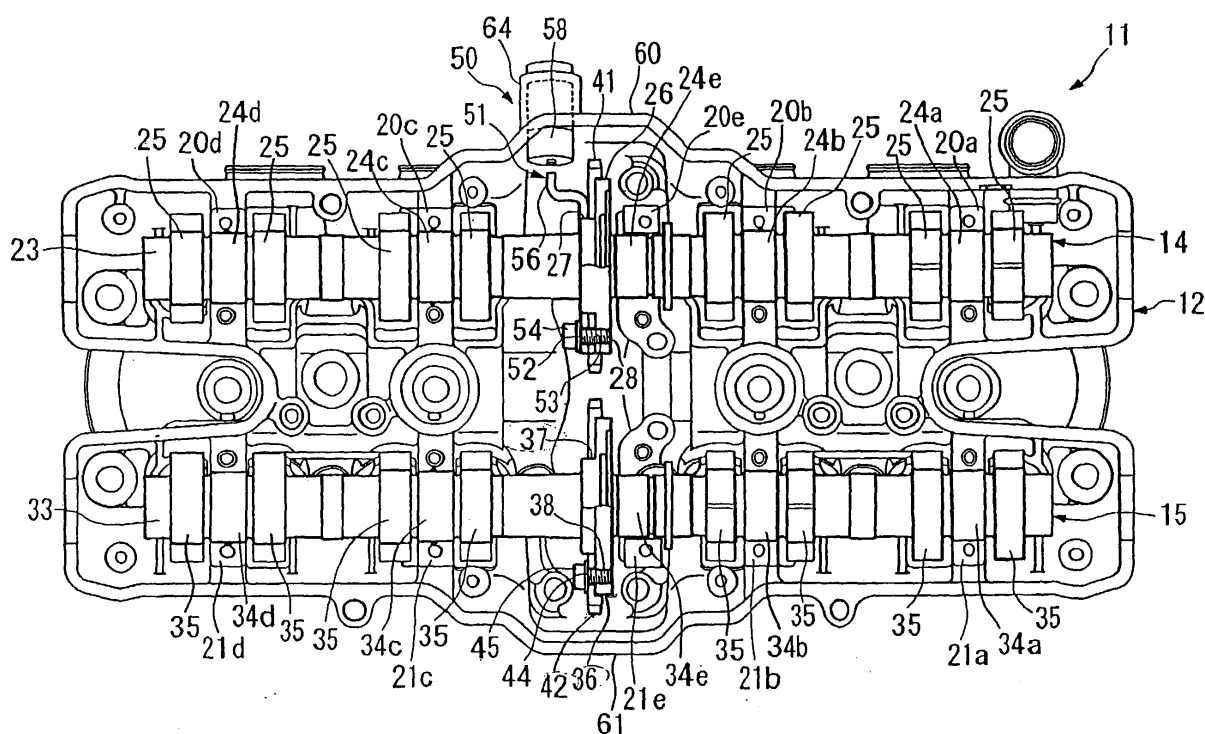
(54) **Engine rotation angle detection device arrangement configuration**

(57) Problem: To provide an arrangement configuration for an engine rotation angle detection device capable of enabling the external appearance of an engine to be superior.

Resolving Means: An engine rotation angle detection device (50) comprising a detection plate (51) fitted

to a cam shaft (14) of an engine (11) and integrally rotating with the cam shaft (14), and a sensor (58) for detecting a detection part (56) provided at the detection plate (51), wherein the detection plate (51) is arranged so as to be positioned between fellow cam parts (25) of a the cam shaft (14).

FIG. 1



Description

[0001] The present invention relates to an arrangement configuration for an engine rotation angle detection device for detecting a rotation angle of a rotating portion of an engine.

[0002] Engine rotation angle detection devices for detecting the angle of rotation of rotating portions of an engine are provided with the purpose of, for example, optimally controlling ignition timing of an engine. With such engine rotation angle detection devices, a detection plate rotating integrally with a cam shaft is fitted to an end in an axial direction of a cam shaft and a sensor for detecting a detection part of the detection plate is arranged on an outer side in a direction orthogonal to that of an axis of the detection plate (refer, for example, to patent document 1).

Patent Document 1:

[0003] Japanese Patent Laid-open Publication No. Hei. 8-68346.

[0004] When a detection plate is fitted at the cam shaft as described above, it is necessary to provide a space for housing the detection plate that protrudes further to the outside in the radial direction than the cam in the engine so that the engine is made to have a shape partially projecting to the outside.

Further, a sensor for detecting a detection part of the detection plate is also fitted so as to project from the engine.

[0005] Therefore, when a configuration is adopted of arranging a detection plate at an end in an axial direction of the cam shaft as described above, a projecting part of an engine formed in order to house the detection plate is formed at an end of the engine and a sensor for detecting a detection part of the detection plate is also fitted so as to project from an end of the engine. When these are provided at an end part of the engine they are extremely noticeable and there are cases where this impairs the external appearance of the engine.

[0006] It is therefore the object of the present invention to provide an arrangement configuration for an engine rotation angle detection device capable of enabling superior external appearance of an engine.

[0007] In order to achieve the aforementioned object, according to the invention as disclosed in claim 1, there is provided a detection plate (for example, a cam pulse plate 51 in this embodiment) fitted to a cam shaft (for example, an intake side cam shaft 14 in this embodiment) of an engine (for example, an engine 11 in this embodiment) and rotating in an integral manner with the cam shaft; and a sensor (for example, a cam pulser pick-up 58 in this embodiment) for detecting a detection part (for example, a detection part 56 in this embodiment) provided on the detection plate, wherein the detection plate is arranged so as to be positioned between fellow cam parts (for example, the cam parts 25 in this embod-

iment) of the cam shaft.

[0008] In this way, because the detection plate is arranged positioned between fellow cam parts of the cam shaft, the projecting part of the engine for housing the detection plate can be formed in a middle part of the engine, and a sensor for detecting the detection part of the detection plate can be arranged so as to project from a central part of the engine. When providing these parts at a central portion of the engine is compared with the case of providing these parts at an end part, the parts are not as striking and the external appearance of the engine is not impaired.

[0009] Regarding the invention as disclosed in claim 2, in the invention as disclosed in claim 1, the detection plate is arranged at a position in such a manner as to divide the plurality of cam parts of the cam shaft into two equal parts.

[0010] In this way, because the detection plate is arranged positioned at a location bisecting the plurality of cam parts of the cam shaft, a projecting part formed in the engine for housing the detection plate can be formed substantially in a middle part of the engine, and a sensor for detecting the detection part of the detection plate can be fitted substantially at the center of the engine. By providing these parts substantially centrally, the engine can be made a symmetrical shape in practical terms so that these parts are less striking.

[0011] In the invention as disclosed in claim 3, with the invention as disclosed in claim 1 and claim 2, the detection plate is arranged next to a sprocket (for example, a sprocket 41 in this embodiment) driving a cam chain (for example, a cam chain 40 in this embodiment).

[0012] By arranging the detection plate next to a sprocket driving a cam chain in this manner, the detection plate can be housed within a projection of the engine formed for housing the sprocket.

[0013] In the invention as disclosed in claim 4, in the invention as disclosed in any one of claims 1 to 3, the detection plate and the sprocket for driving the cam chain are tightened together with respect to the cam shaft.

In this way, because the detection plate is tightened together with the sprocket for driving the cam chain with respect to the cam shaft, the parts, locations and work involved in fitting can be shared.

[0014] Hereinafter, a preferred embodiment of the present invention will be described with reference to the accompanying drawings, in which:

FIG. 1 is a plan view of the essential parts of an engine to which the arrangement configuration for an engine rotation angle detection device of an embodiment of the present invention is applied with the cam cover and cam cap removed.

FIG. 2 is a front cut-away view of the essential parts of an engine to which the arrangement configuration for an engine rotation angle detection device of

the embodiment of the present invention is applied.

FIG. 3 is a side cut-away view of the essential parts of an engine to which the arrangement configuration for an engine rotation angle detection device of the embodiment of the present invention is applied.

FIG. 4 is a front view of a cam pulse plate used in the arrangement configuration for an engine rotation angle detection device of the embodiment of the present invention is applied.

[0015] The following is a description with reference to the drawings of an arrangement configuration for an engine rotation angle detection device of a first embodiment of the present invention.

[0016] The engine 11 to which this embodiment is applied is an in-line four-cylinder DOHC engine with each cylinder having four valves for mounting on a motorcycle and in particular for mounting on so-called "naked" models where there is no cowl covering the engine.

[0017] As shown in FIG. 1 to FIG. 3, an intake side cam shaft (cam shaft) 14 and an exhaust side cam shaft 15 are arranged in parallel with each other so as to be arranged on an axis along the direction of arrangement of the cylinders (from left to right in FIG. 1 and FIG. 2) above the cylinder head 12 at the engine 11. The intake side cam shaft 14 and the exhaust side cam shaft 15 are supported in a rotatable manner by the cylinder head 12 and a cam cap 16 in such a state that movement in the axial direction is limited. A cam cover 17 covering the intake side cam shaft 14 and the exhaust side cam shaft 15 is fitted above the cylinder head 12.

[0018] At the intake side of the cylinder head 12, cam journal bearings 20a to 20e rotatably supporting the intake side cam shaft 14 are provided at a total of five locations, one location for each cylinder, and one location in the vicinity of a central position in the direction of arrangement of the cylinders. Further, at the exhaust side of the cylinder head 12 also, cam journal bearings 21 a to 21 e rotatably supporting the exhaust side cam shaft 14 are provided at a total of five locations, one location for each cylinder, and one location in the vicinity of a central position in the direction of arrangement of the cylinders.

[0019] Of the intake side cam journal bearings 20a to 20d and the exhaust side cam journal bearings 21 a to 21 d provided at each cylinder, the positions of bearings that are for the same cylinder (cam journal bearings 20a and 21 a, cam journal bearings 20b and 21 b, cam journal bearings 20c and 21c, and cam journal bearings 20d and 21d) coincide along the direction of arrangement of the cylinders, and the journal bearings 20e and 21 e in the vicinity of the central position also coincide with a position in the direction of arrangement of the cylinders.

[0020] The intake side cam shaft 14 comprises a shaft section 23, cam journals 24a to 24e formed with larger diameters than the shaft section 23 and formed at posi-

tions matching the cam journal bearings 20a to 20e at the shaft section 23, cam parts 25 formed on both sides in the axial direction at the cam journals 24a to 24d corresponding to the cam journal bearings 20a to 20d for each cylinder, a fitting flange section 26 with a larger diameter than the shaft section 23 and formed next to the cam journal 24e in the vicinity of the center, and an engaging part 27 of a larger diameter than the shaft section 23 and of a smaller diameter than the fitting flange section 26, formed on the opposite side with respect to the cam journal 24e of the fitting flange section 26. A fitting hole 28 is formed parallel to a center axis at the fitting flange section 26.

[0021] The intake side cam shaft 14 is mounted in such a manner that each of the cam journals 24a to 24e corresponds to each of the cam journal bearings 20a to 20e of the cylinder head 12 so as to be rotatably supported by the cam journal bearings 20a to 20e and the cam caps 16 fitted to the cam journal bearings 20a to 20e.

[0022] The exhaust side cam shaft 15 also similarly comprises a shaft section 33, cam journals 34a to 34e formed with larger diameters than the shaft section 33 and formed at positions matching the cam journal bearings 21a to 21e at the shaft section 33, cam parts 35 formed on both sides in the axial direction at the cam journals 34a to 34d corresponding to the cam journal bearings 21 a to 21 d for each cylinder, a fitting flange section 36 with a larger diameter than the shaft section 33 and formed next to the cam journal 34e in the vicinity of the center, and an engaging part 37 of a larger diameter than the shaft section 33 and of a smaller diameter than the fitting flange section 36, formed on the opposite side with respect to the cam journal 34e of the fitting flange section 36. A fitting hole 38 is formed parallel to a center axis also at the fitting flange section 36.

[0023] The exhaust side cam shaft 15 is also mounted in such a manner that each of the cam journals 34a to 34e corresponds to each of the cam journal bearings 21a to 21e of the cylinder head 12 so as to be rotatably supported by the cam journal bearings 21 a to 21 e and the cam caps 16 fitted to the cam journal bearings 20a to 20e.

[0024] A ring-shaped sprocket 41 for driving a cam chain 40 shown in FIG. 3 is fitted at the intake side cam shaft 14 positioned at the center in the axial direction, and a ring-shaped sprocket 42 for driving the cam chain 40 is also fitted at the exhaust side cam shaft 15 positioned at the center in the axial direction, with the cam chain 40 then being hung between these sprockets 41 and 42. Namely, the engine 11 is a center cam chain type engine.

[0025] On the exhaust side, the sprocket 42 makes contact with the fitting flange section 36 with the engaging part 37 of the exhaust side cam shaft 15 in an engaged state on the internal diameter side. The sprocket 42 is then fitted to the fitting flange section 36 of the exhaust side cam shaft 15 using a fitting bolt 45 inserted

through a fitting hole 44 formed in the sprocket 42 so as to screw into a fitting hole 38 of the fitting flange section 36 of the exhaust side cam shaft 15.

[0026] Next, in this embodiment, a spring-shaped cam pulse plate (detection plate) 51 constituting the engine rotation angle detection device 50 is arranged next to the sprocket 41 at the intake side cam shaft 14. As a result, the cam pulse plate 51 is arranged at a position between (fellow) cam parts 25 of the intake side cam shaft 14, and more specifically, is located at a position bisecting the plurality of cam parts 25 for the intake side cam shaft 14, i.e. at a position dividing cam parts 25 provided at eight locations into four locations and four locations.

[0027] Here, the sprocket 41 makes contact with the fitting flange section 26 with the engaging part 27 of the intake side cam shaft 14 in an engaged state at the inner diameter side, and the cam pulse plate 51 also makes contact with the opposite side with respect to the fitting flange 26 of the sprocket 41 with the engaging part 27 in the same engaged state on the internal diameter side. In this way, the sprocket 41 and the cam pulse plate 51 are given the same diameter because of being engaged with the same engaging part 27. The cam pulse plate 51 and the sprocket 41 are then fastened to the fitting flange part 26 of the intake side cam shaft 14 using a common fitting bolt 54 that is inserted through a fitting hole 52 formed in the cam pulse plate 51 and a fitting hole 53 formed in the sprocket 41 and screwed into the fitting hole 28 of the fitting flange 26 of the intake side cam shaft 14. At the position in the vicinity of the sprocket 41, a cam journal is provided not on both sides of the sprocket 41 but rather the cam journal 24e is provided only on one side. In this way, space is ensured for arranging the cam pulse plate 51 on the opposite side to the cam journal 24e of the sprocket 41.

[0028] As shown in FIG. 3 and FIG. 4, at the cam pulse plate 51, the fitting holes 52 through which the fitting bolts 54 for fitting to the fitting flange section 36 are provided at a plurality of locations, specifically, two locations. A positioning hole 55 with which a positioning pin (not shown) engages for positioning of the fitting flange section 36, i.e. the intake side cam shaft 14, in the direction of rotation is also formed. In addition, at the cam pulse plate 51, after curving to one side in the axial direction, the detection part 56 curves towards the outside in a direction orthogonal to the axis, and at a plurality, specifically, three locations, projects to the outside in the direction orthogonal to the axis so as to bend towards the same side as the axial direction. The cam pulse plate 51 is fixed to the intake side cam shaft 14 with the detection parts 56 arranged on a side away from the sprocket 41.

[0029] A cam pulser pick-up (sensor) 58 constituting the engine rotation angle detection device 50 is then fitted at the intake side of the cylinder head 12, i.e. at the side of the intake side cam shaft 14 opposite with respect to the exhaust side cam shaft 15 so as to be or-

thogonal to the axial direction of the intake side cam shaft 14. The cam pulser pick-up 58 detects the rotational position of the intake side cam shaft 14 by detecting the passage of the detection parts 56 of the cam pulse plate 51 and is fitted at a position to the outside in the radial direction of the detection parts 56 of the cam pulse plate 51. Namely, the cam pulser pick-up 58 is fitted at a substantially central position in the direction of arrangement of the cylinders (axial direction of the cam shaft) at the engine 11.

[0030] A projecting part 60 projecting in a direction orthogonal with respect to the direction of arrangement of the cylinders is formed at substantially the center of the cylinder head 12 in the direction of arrangement of the cylinders in order to house the cam pulse plate 51 and the sprocket 41 of large outer diameters. Similarly, a projecting part 61 projecting in a direction orthogonal with respect to the direction of arrangement of the cylinders is formed at the exhaust side in order to house the sprocket 42 of a large outer diameter.

[0031] Further, as shown in FIG. 2 and FIG. 3, a projecting part 62 projecting continually at the intake side, upper side, and exhaust side in a direction orthogonal with respect to the direction of arrangement of the cylinders is formed at substantially the center in the direction of arrangement of the cylinders at the cam cover 17 in order to house the large diameter cam pulse plate 51 and sprockets 41 and 42.

[0032] Further, a pick-up fitting part 64 for fitting the cam pulser pick-up 58 is formed at the cylinder head 12 so as to project from the projecting part 60 on the intake side towards the outside.

[0033] According to the embodiment described above, because the cam pulse plate 51 is arranged at a position between fellow cam parts 25 of the intake side cam shaft 14, a projecting part 60 of the cylinder head 12 and a projecting part 62 for the cam cover 17 formed for housing the cam pulse plate 51 are formed at a central portion in the direction of cylinder arrangement of the engine 11. The cam pulser pick-up 58 for detection of the detection parts 56 of the cam pulse plate 51 and the pick-up fitting part 64 for fitting the cam pulser pick-up 58 can also then be provided so as to project from a central portion occurring in the direction of arrangement of the cylinders of the engine 11. By providing the projecting part 60, projecting part 62, cam pulser pick-up 58 and pick-up fitting part 64 constituting portions projecting from the engine 11 at a central portion of the engine 11, compared with the case of providing these parts at an end part, the degree to which they can be noticed is eliminated and the external appearance of the engine 11 is not impaired. The external appearance of the engine 11 can therefore be made superior. This particularly improves the marketability of motorcycles where the engine 11 is exposed.

[0034] More specifically, because the cam pulse plate 51 is arranged at such a position that bisects the plurality of cam parts 25 of the intake side cam shaft 14, a pro-

jecting part 60 of the cylinder head 12 and a projecting part 62 for the cam cover 17 formed for housing the cam pulse plate 51 can be formed at a substantially central portion in the direction of cylinder arrangement of the engine 11. The cam pulser pick-up 58 for detection of the detection parts 56 of the cam pulse plate 51 and the pick-up fitting part 64 for fitting the cam pulser pick-up 58 can also then be provided so as to project from a substantially central portion occurring in the direction of arrangement of the cylinders of the engine 11. By providing the projecting part 60, projecting part 62, cam pulser pick-up 58 and pick-up fitting part 64 constituting portions projecting from the engine 11 at a substantially central portion of the engine 11, the engine 11 can be formed in a shape that is substantially symmetrical from left to right, to further eliminate the degree to which the projecting portions stand out. The external appearance of the engine 11 can therefore be made dramatically superior. This particularly improves the marketability of motorcycles where the engine 11 is exposed.

[0035] In addition, because the cam pulse plate 51 is arranged next to the sprocket 41 driving the cam chain 40, the cam pulse plate 51 can be housed on the inside of the projecting part 60 of the cylinder head 12 and the projecting part 62 of the cam cover 17 formed for housing the sprocket 41. The external appearance of the engine 11 can therefore be made even more dramatically superior. This particularly further improves the marketability of motorcycles where the engine 11 is exposed.

[0036] Further, the cam pulse plate 51 is fastened together with the sprocket 41 with respect to the intake side cam shaft 14. Parts such as the fitting bolt 54 for fitting, parts such as the fitting hole 28, and work such as the screwing in of the fitting bolt 54 etc. can therefore be shared. Costs can therefore be reduced.

[0037] As described above, according to the invention as pertaining to claim 1, because the detection plate is arranged positioned between fellow cam parts of the cam shaft, the projecting part of the engine for housing the detection plate can be formed in a middle part of the engine, and a sensor for detecting the detection part of the detection plate can be arranged so as to project from a central part of the engine. When providing these parts at a central portion of the engine is compared with the case of providing these parts at an end part, the parts are not as striking and there the external appearance of the engine is not impaired. The external appearance of the engine can therefore be made superior. This particularly improves the marketability of motorcycles where the engine is exposed.

[0038] According to the invention as disclosed in claim 2, because the detection plate is arranged positioned at a location bisecting the plurality of cam parts of the cam shaft, a projecting part formed in the engine for housing the detection plate can be formed substantially in a middle part of the engine, and a sensor for detecting the detection part of the detection plate can be fitted substantially at the center of the engine. By pro-

viding these parts substantially centrally, the engine can be made a symmetrical shape in practical terms so that these parts are less striking. The external appearance of the engine can therefore be made dramatically superior. This particularly improves the marketability of motorcycles where the engine is exposed.

[0039] According to the invention as disclosed in claim 3, by arranging the detection plate next to a sprocket driving a cam chain in this manner, the detection plate can be housed within a projection of the engine formed for housing the sprocket. The external appearance of the engine can therefore be made even more dramatically superior. This particularly further improves the marketability of motorcycles where the engine is exposed.

[0040] According to the invention as disclosed in claim 4, because the detection plate is tightened together with the sprocket for driving the cam chain with respect to the cam shaft, the parts, location, and work involved in fitting can be shared. Costs can therefore be reduced.

[0041] Problem: To provide an arrangement configuration for an engine rotation angle detection device capable of enabling the external appearance of an engine to be superior.

Resolving Means: An engine rotation angle detection device 50 comprising a detection plate 51 fitted to a cam shaft 14 of an engine 11 and integrally rotating with the cam shaft 14, and a sensor 58 for detecting a detection part 56 provided at the detection plate 51, wherein the detection plate 51 is arranged so as to be positioned between fellow cam parts 25 of a the cam shaft 14.

Claims

1. An arrangement configuration for an engine rotation angle detection device comprising: a detection plate (51) fitted to a cam shaft (14) of an engine (11) and rotating in an integral manner with the cam shaft (14); and a sensor (58) for detecting a detection part (56) provided on the detection plate (51), wherein the detection plate (51) is arranged so as to be positioned between cam parts (25) of the cam shaft (14).
2. The arrangement configuration for an engine rotation angle detection device of claim 1, wherein the detection plate (51) is arranged at a position in such a manner as to bisect the plurality of cam parts (25) of the cam shaft (14).
3. The arrangement configuration for an engine rotation angle detection device of claim 1 or 2, wherein the detection plate (51) is arranged next to a sprocket (41) driving a cam chain (40).
4. The arrangement configuration for an engine rota-

tion angle detection device of any one of claims 1 to 3, wherein the detection plate (51) and the sprocket (41) for driving the cam chain (40) are tightened together with respect to the cam shaft (14).

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FIG. 1

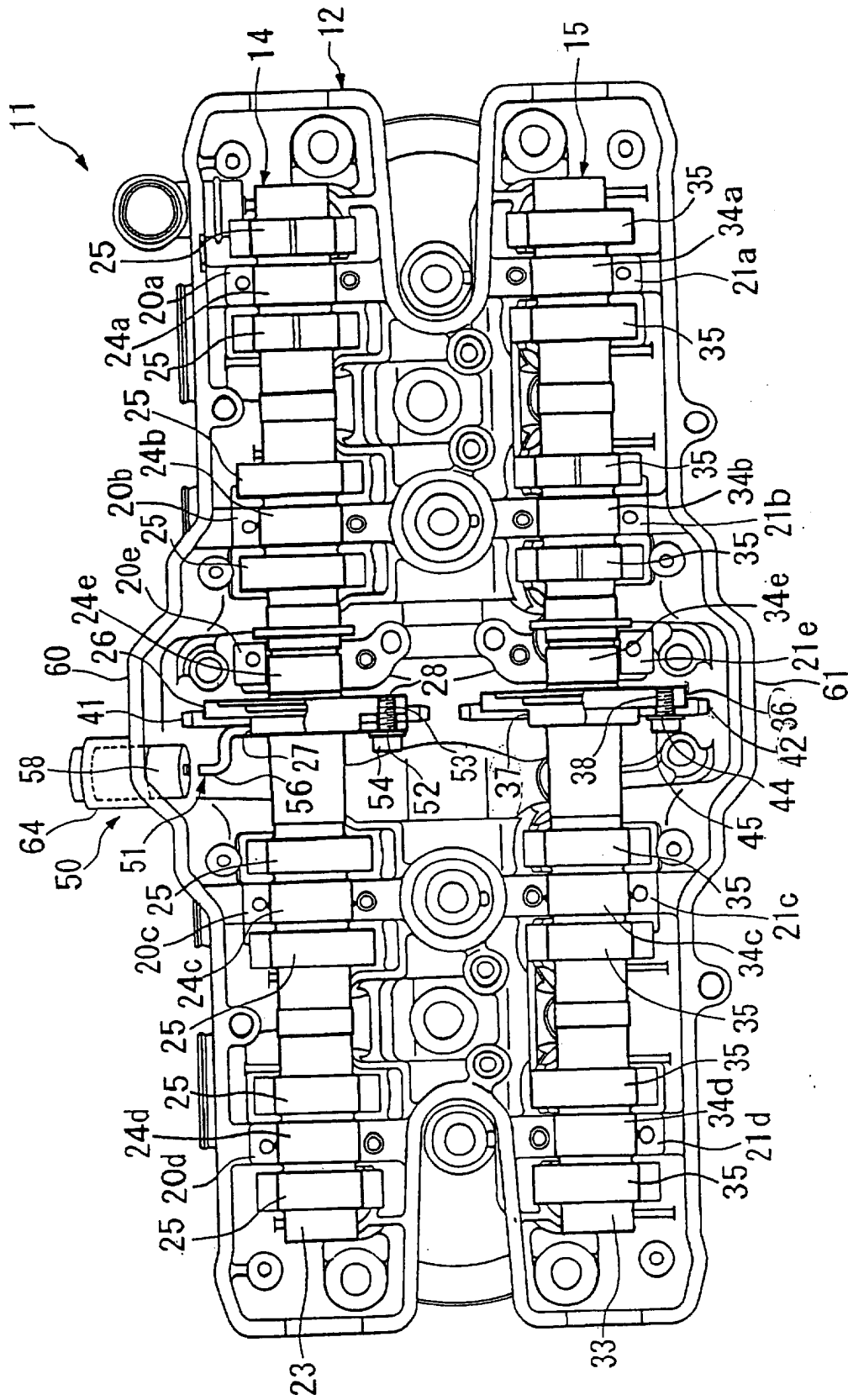


FIG. 2

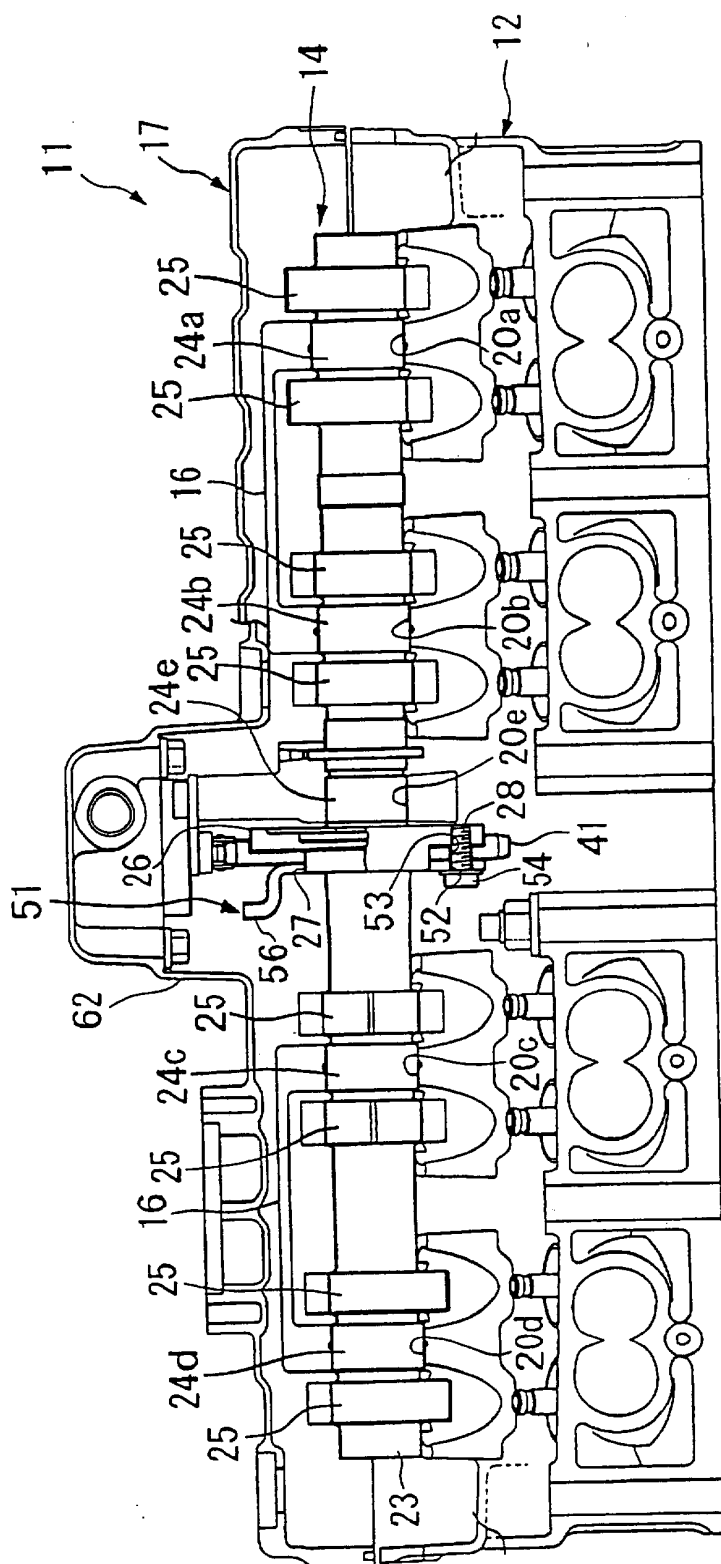


FIG. 3

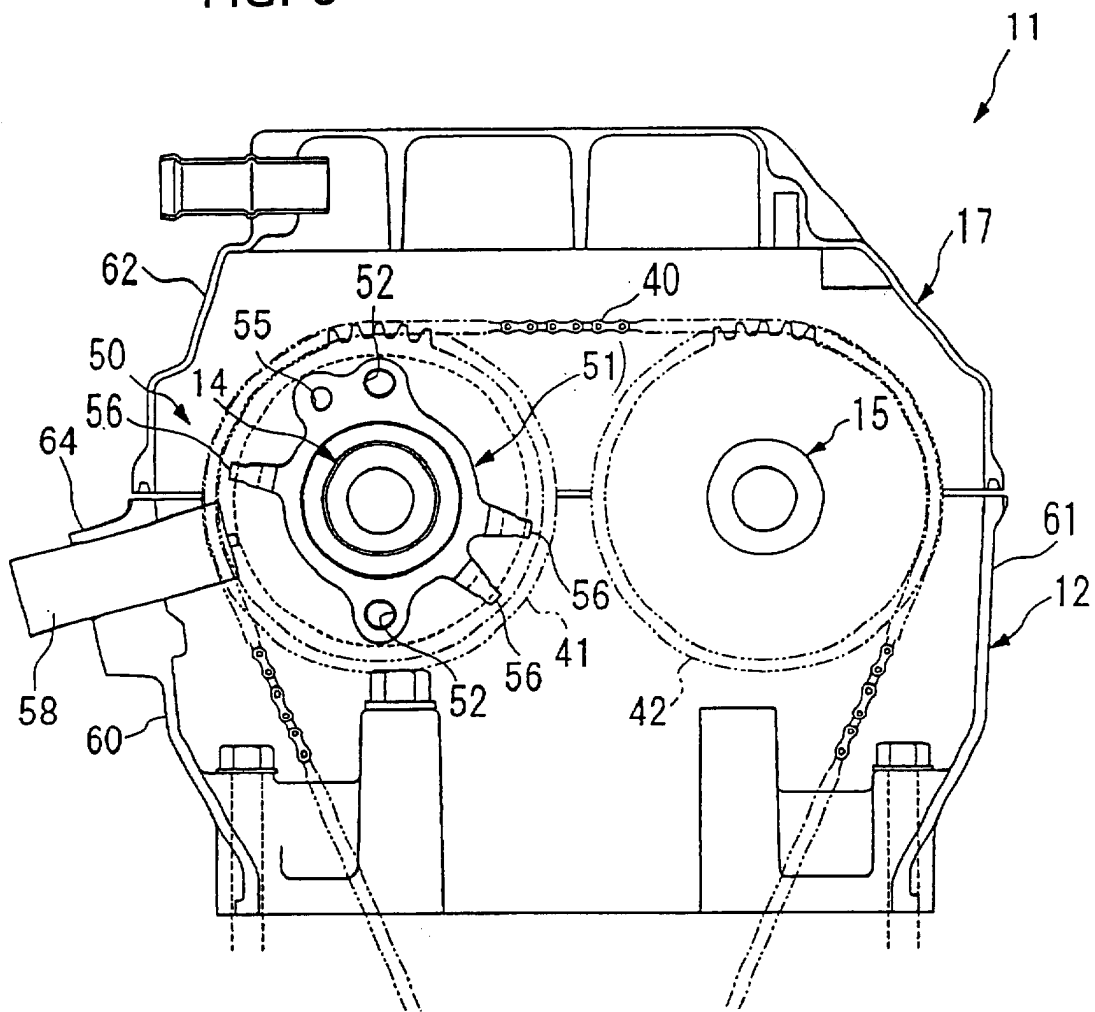
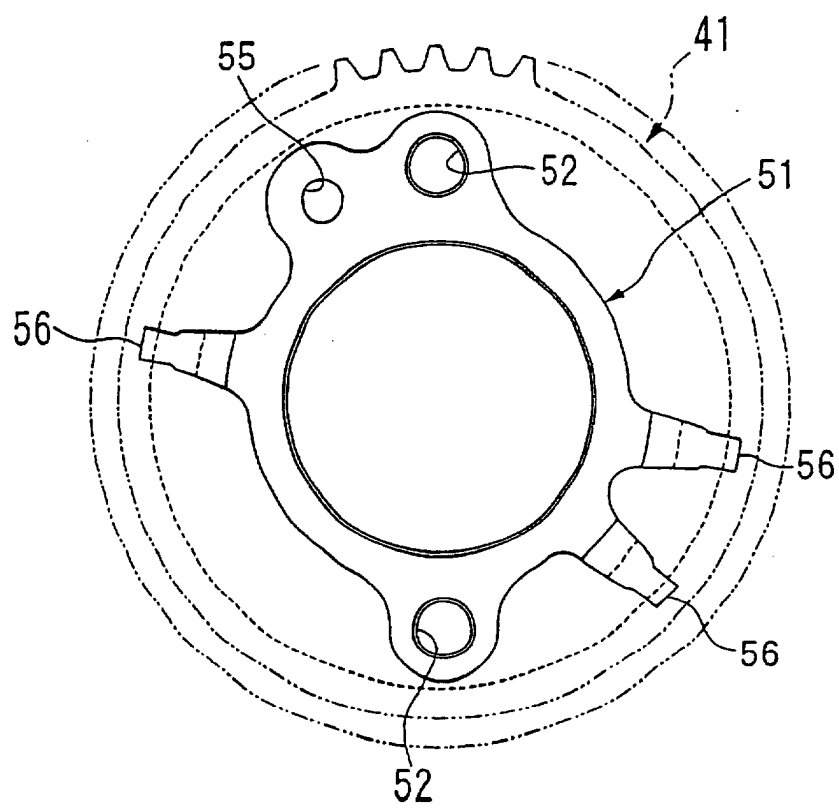


FIG. 4





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 02 0694

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.7)
X	EP 1 079 078 A (TOYOTA MOTOR CO LTD) 28 February 2001 (2001-02-28) * paragraphs [0036]-[0038]; claims 3,6; figure 4 *	1,2	F02P7/067 F02D41/34 F01L1/047
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F02D G01M G10P G01P G01D F02P F01L F16H F16C
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 13 November 2003	Examiner Ulivieri, E
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 03 02 0694

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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13-11-2003

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