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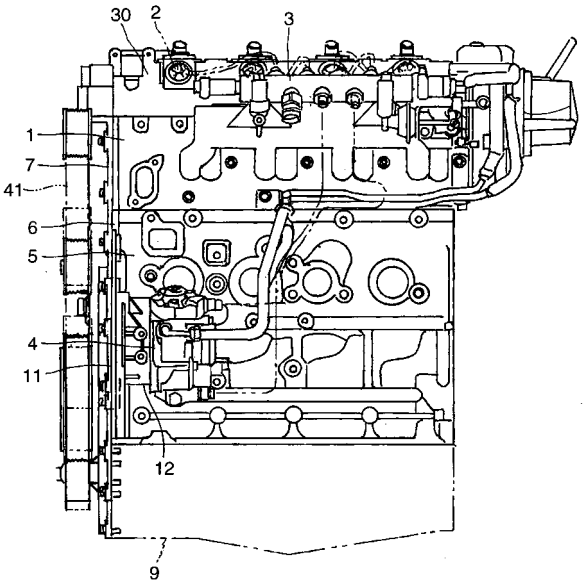
(54) **Attachment structure for engine fuel pump**

(57) A cast rear case (6) is provided on a front of an engine, and defines, with a front cover (7), a housing space for a timing chain mechanism. The rear case (6) includes an extension (11) extending outwardly in a sideways direction of the engine. A pump attachment portion (12) is formed on a surface of the extension (11) at a rear of the engine. A supply pump (4) is fastened to the pump attachment portion (12) by a bolt so that the supply pump (4) is driven by a crankshaft via chains of the timing chain mechanism. This provides secure support of the fuel pump (4) to be driven by a rotational force of the engine as a power source, without use of a dedicated bracket, and without lowering latitude in layout of other devices or accessories attached to a side of the engine.

FIG.1



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Description

[0001] The invention relates to an attachment structure for an engine fuel pump, and more particularly to an attachment structure adapted for a high-pressure fuel pump for use in a relatively large and heavy weight direct-injection engine.

[0002] A high-pressure fuel pump for use in a diesel engine or a direct-injection gasoline engine of directly injecting a fuel into a combustion chamber needs to supply the fuel with a high pressure, which makes the size and the weight of the fuel pump relatively large. The high-pressure fuel pump is generally driven by a timing belt or an equivalent part for transmitting a rotational force of the engine, and is attached to a side of the engine via a dedicated bracket (see Japanese Unexamined Patent Publication No. 11-324698, for instance).

[0003] Various devices or accessories are supportively attached to the side of the engine via brackets or equivalent parts, as well as the fuel pump. This may lower the latitude in layout of the devices or the accessories, which obstructs development of engines.

[0004] In view of the above drawbacks residing in the prior art, an object of the invention is to provide an attachment structure which can securely support a fuel pump to be driven by a rotational force of the engine as a power source, without use of a dedicated bracket, and without lowering latitude in layout of the other devices or accessories to be attached to a side of the engine.

[0005] To achieve the above object, an aspect of the invention is directed to an attachment structure for mounting a fuel pump on a side portion of a front of an engine, the fuel pump being driven by a crankshaft via a power transmitter. The attachment structure comprises: a rear case which is attached to a front end surface of a cylinder block; and a front cover which is attached to a front surface of the rear case, and defines, with the rear case, a housing space for the power transmitter, wherein the rear case includes an extension extending outwardly in a sideways direction of the engine, a pump attachment portion is formed on a surface of the extension at a rear of the engine for attachment of the fuel pump, and the rear case and the front cover are fastened to each other at a position near the pump attachment portion.

[0006] These and other objects, features and advantages of the present invention will become clear upon a reading of the following description of the preferred embodiments thereof, taken in connection with the accompanying drawings, in which:

FIG. 1 is a diagram of an attachment structure in accordance with an embodiment of the invention, viewed from a side of an engine;
FIG. 2 is a diagram of the attachment structure, viewed from above the engine;
FIG. 3 is a diagram of the attachment structure, viewed from a rear of the engine;
FIG. 4 is a diagram of a rear case body of the attachment structure, viewed from the rear of the engine;
FIG. 5 is a diagram of the rear case body of the attachment structure, viewed from the side of the engine;
FIG. 6 is a diagram of a front cover body of the attachment structure, viewed from a front of the engine;
FIG. 7 is a diagram of a timing chain mechanism of the engine, viewed from the front of the engine; and
FIG. 8 is a diagram of a belt mechanism for driving an accessory of the engine, viewed from the front of the engine.

[0007] In the following, a preferred embodiment of the invention is described referring to the drawings.

[0008] FIGS. 1 through 8 are illustrations showing an embodiment of the invention. FIG. 1 is a diagram of an attachment structure for an engine fuel pump embodying the invention, viewed from a side of an engine. FIG. 2 is a diagram of the attachment structure, viewed from above the engine. FIG. 3 is a diagram of the attachment structure, viewed from a rear of the engine. FIG. 4 is a diagram of a rear case body of the attachment structure, viewed from the rear of the engine. FIG. 5 is a diagram of the rear case body of the attachment structure, viewed from the side of the engine. FIG. 6 is a diagram of a front cover body of the attachment structure, viewed from a front of the engine. FIG. 7 is a diagram of a timing chain mechanism of the engine, viewed from the front of the engine. FIG. 8 is a diagram of a belt mechanism for driving an accessory of the engine, viewed from the front of the engine.

[0009] The engine in the embodiment is a common-rail direct-injection diesel engine of supplying a high-pressure fuel fed from a supply pump 4, as a high-pressure fuel pump, to cylinder fuel injectors 2 provided in a cylinder head 1 via a common rail 3. In the following description, an input end of a crankshaft (not shown), i.e., a left side in FIG. 1 is referred to as a "front of the engine", and an output end of the crankshaft, i.e., a right side in FIG. 1 is referred to as a "rear of the engine". The engine is loaded in an automotive vehicle, with a side thereof corresponding to an engine's intake side, i.e., a front side in FIG. 1 being directed in a forward direction of the automotive vehicle, in other words, with an axis of the crankshaft being set horizontally parallel to a vehicle width.

[0010] A cast rear case 6 is attached to a front end surface of a cylinder block 5 of the engine. A cast front cover 7 is attached to a front surface of the rear case 6. The rear case 6 and the front cover 7 define a housing space for a timing chain mechanism, which will be described later.

[0011] The rear case 6 has such a height as to substantially cover from an upper end to a lower end of the cylinder block 5. The front cover 7 has a vertically elongated shape, and has such dimensions as to cover substantially the entire area of front surfaces of the cylinder head 1, the cylinder block 5, and a lower block 8. A lower

end portion of the front cover 7 covers a balancer attachment portion of an oil pan 9.

[0012] As shown in FIGS. 1 through 5, the rear case 6 includes an extension 11 extending outwardly in a sideways direction of the engine corresponding to the engine's intake side. A pump attachment portion 12 is formed on a surface of the extension 11 at the rear of the engine for attachment of the supply pump 4. Specifically, the supply pump 4 is fastened by bolts 14 to a bolt-hole defining area on the pump attachment portion 12 where a pair of bolt holes 13 are formed.

[0013] The rear case 6 has such a shape that the pump attachment portion 12 projects toward the rear of the engine relative to the other portions of the rear case 6. The pump attachment portion 12 has a thickness larger than the thickness of a base portion of the rear case 6, and plural ribs 15 are formed in the vicinity of the pump attachment portion 12 to increase the rigidity of the pump attachment portion 12.

[0014] The rear case 6 and the front cover 7 are fastened to each other by bolts as an assembly, which is fastened to the cylinder block 5 by bolts.

[0015] The supply pump 4 is a dual-plunger type fuel pump provided with a pair of plunger units, which are disposed opposite to each other with substantially 180-degrees angular-displacement with respect to an axis of a rotational shaft of the supply pump 4. The supply pump 4 is chain-driven by the crankshaft via a timing chain mechanism provided on the front of the engine.

[0016] As shown in FIG. 7, the engine in the embodiment is a double overhead cam engine which is provided with a cam shaft for intake and a cam shaft for exhaust on the cylinder head 1. Cam drive sprockets 16 and 17 at front ends of the respective cam shafts, and a main sprocket 18 at a front end of the crankshaft are drivingly interconnected to each other by the timing chain mechanism including upper and lower endless chains 20 and 21 via an intermediate shaft sprocket 19. A balancer drive sprocket 22 is provided on a front end surface of the oil pan 9. The balancer drive sprocket 22 and the main sprocket 18 are interconnected to each other by a balancer chain 23.

[0017] Of the upper and lower chains 20 and 21 of the timing chain mechanism, the lower chain 21 which is directly driven by the crankshaft extends toward the supply pump 4, i.e., outwardly in the sideways direction of the engine corresponding to the intake side so as to drive a pump drive sprocket 24 fixed to the rotational shaft of the supply pump 4 by the crankshaft via the lower chain 21 of the timing chain mechanism.

[0018] The lower chain 21 has larger thickness and strength than the upper chain 20 to secure durability appropriate for a drive load of the supply pump 4.

[0019] Also, as shown in FIG. 8, an accessory driving belt 41 is provided at a front of the front cover 7. An alternate drive pulley 32 for driving an alternator 31, which is disposed at an upper position on a side portion of the engine substantially at the same level as a head cover 30 provided on the engine's intake side; a water pump drive pulley 34 for driving a water pump 33 located below the alternator 31; a compressor drive pulley 36 for driving a compressor for an air-conditioner; and a drive pulley 37 provided at the front end of the crankshaft are drivingly interconnected to each other by the accessory driving belt 41 via idlers 38 and 39, and a tensioner 40.

[0020] As shown in FIG. 7, the rear case 6 includes an adjuster arm attachment portion 44, as a part attachment portion, where a support portion of an adjuster arm 42 (see FIG. 8) of the tensioner 40 is attached. The adjuster arm attachment portion 44 is formed on a surface of the extension 11 at the front of the engine, in other words, at the position opposite to the position where the pump attachment portion 12 is formed. The extension 11 of the rear case 6 has a damper attachment portion 45 (see FIG. 7) where a support portion of a damper 43 is attached. A damper attachment portion 71 (see FIGS. 6 and 8) is formed on the front cover 7 at such a position as to overlap the damper attachment portion 45. As shown in FIG. 8, the adjuster arm 42 of the tensioner 40 is supportively attached to a support-hole defining area on the adjuster arm attachment portion 44 where a support hole 46 (see FIG. 4) is formed through the adjuster arm attachment portion 44, by a bolt (not shown). The damper 43 is securely and supportively attached to a support-hole defining area on the damper attachment portion 45 where a support hole 47 (see FIG. 7) is formed through the overlap portions of the damper attachment portion 45 and the damper attachment portion 71, by a bolt (not shown). The ribs 15 of the rear case 6 extend to rear surfaces of the adjuster arm attachment portion 44 and the damper attachment portion 45 to increase support strength of the fuel pump.

[0021] The fuel pump attachment structure according to the embodiment of the invention is applied to the common-rail diesel engine. Alternatively, the invention may be applied to a fuel pump attachment structure for other diesel engines and direct-injection gasoline engines.

[0022] As described in the foregoing embodiment, an attachment structure mounts a fuel pump, e.g., the supply pump 4 on the side portion of the front of the engine, the fuel pump being driven by the crankshaft via a power transmitter, e.g., the chain 21. The attachment structure comprises: the cast rear case 6 which is attached to the front end surface of the cylinder block 5; and the cast front cover 7 which is attached to the front surface of the rear case 6, and defines, with the rear case 6, the housing space for the power transmitter. The rear case 6 includes the extension 11 extending outwardly in the sideways direction of the engine, the pump attachment portion 12 is formed on the surface of the extension 11 at the rear of the engine for attachment of the fuel pump 4, and the rear case 6 and the front cover 7 are fastened to each other by the bolt at the position near the pump attachment portion 12.

[0023] In the above arrangement, the cast rear case 6 for defining the housing space for the chain 21 as the

power transmitter includes the extension 11 which extends outwardly in the sideways direction of the engine. The extension 11 has the pump attachment portion 12 which is formed on the surface on the extension 11 at the rear of the engine for attachment of the supply pump 4 as the fuel pump. The rear case 6 and the front cover 7 are fastened to each other by the bolt at the position near the pump attachment portion 12. This enables to eliminate a dedicated bracket for use in attachment of the fuel pump, and to mount the fuel pump to the engine without intruding an area for other devices or accessories to be attached to a side of the engine. Thus, the arrangement allows for securely supporting the fuel pump which is driven by a rotational force of the engine as a power source, without lowering latitude in layout of the other devices or accessories to be attached to the side of the engine.

[0024] Preferably, the rear case 6 may have such a shape that the pump attachment portion 12 projects toward the rear of the engine relative to a portion of the rear case other than the pump attachment portion 12, and the pump attachment portion 12 may have a rigidity higher than a rigidity of the other portion.

[0025] The higher rigidity of the pump attachment portion 12 can be secured by increasing the thickness of the pump attachment portion 12 or by forming the ribs 15. Thereby, the support strength of the fuel pump can be effectively increased. Also, projecting the pump attachment portion 12 toward the rear of the engine facilitates increase of the thickness of the pump attachment portion 12 and the formation of the ribs 15, which enable to increase the rigidity of the pump attachment portion 12. Further, the thick pump attachment portion 12 or the ribs 15 can be easily formed by casting.

[0026] Preferably, the rear case 6 may have a part attachment portion on a surface of the extension 11 at the front of the engine, in other words, at the position opposite to the position where the pump attachment portion 12 is formed, for attachment of a part for driving an accessory of an automotive vehicle, e.g., the adjuster arm 42.

[0027] The above arrangement allows for efficient layout of the parts for driving the accessories.

[0028] In the inventive fuel pump attachment structure, particularly preferably, the fuel pump may include the supply pump 4 for pneumatically feeding a fuel to the common rail 3 of the common-rail direct-injection diesel engine of supplying a high-pressure fuel, via the common rail 3, to the cylinder fuel injectors 2 provided in the cylinder head 1, and the power transmitter may include the chain 21.

[0029] The above arrangement allows the inventive fuel pump attachment structure to securely support the relatively large and heavyweight supply pump 4 having a large drive load, thereby securing stabilized fuel supply.

[0030] In the case where the engine is a double overhead cam engine which is provided with a cam shaft for intake and a cam shaft for exhaust on the cylinder head 1, and which is so configured that the cam shafts and the crankshaft are drivingly interconnected to each other by the chain mechanism including the upper and lower chains 20 and 21 via the intermediate shaft, preferably, the supply pump may be driven by the lower chain 21 which is directly driven by the crankshaft, and the lower chain 21 may have a strength larger than a strength of the upper chain 20.

[0031] Making the strength of the lower chain 21 for driving the supply pump 4 larger than the strength of the upper chain 20 enables to secure durability of the lower chain 21 appropriate for the drive load of the supply pump 4, as the high-pressure fuel pump, and to reduce the cost of the upper chain having a smaller drive load.

[0032] This application is based on Japanese Patent Application No. 2005-200226 filed on July 8, 2005, the contents of which are hereby incorporated by reference.

[0033] Although the present invention has been fully described by way of example with reference to the accompanying drawings, it is to be understood that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention hereinafter defined, they should be construed as being included therein.

Claims

1. An attachment structure for mounting a fuel pump (4) on a side portion of a front of an engine, the fuel pump (4) being driven by a crankshaft via a power transmitter, the attachment structure comprising:

   a rear case (6) which is attached to a front end surface of a cylinder block (5); and
   a front cover (7) which is attached to a front surface of the rear case (6), and defines, with the rear case (6), a housing space for the power transmitter, wherein
   the rear case (6) includes an extension (11) extending outwardly in a sideways direction of the engine,
   the extension (11) is formed with a pump attachment portion (12) a surface thereof at a rear of the engine for attachment of the fuel pump (4), and
   the rear case (6) and the front cover (7) are fastened to each other at a position near the pump attachment portion (12).

2. The attachment structure according to claim 1, wherein
   the rear case (6) is made by casting and has such a shape that the pump attachment portion (12) projects toward the rear of the engine relative to a portion of the rear case (6) other than the pump attachment portion (12), and
   the pump attachment portion (12) has a rigidity high-

er than a rigidity of the other portion.

3. The attachment structure according to claim 1 or 2, wherein
the extension (11) is formed with a part attachment portion on a surface thereof at a front of the engine for attachment of a part for driving an accessory of an automotive vehicle.

4. The attachment structure according to any one of claims 1 to 3, wherein
the fuel pump (4) includes a supply pump (4) for pneumatically feeding a fuel to a common rail of a common-rail direct-injection diesel engine of supplying a high-pressure fuel, via the common rail, to cylinder fuel injectors provided in a cylinder head, and
the power transmitter includes a chain.

5. The attachment structure according to claim 4, wherein
the engine is a double overhead cam engine which is provided with a cam shaft for intake and a cam shaft for exhaust on the cylinder head, and which is so configured that the cam shafts and the crankshaft are drivingly interconnected to each other by a chain mechanism including an upper chain (20) and a lower chain (21) via an intermediate shaft,
the supply pump (4) is driven by the lower chain (21) which is directly driven by the crankshaft, and
the lower chain (21) has a strength larger than a strength of the upper chain (20).

FIG.1

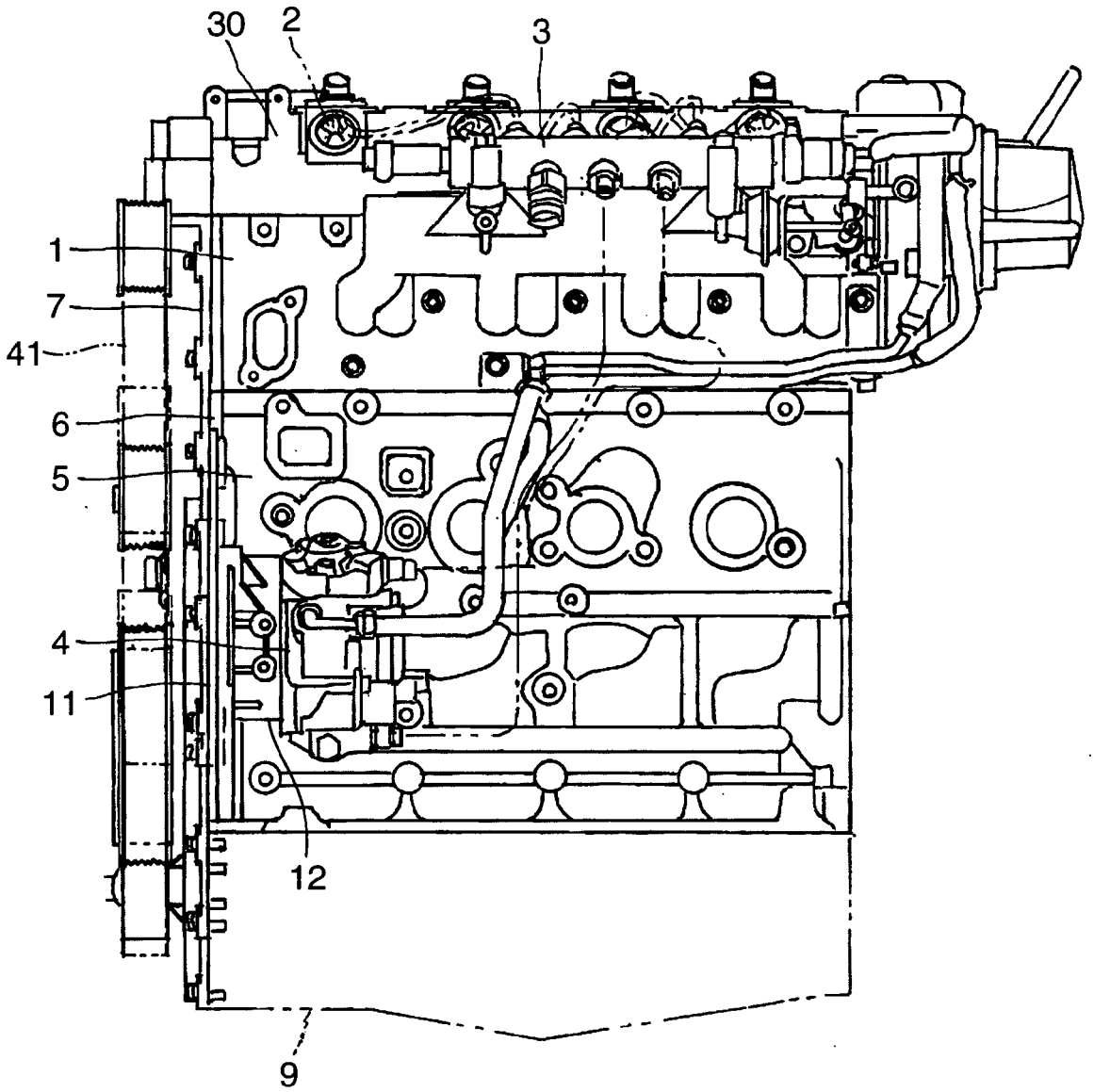


FIG.2

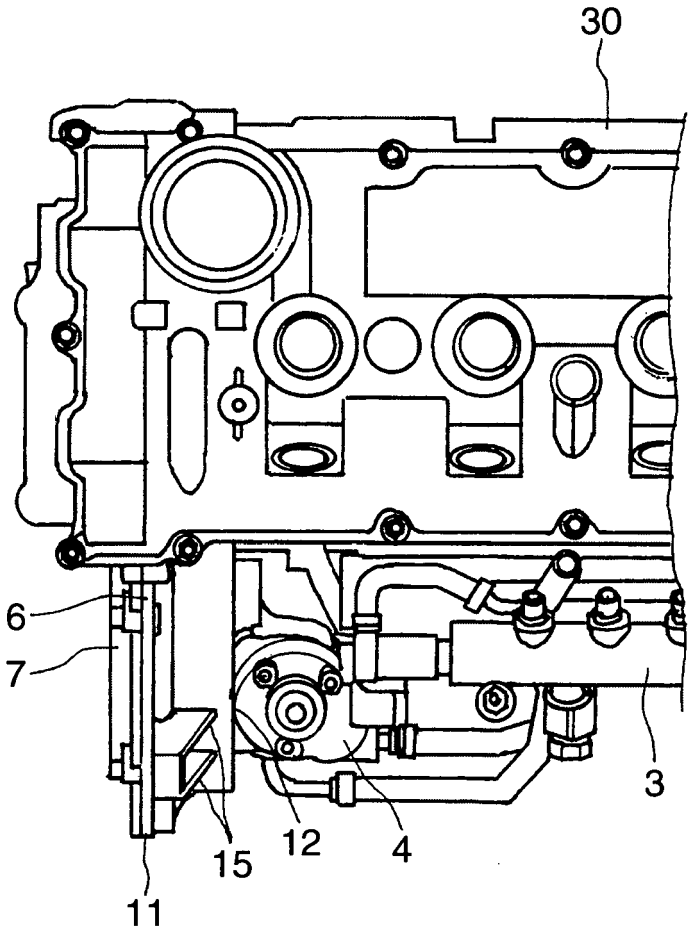


FIG.3

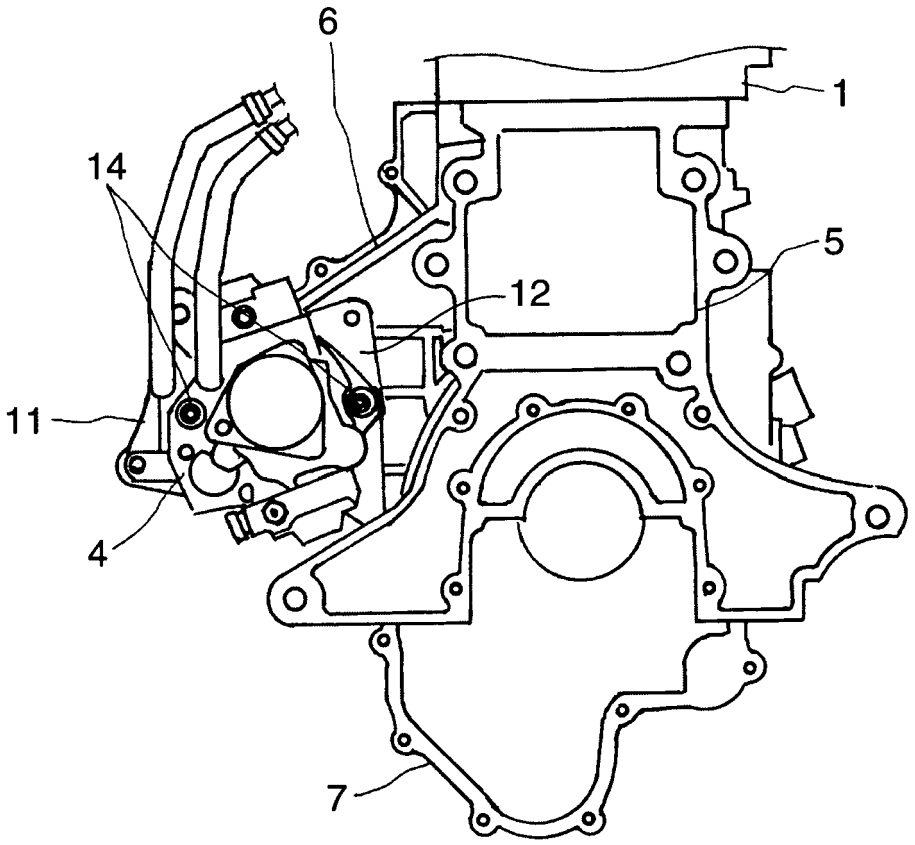


FIG.4

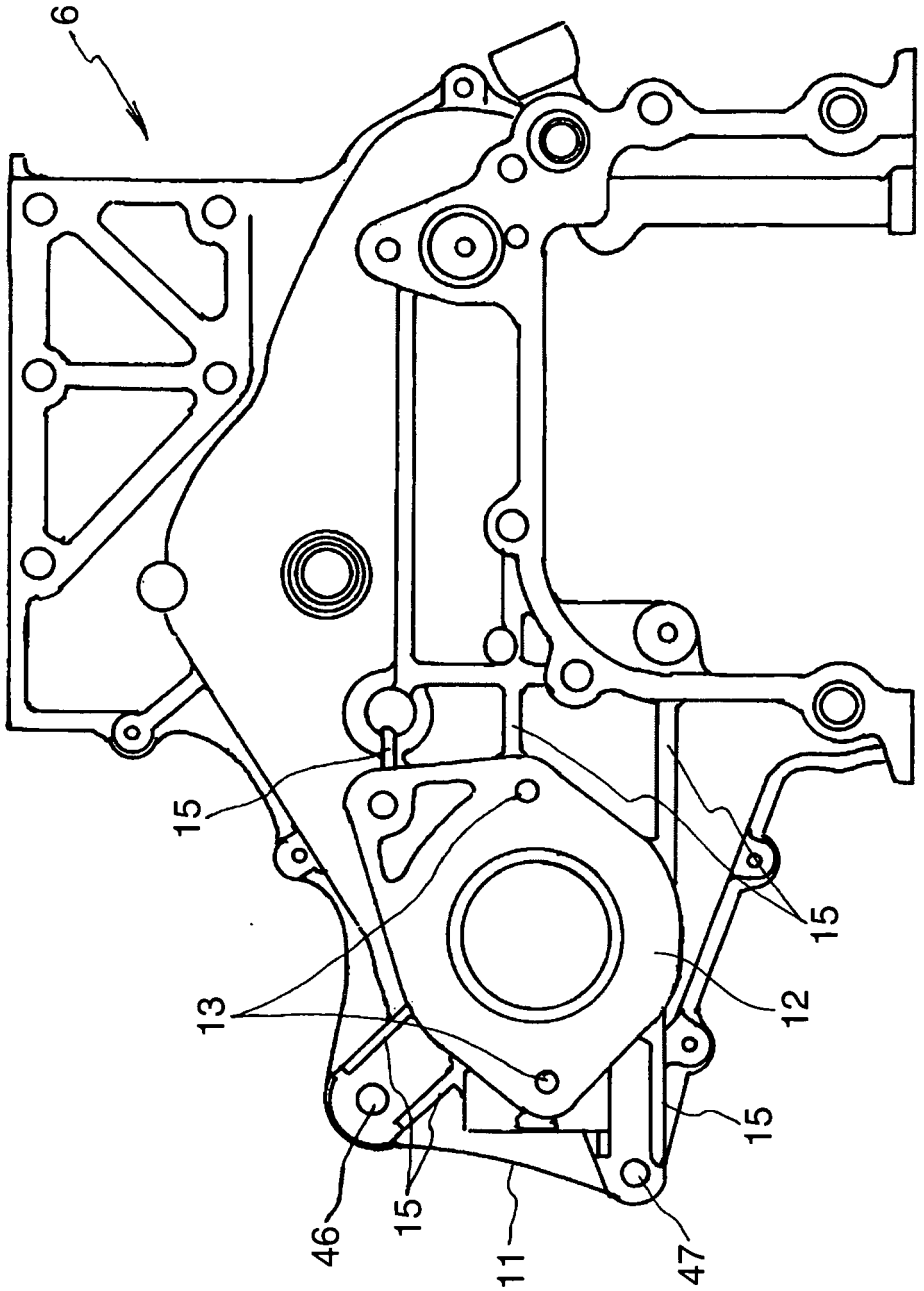


FIG.5

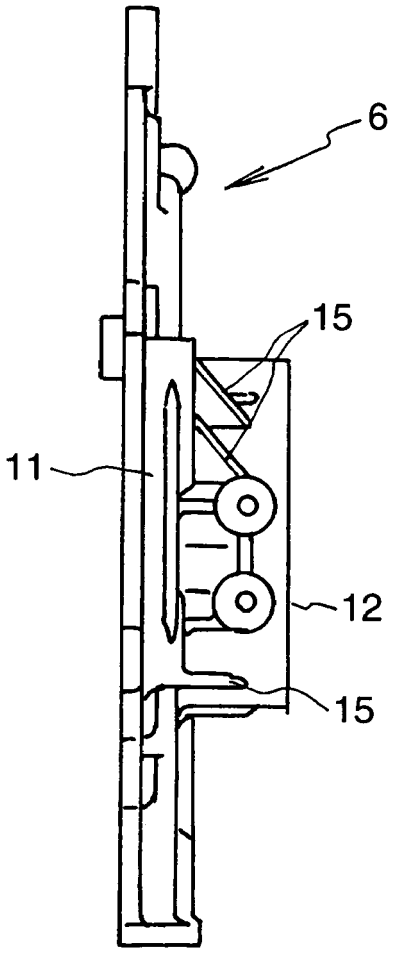


FIG.6

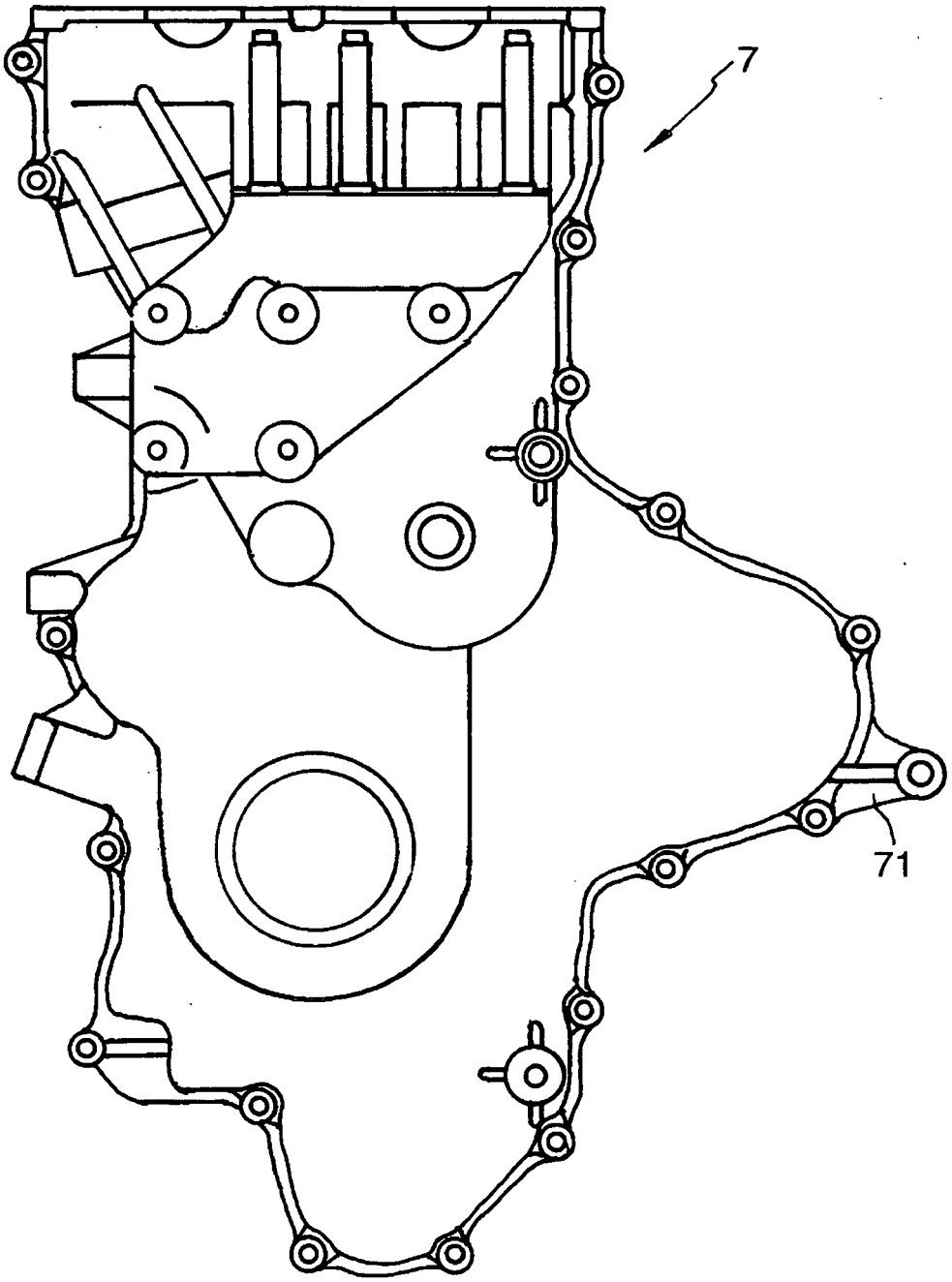


FIG.7

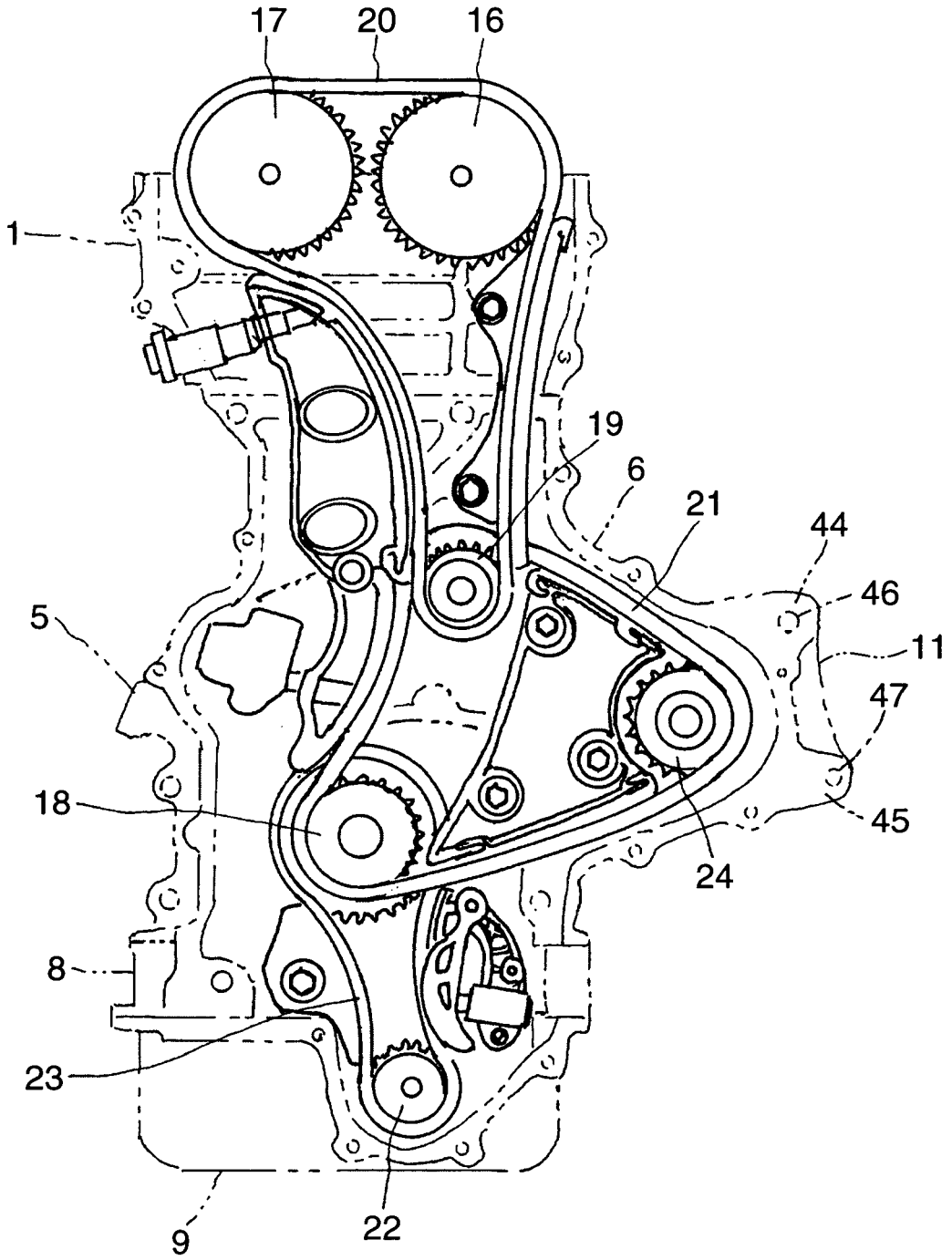
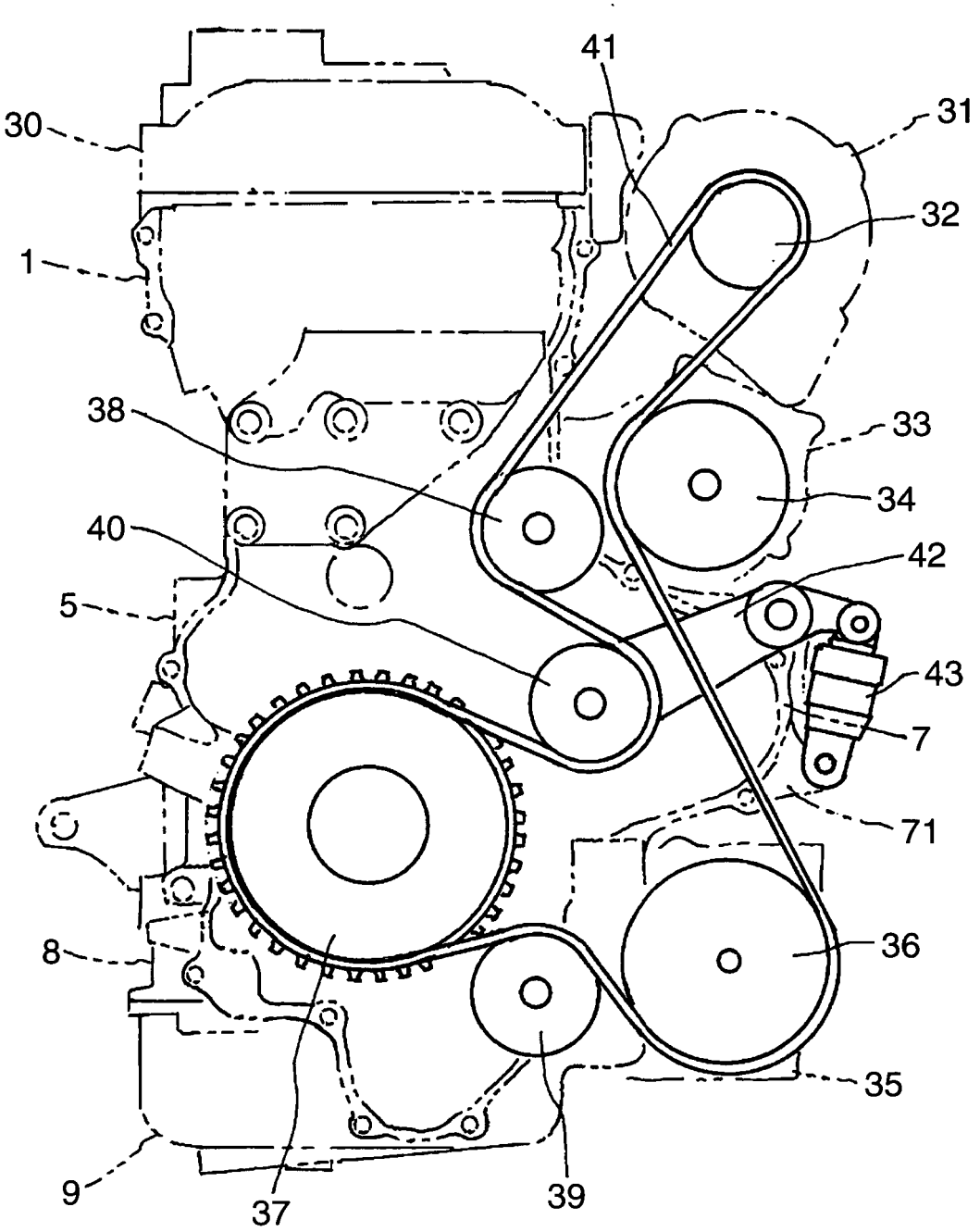


FIG.8



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 11324698 A **[0002]**
- JP 2005200226 A **[0032]**