(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 211 390 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
12.07.2006 Bulletin 2006/28

(51) Int Cl.:
F01M 11/03 *(2006.01)* ***F02B 67/06*** *(2006.01)*

(21) Application number: **01128636.6**

(22) Date of filing: **30.11.2001**

(54) **Unit housing for supporting auxiliary machineries of an engine**

Trägergehäuse für Nebenaggregate für eine Brennkraftmaschine

Carter support pour auxiliaires de moteur à combustion

(84) Designated Contracting States:
DE GB

(30) Priority: **01.12.2000 JP 2000367627**
04.12.2000 JP 2000368758
05.12.2000 JP 2000370679

(43) Date of publication of application:
05.06.2002 Bulletin 2002/23

(73) Proprietor: **HONDA GIKEN KOGYO KABUSHIKI KAISHA**
Minato-ku, Tokyo (JP)

(72) Inventors:
- **Matsui, Kazuhiro**
  Wako-shi,
  Saitama (JP)
- **Yamazaki, Masakazu**
  Wako-shi,
  Saitama (JP)
- **Hujiki, Kenji**
  Wako-shi,
  Saitama (JP)

(74) Representative: **Liska, Horst et al**
Weickmann & Weickmann
Patentanwälte
Postfach 860 820
81635 München (DE)

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Description

[0001] This invention relates to a unit housing to be detachably affixed to the engine body of an engine to support auxiliary machineries such as cooling water pump, oil filter, oil cooler, alternating-current generator, or the like.

[0002] With conventional engines, auxiliary machineries, namely, cooling water pump, oil filter, oil cooler and alternating-current generator are configured to be affixed independently from each other to the engine body of an engine like its cylinder block.

[0003] In this design of conventional engines, attention has to be paid to mount respective auxiliary machineries not to interfere each other. Therefore, there is restriction to the layout of the auxiliary machineries, and these auxiliary machineries projecting outward from the engine body make it very difficult to design the entire engine compactly.

[0004] In addition, that type of conventional engines need pipes for making communication for fluid like cooling water or lubricant oil between those auxiliary machineries and the engine body, or between different auxiliary machineries. This type of configuration not only increases the parts, but also increases the flow path resistance because of the use of a long extension of the entire flow passage due to connection by pipes. Therefore, there is a difficulty in reducing the cost and improving the performance, and the problem that it takes much labor to affix respective auxiliary machineries to the engine body.

[0005] On the other hand, with that type of conventional engines, an automatic tensioner for applying a tensile force to an auxiliary machinery belt for driving various auxiliary machineries is mounted on a cylinder block of an engine. Therefore, the cylinder block has a mount seat formed to project for supporting the automatic tensioner, and the unit housing for supporting auxiliary machineries has to be fabricated to avoid the mount seat. Thus, various restrictions exist regarding its shape, and there only small freedom for its design.

[0006] On the other hand, in the above-discussed prior art, since the oil flowing through the oil path communicating with the oil filter is cooled only on cooling water flowing through the cooling water outlet path communicating with the suction side of the cooling water pump mounted in the engine body, there is room for improvement from the viewpoint of the oil cooling efficiency.

[0007] Furthermore, in the above-discussed prior art, since the cooling water pump provided in the engine body is brought into communication with the oil cooler for the purpose of supplying cooling water to the oil cooler attached o the thermostat case, relatively long exterior piping is required, and reduction of the piping space is insufficient. Taking it into consideration, for the purpose of shortening or removing the exterior piping, if the cooling water pump is also mounted in the thermostat housing like the oil cooler, there arises the problem how the thermostat case, the problem of a compact layout of the oil cooler and cooling water pump newly arises. Moreover, in the prior art under discussion, since the thermostat case and the oil cooler are mounted on flange surfaces different in level, the need of changing the fixed posture of the thermostat housing upon processing of the flange surfaces, for example, increases the time for the processing, and there here again exists room for improvement from the viewpoint of productivity.

[0008] US-A-4 370 957 shows a module including a cooling water pump and an oil filter in accordance with the preamble of claim 1. The oil and the cooling water channels partly extend adjacent to each other, but without disclosing a recess for auxiliary machinery.

[0009] In DE-A-196 35 534, the timing case cover is integrally provided with an oil filter case 6, and mountings for any other auxiliary machinery, for example a cooling water pump, but without disclosing where this cooling water pump should be mounted, and a unit housing is formed for accommodating an oil filter 6 and a water pump. However, the water pump is not labelled. A fixing surface is marked as 3b.

[0010] In EP-A-0 838 577, an oil supply system for an engine is disclosed, with an oil filter casing 12 and a water pump casing as separate members, but no recess for any other auxiliary machinery is shown. The water pump 101 is visible in fig. 2, along with the filter 12 as separate members. A joint surface around the water chamber 102 is a connection to the engine.

[0011] In DE-A-42 11 896, the oil filter is mounted adjacent to the water pump without recess therebetween for any auxiliary machinery. The portion connecting the water pump casing and the oil filter casing is no center portion of the housing, and no recess for mounting auxiliary machinery is shown there.

[0012] Having the purpose of providing a unit housing for supporting auxiliary machineries of an engine, which overcomes those various problems, the main object of the invention is to provide a unit housing for supporting auxiliary machineries of an engine, capable of removing restriction in placement of auxiliary machineries and capable of preventing that auxiliary machineries project from the engine body and disturbs compaction of the entire engine.

[0013] A further object of the invention is to provide a unit housing for supporting auxiliary machineries of an engine, not requiring connection between auxiliary machineries and the engine body, or between auxiliary machineries themselves for passage of fluids like cooling water or lubricant oil, therefore decreasing parts, reducing the flow path resistance, capable of achieving cost reduction and enhancement of performance and capable of removing the labor for affixing individual auxiliary machineries to the engine body.

[0014] A still further object of the invention is to provide a unit housing for supporting auxiliary machineries of an engine, having larger freedom in design thereof and facilitating assemblage of an automatic tensioner in addition to auxiliary machineries.

[0015] It is also an object of the invention to improve the heat exchange efficiency of oil flowing in an oil path in communication with an oil filer with cooling water in a unit housing for supporting auxiliary machineries of an engine, in which the oil filter is provided.

[0016] A yet further object of the invention is to provide a unit housing for supporting auxiliary machineries of an engine capable of compactly arranging a thermostat case, oil cooler and a cooling water pump, and facilitating treatment of mount seats for joint with the thermostat case and the oil cooler, and improved in productivity.

[0017] To attain the main object, according to the invention, there is provided a unit housing for supporting auxiliary machinery to be detachably attached to a body of an engine, wherein said unit housing includes a cooling water pump case and an oil filter case integral with said cooling water pump case, wherein a fixture surface for joint with said engine body is disposed between said cooling water pump case and said oil filter case, and a recess is formed between said oil filter case and said cooling water pump case, and another auxiliary machinery is disposed in said recess, said unit housing defines therein oil paths in communication with an oil filter within said oil filter case, an intake path in communication with a pump chamber inside said cooling water pump case, and a release path in communication with said pump chamber, characterized in that said cooling water pump case and said oil filter case are connected by a center portion of the unit housing having said recess and said fixture surface on opposite sides thereof, wherein said oil paths, said intake path and said release path are located adjacent to each other within said center portion to enable heat exchange between oil and cooling water via said center portion of the unit housing.

[0018] Because of the configuration incorporating the cooling water pump housing and the oil filter case, the cooling water pump and the oil filter need not be mounted separately to the engine body, and this makes assemblage and maintenance of auxiliary machineries easier.

[0019] The fixture surface for joint with the engine body is disposed between the cooling water pump case and the oil filter case. This configuration removes the process of individually attaching the cooling water pump and the oil filter to the engine body, and thereby facilitates assemblage and maintenance of the auxiliary machineries. Additionally, since the fixture surface for joint with the engine body is positioned between the cooling water pump case and the oil filter case, the center of gravity of the unit housing is placed near the fixture surface, and it is ensured that vibrations of the unit housing, vibrating stress and inertial force caused by operation of the engine are uniformly applied to the entire area of the fixture surface. Therefore, the fastening intensity and rigidity of the unit housing enhanced, and this permits reduction of fastening portions.

[0020] Oil flowing in the oil path in communication with the oil filter undergoes heat exchange not only with cooling water flowing in the intake path in communication with the pump chamber of the cooling water pump but also with cooling water flowing in the release path. This means an increase of the amount of exchanged heat with cooling water in the housing. In addition, since the housing also defines the pump chamber of the cooling water pump in addition to the intake path and the release path, cooling water in the pump chamber also contributes to heat exchange with the oil through the housing. Temperature of the cooling water cooled by a radiator and flowing in the release path is substantially equal to the temperature of the cooling water in the intake path, unlike the prior art in which cooling water is inevitably heated when passing the engine body upon suction and discharge of the cooling water pump. That is, since the oil flowing in the oil path in communication with the oil filter undergoes heat exchange with both the cooling water flowing in the intake path and the cooling water flowing in the release path, both in communication with the pump chamber of the cooling water pump, the heat exchange efficiency between oil and cooling water is improved. Moreover, since the housing defines the pump chamber of the cooling water pump as well, and the cooling water in the pump chamber also contributes to heat exchange with oil, the heat exchange efficiency between oil and cooling water in the housing is further improved. Then, temperature of the cooling water in the release path remains cool substantially as the cooling water in the intake path, and the cooling efficiency in the housing is improved.

[0021] An auxiliary machinery other than a cooling water pump and an oil filter may be disposed between the cooling water pump case and the oil filter case.

[0022] The oil filter case may be cylindrical, and may have at least one mount portion for attaching the other auxiliary machinery. With this arrangement, other auxiliary machineries can be supported on the cylindrical oil filter having high intensity and rigidity, without the use of a mount bracket, for example. Therefore, it is possible to firmly support other machineries, decrease parts of the assembly, and reduce the weight and the cost.

[0023] The oil filter case may be formed to project. In the recess, ribs may be formed to connect the oil filter case and the cooling water pump case. In this configuration, the ribs formed in the recess integrally connect the oil filter case and the cooling water pump housing, thereby ensure sufficient support rigidity of auxiliary machineries and enable compact design of the system.

[0024] An oil cooler may be provided, and at least one of a plurality of bolt holes formed in the fixture surface for joint with the engine body may open at a surface of the unit housing nearer to the oil cooler.

[0025] This configuration makes it possible for a bolt inserted in the bolt hole located nearer to the oil cooler to bear the center of gravity of the oil cooler and the inertial force, and the fastening intensity and rigidity of the unit housing can be increased.

[0026] The fixture surface for joint with the engine body may have openings for inflow and outflow of cooling water and oil to and from the engine body, the housing may include fastening portions disposed along the circumference of the fixture surface; and ribs connecting the fixture surface and the fastening portions. In this configuration, since the fastening force can be applied uniformly to the seal portions around the openings for inflow and outflow of cooling water and oil to and from the engine body, the sealing efficiency of the seal portions can be improved significantly.

[0027] An oil cooler may be mounted between the cooling water pump case and the oil filter case, and a fitting surface for delivery of oil and cooling water to and from the engine body may be provided between the cooling water pump case and the oil filter case. With this configuration, passage of cooling water and oil can be shortened, and the load to the cooling water pump and the oil pump can be reduced. This contributes to smooth circulation of cooling water and oil and enhanced performance of the auxiliary machineries.

[0028] An automatic tensioner may be attached to the unit housing. In this configuration, a mount seat for the automatic tensioner need not be formed to project from the engine body, and the unit housing can be designed more freely. Since the automatic tensioner is incorporated as a unit together with other auxiliary machineries mounted to the unit housing, their assemblage is easy.

[0029] The automatic tensioner is preferably attached to a mount seat formed between a fixture surface of the unit housing for joint with the engine body and another auxiliary machinery to be provided in the unit housing. Thus the automatic tensioner can be affixed by making the use of a space between the engine body and the other auxiliary machinery, efficient use of the space and compact design are possible. Additionally, the mount seat of the automatic tensioner contributes to enhancing the rigidity of that portion, rigidity of the other auxiliary machinery or mounting rigidity.

[0030] The automatic tensioner is preferably attached between the oil filter case and a fixture surface of the unit housing for joint with the engine body.

[0031] The oil paths may be located between the intake path and the release path. In this case, since the oil flowing in the oil path is subjected to heat exchange with the cooling water in the intake path and the release path from opposite sides of the oil paths, the heat exchange efficiency is improved further. Furthermore, since the oil paths are formed by making the use of the space formed between the intake path and the release path, the housing can be designed compactly.

[0032] A water-type oil cooler may be attached to the housing to permit oil to flow in after passing the oil filter, and the oil cooler may be so configured that oil is cooled by heat exchange with cooling water supplied from the release path and returning back to the intake path, and positioned nearer to the rotation axis of the cooling water pump than the oil filter.

[0033] With this configuration, the passage of cooling water formed between the release path and the intake path of he cooling water pump to cool oil can be shortened, and the flow path resistance can be reduced. Therefore, a large quantity of cooling water can be supplied to the oil cooler without increasing the size of the cooling water pump, and the heat exchange efficiency in the oil cooler can be improved.

[0034] The housing preferably has formed a first mount seat for mounting a cooling water oil cooler supplied with cooling water released from a cooling water pump including the cooling water pump case, and a second mount seat for mounting a thermostat case, and the housing preferably has formed on one side surface thereof a third mount seat for mounting a pump body composing the cooling water pump. The first mount seat and the second mount seat are preferably formed on the other surface thereof opposite from the third mount seat, and the first mount seat and the second mount seat (22) preferably lie on a common plane.

[0035] With this configuration, since the cooling water pump having the largest size among the thermostat case, oil cooler and cooling water pump is located on one side surface of the housing whereas the oil cooler is located on the other side surface of the housing, their compact layout is attained. Further, since the oil cooler and the thermostat case are attached in joint with the first mount seat and the second mount seat that are on a common plane of the other side surface, both can be positioned compactly. Moreover, since the first mount seat and the second mount seat are processed to lie on a common plane, the housing need not be changed in posture upon the processing, so the processing is easy. As a result, the following effects are obtained. That is, since the cooling water pump and the oil cooler are disposed on one surface and the other surface of the housing, a compact layout is attained. In addition, since the oil cooler and he thermostat case are attached in joint with the first mount seat and he second mount seat that lie on a common plane of the other side surface, both can be positioned compactly. Furthermore, since the first mount seat and the second mount seat lie on a common plane, their processing is easy, and the productivity of the housing is improved.

[0036] A reinforcing rib (R15) preferably connects the first mount seat and the second mount seat. Connection by the reinforcing rib enhances the rigidity of the first mounting seat for mounting the oil cooler and the second mount seat for mounting the thermostat case. As a result, the oil cooler, relatively heavy, can be affixed firmly.

[0037] The second mount seat may have a plurality of fastening portions for fastening the thermostat case to the second mount seat, and the reinforcing rib may connect one of the fastening portions nearest to the first mount seat to a portion of the first mount seat nearer to the second mount seat. In this case, the reinforcing rib enhances the rigidity of the fastening portions of the second mount seat for mounting he thermostat case, and therefore permits the thermostat case to be firmly fixed with a large fastening force. Moreover, since he reinforcing rib is short, it does not invite an increase of the weight of the third bracket, and hence the weight of the engine.

[0038] More detailed features of the invention, summarized above, will be more apparent from the detailed description given below with reference to the drawings, in which:

Fig. 1 is a right side-elevational view of an engine having a bracket as a housing to be mounted to the engine, in which an oil filter is provided;
Fig. 2 is a front elevational view of the engine shown in Fig. 1;
Fig. 3 is an exploded perspective view of parts decomposed from the bracket of Fig. 1;
Fig. 4 is a schematic, perspective phantom view of the bracket, particularly illustrating cooling water paths and oil paths formed in the bracket of Fig. 3;
Fig. 5 is a front elevational view of the bracket of Fig. 3;
Fig. 6 is a back elevational view of the bracket of Fig. 3;
Fig. 7 is a right side-elevational view of the bracket of Fig. 3;
Fig. 8 is a left side-elevational view of the bracket of Fig. 3;
Fig. 9 is a cross-sectional view taken along the IX-IX line of Fig. 5;
Fig. 10 is a cross-sectional view taken along the X-X line of Fig. 5;
Fig. 11 is a cross-sectional view taken along the XI-XI line of Fig. 6;
Fig. 12 is a cross-sectional view taken along the XII-XII line of Fig. 6;
Fig. 13 is a cross-sectional view taken along the XIII-XIII line of Fig. 8;
Fig. 14 is a fragmentary, exploded, perspective view of an oil cooler with related parts involved, decomposed from the bracket of Fig. 3; and
Fig. 15 is a back-elevational view similar to Fig. 6, which illustrates a modification of the bracket shown in Fig. 6.

[0039] In an embodiment of the invention shown in Figs. 1 through 14, an engine E is an overhead-camshaft, water-cooled, serial four-cylinder, four-cycle engine to be mounted in a car. In the explanation made below, "front, back, left and right" directions or portions pertain to "front, back, left and right" directions or portions with respect to a car to mount the engine in unless specified otherwise.

[0040] In Fig. 1 illustrating the right side surface of the engine and Fig. 2 illustrating its front surface, at the upper end of a cylinder block 1, a cylinder head 2 and a head cover 3 are sequentially stacked and joined together. At the lower end of the cylinder block 1, a lower block 4 is joined, and an oil pan 5 is united to the lower end of the lower block 4. A crankshaft 6 having a rotating axis on a plane containing the fitting plane between the cylinder block 1 and the lower block 4 is rotatably supported on the cylinder block 1 via a main bearing.

[0041] The engine body of the engine E is made up of the cylinder block 1, cylinder head 2, head cover 3, lower block 4 and oil pan 5, and a lower part of the cylinder block 1, lower lock 4 and oil pan 5 form a crank chamber 17 (see Fig. 9). On the right end (the surface shown in Fig. 1), a timing chain is placed to wrap the crank shaft 6 and a cam shaft for opening and closing an intake valve and an exhaust valve formed in the cylinder head 2 synchronously with rotation of the crankshaft 6, and a chain cover 7 is fastened to the right end of the cylinder block 1 to define a chain chamber together with the right end for accommodating the timing chain therein.

[0042] The cylinder block 1 has formed four cylinders 8 (see Fig. 9) each having a center axis extending slightly aslant backward from the crankshaft 6 extending in the right and left direction of a car. A piston (not shown) slidably fits in a bore 8a of each cylinder 8, and reciprocal motion of the piston is converted to rotation of the crankshaft 6 via a connecting rod.

[0043] As shown in Fig. 2, in front of the cylinder block 1, an intake unit 9 made up of an intake manifold and others is located, and on the back surface of the cylinder block 1, an exhaust unit 10 made up of an exhaust manifold and others is located. In a right area, which is one side of the intake unit 9, a plurality of brackets for auxiliary machineries are located to be fastened by bolts to the cylinder head 2, cylinder block 1 and lower block 4. That is, a first bracket 11 is fastened by bolts to a right portion of the front face of the cylinder head 2; a hydraulic pump 14 for generating hydraulic pressure for hydraulic power steering is attached to the first bracket 11; a second bracket 12 is fastened with bolts to a right, lower portion of the front face of the cylinder block 1 and a right region of the front face of the lower block 4; and an air-conditioning compressor 15 is attached to the second bracket 12. Further, in a right, central region of the front face of the cylinder block 1 located between the first and second brackets 11, 12, a third bracket 13 made of a metal, such as die-cast aluminum alloy, as a housing to be attached to the engine body is fastened with bolts, and an alternating-current generator G and a pump body 31 of a cooling water pump P (see Fig. 3) are affixed.

[0044] Then, as shown in Fig. 1, a driving pulley 6a is coupled to the right axial end of the crankshaft 6 extending to the right through the chain cover 7, and an endless belt 16 adjusted in tensile force by a tensioner A is wound on that driving pulley 6a, hydraulic pump pulley 14a of the hydraulic pump 14, generator pulley G3 of the alternating-current generator G, compressors pulley 15a of the compressor 15 of an air conditioning refrigerator and cooling water pump pulley P1 of the cooling water pump P. Therefore, these auxiliary machineries are driven to rotate with the driving power of the crankshaft 6 transmitted from the driving pulley 6a via the endless belt 16.

[0045] Referring to Figs. 3 through 8, in particular Fig. 3, the third bracket 13 includes three support arms 20a, 20b, 20c formed to mount the alternating-current generator G disposed in a vertically central position of the front surface of the third bracket 13; a first mount seat 21 located in a vertically central position of the left side surface of the third bracket 13 to mount a cylindrical water-type oil cooler C on; a second mount seat 22 located below the first mount seat 21 of the left side surface of the third bracket 13; a third mount seat 23 located over an area from a lower portion to a central portion of the right side surface of the third bracket 13 to mount the pump body 31 of the cooling water pump P on; a pump case half 30 for the cooling water pump P defining a pump chamber 32 including the third mount seat 23 and opening at the third mount seat 23; and a fourth mount seat 24 located above the third bracket 13 to mount the tensioner A on; a cylindrical filter case 40 for an oil filter F, located in front of the fourth mount seat 24 in an upper part of the third bracket 13 and extending aslant forwardly and upwardly; and a fixture portion 25 located at a vertically central position of the back surface of the third bracket 13 to be joined with a fitting surface 26a of a main mount seat 26 (see Fig. 7) formed on the cylinder block 1.

[0046] Further referring to Figs. 4 through 6, in particular Fig. 6, the third bracket 13 further includes six fastening portions K1 through K6 in form of boss portions having through holes H1 through H6 extending through the third bracket 13 in the front-to-back direction so that the third bracket 13 is fastened to the cylinder block 1 with bolts inserted in the through holes H1 through H6, respectively (among them, a bolt B1 inserted in the through hole H1 is illustrated in Fig. 1). More specifically, on the back surface of the third bracket 13 best shown in Fig. 6, the fastening portions K1 through K6 include the first and second fastening portions K1, K2 between an upper portion and a central portion of the third bracket 13, that is, the first fastening portion K1 located in a left part of the third bracket adjacent to the first mount seat 21 between the filter case 40, the fourth mount seat and the fixture portion 25, and the second fastening portion K2 located on a right part of the third bracket 13; a left and right pair of third and fourth fastening portions K3, K4 on the lowermost part of the third bracket 13; and a upper and lower pair of fifth and sixth fastening portions K5, K6 on a central part of the third bracket 13. Among them, the second, fifth and sixth fastening portions K2, K5, K6 are disposed on the fitting surface 25a of the fixture portion 25 for joint with the fitting surface 26a of the main mount seat 26 whereas the first, third and fourth fastening portions K1, K3, K4 are disposed along the circumference of the fixture portion 25.

[0047] Since the fitting surface 25a of the fixture portion 25 for abutment with the cylinder block 1 is disposed between the pump case 30 of the cooling water pump P and the oil filter cased 40 in this manner, even under vibrations caused by the engine E in operation and an inertial force due to acceleration or deceleration of the car, the fitting surface 25a of the abutting fixture portion 25 can abut uniformly with the cylinder block 1, and the unit housing for supporting auxiliary machineries can be affixed to the cylinder block 1 stably and firmly.

[0048] In addition, among three fastening portions K2, K5, K6 formed on the fitting surface 25a of the fixture portion 25, the fastening portion K5 is adjacent to the oil cooler C. Therefore, a bolt inserted in the bolt hole of the fastening portion K5 can stably and firmly bear various forces applied to the oil cooler C, and enables an increase of the fastening force and rigidity of the unit housing for supporting auxiliary machineries.

[0049] As shown in Fig. 6, the fist fastening portion K1 is connected to the second, fifth fastening portions K2, K5 and an area near an oil outlet 56b of a third supply oil path 56, which will be explained later, with reinforcing ribs R1, R2, R3. The third fastening portion K3 is connected to the sixth fastening portion K6 with a reinforcing rib R4, and the fourth fastening portion K4 is connected to an area near an oil inlet 50a of an inflow oil path 50, explained later, communicating with the oil filter F with a reinforcing rib R5. Therefore, the first, third and fourth fastening portions K1, K3, K4 are connected to the fixture portion 25 with reinforcing ribs R1 through R5. Further, the third and fourth fastening portions K3, K4 are connected together with the reinforcing rib R6.

[0050] On the other hand, as shown in Fig. 5, on the front surface of the third bracket 13, the second fastening portion K2 is connected to the pump case 30 with a reinforcing rib R7 extending downward, the third fastening portion K3 and the fourth fastening portion K4 are connected together with a reinforcing rib R8, the fourth fastening portion K4 is also connected to a reinforcing rib R11, which in turn connecting a left and right pair of lower support arms 20a, 20b explained later, with a reinforcing rib R9, a reinforcing rib R12 extending downward from under the filter case 40 is perpendicularly connected to the reinforcing rib R11, and the sixth fastening portion K6 is connected to the left-side lower support arm 20a with a reinforcing rib R10.

[0051] Furthermore, on a left area of the outer circumferential surface of the filter case 40, a reinforcing rib R 13 is formed to extend from the top of the filter case 40 to the first mount seat 21 along the center axis of the filter case 40 to enhance the rigidity of the filter case 40, and a reinforcing r13 to rib R14 is formed to extend horizontally from the reinforcing rib R13 to the left side surface of an upper support arm 20c, explained later, to enhance the rigidity of the upper support arm 20c.

[0052] Since the filter case 40, first mount seat 21, fourth mount seat 24 and fixture portion 25 are portions having a relatively high rigidity because of the nature of their own, the first and second fastening portions K1, K2 are located between the rigid filter case 40, rigid mount seat 24 and the rigid fixture portion 25 and the first fastening portion K1 is adjacent to the first mount seat 21, the third bracket 13 can be rigidly fastened to the cylinder block 1 with a large fastening force of bolts at a reduced number of fastening portions. In addition, the reinforcing ribs R1 through R10 connected to the respective fastening portions K1 through K6 enhance the rigidity of the respective fastening portions K1 through K6.

[0053] As shown in Figs. 3, 5, 7 and 8, and as best shown in Fig. 3, support arms, integral with the third bracket 13 to mount the alternating-current generator G on, includes a left and right pair of lower support arms 20a, 20b horizontally extending forward from a lower part of the third bracket 13 and an upper support arm 20c horizontally extending forward from a lower part of the outer circumferential surface of the filter case 40. As shown in Figs. 1 and 2, a first mount flange G1 integral with a lower part of the alternating-current generator G is fastened to be held between the lower support arms 20a, 20b with bolts B2 inserted in through holes 20a1, 20b1 of the lower support arms 20a, 20b and a through hole of the first mount flange G1. Similarly, a second mount flange G2 integral with an upper part of the alternating-current generator G is fastened with its left side surface in joint with the right side surface of the upper support arm 20c with a bolt B3 inserted through a through hole of the second mount flange G2 into engagement with a screwed hole 20c1 of the upper support arm 20c. Thus the alternating-current generator G is mounted to the third bracket 13.

[0054] Under the condition where the alternating-current generator G is assembled to the third bracket 13, since the alternating-current generator G is positioned using the space defined under the oil filter F projecting forward, forward projection of the alternating-current generator G can be minimized, thereby to compactly position the alternating-current generator G with respect to the engine body. Additionally, the use of the reinforcing rib R14 and the upper support arm 20c formed on the rigid filter case 40 contribute to stable support alternating-current generator G.

[0055] On the other hand, with reference to Fig. 3, the cooling water pump P includes the pump case half 30, pump body 31 fastened in joint with the third fitting surface 23a (Fig. 7) of the third mount seat 23 with a bolt, a drive shaft (not shown) supported on the pump body 31 via a bearing and having the cooling water pump pulley P1 fixed at one end thereof, and an impeller (not shown) united to the other end of the drive shaft.

[0056] The pump chamber 32, in which the impeller is disposed, communicates with an intake path 33 of cooling water. The intake path 33 is in form of a circular hole concentric with the rotation axis L of the drive shaft (common to the rotation axis of the cooling water pump P), and extends to path through the third bracket 13 in the left-to-right direction between a central portion of the pump chamber 32 and the second mount seat 22. The pump case 30 also communicates with a release path 34 formed to extend tangentially of the rotating direction of the impeller from the pump chamber 32 and having a cooling water outlet 34a opening at the third fitting surface 25a of the fixture portion 25 (see Figs. 6, 7 and 12). The portion of the release path 34 opening at the third fitting surface 23a and the pump chamber 32 are covered with the pump body 31 in a watertight manner.

[0057] Mounted on the second mount seat 22 is a thermostat case T accommodating a thermostat in joint with the fitting surface 22a formed on the second mount seat 22 with the intake path 33 opening there. More specifically, as shown in Fig. 8, the second fitting surface 22a having a substantially rhombic shape has an upper fastening portion K7 and a lower fastening portion K8 having two through holes H7, H8 along the longer diagonal line of the rhombus, and the thermostat case T is fastened with bolts inserted in through holes of the thermostat case T and then into the through holes H7, H8 of the upper and lower fastening portions K7, K8.

[0058] The second fitting surface 22a is disposed on the left surface of the third bracket 13, which is opposite from the right side surface, viewed from the direction opposed to the third fitting surface 23a on the right side surface of the third bracket 13, i.e. from the direction intersecting approximately at a right angle with the third fitting surface in this embodiment, together with the first fitting surface 21a of the first mount seat 21 for joint of the oil cooler C as explained later, so as to be flush with the first fitting surface 21a, that is, to lie on the common plane. Since the cooling water pump P, which is the largest among the thermostat case T, oil cooler C and cooling water pump P, is disposed on the right side surface of the third bracket 13 and the oil cooler C on the left side surface of the third bracket 13, a compact layout is achieved. Furthermore, since the oil cooler C and the thermostat case T are attached to the fitting surface 21a and the second fitting surface 22a that are on the common plane, these both can be assembled compactly. Moreover, since the first fitting surface 21a and the second fitting surface 22a are processed to lie on the common plane, the third bracket 13 need not be changed in the fixed posture upon processing, thereby facilitating the processing and improving the productivity of the third bracket 13.

[0059] As shown in Fig. 8, the second mount seat 22 is connected to the first mount seat 21 with a reinforcing rib R15. Since the reinforcing rib R15 connects the upper fastening portion K7 nearer to the first mount seat 21 than the lower fastening portion K8 to the lowest portion of the first mount seat 21 nearest to the second mount seat 22, length of the reinforcing rib R15 is shortened. Further, a reinforcing rib R16 projecting in a direction intersecting approximately at a right angle with the reinforcing rib R15 connects the first mount seat 21 and the second mount seat 22. Connection by the reinforcing rib R15 in this manner enhances the rigidity of the first mount seat 21 and the second mount seat 22, and the reinforcing rib R 16 additionally enhances these mount seats 21, 22. Therefore, the relatively heavy oil cooler C can be assembled firmly. Furthermore, since the reinforcing rib R15 enhances the rigidity of the upper fastening portion K7 of the second mount seat 22, the thermostat case T can be fixed firmly with a large fastening force, and since the reinforcing rib R15 is configured to connect the upper fastening portion K7 nearest to the first mount seat 21 to the portion of the first mount seat 21 nearest to the second mount seat 22, its length is shortened, thereby preventing the third bracket 13 from being increased in weight due to the existence of the reinforcing rib R16 and hence preventing the engine E from becoming heavy.

[0060] As shown in Fig. 2, the thermostat cover 35 is water-tightly joined to the thermostat case T. The thermostat cover 35 has an inflow section 35a (see Figs. 2 and 3) connected to one end of an outlet hose (not shown) having the other end connected to a radiator, not shown. At a portion of the thermostat case T opened and closed by the thermostat, a bypass pipe (not shown) connected to a cooling water jacket of the cylinder head 2 is connected, and a cooling water return pipe 36 (see Fig. 2) from an air-conditioning heater is connected to a connecting portion T1 (see Fig. 3) of the thermostat T.

[0061] The thermostat permits cooling water to flow from the bypass pipe to the intake path 33 while preventing the cooling water from flowing from the outlet hose to the intake path 33 during warming-up where the temperature of the cooling water does not exceed a predetermined value, and after completion of the warming-up where the temperature of the cooling water exceeds the predetermined value, it prevents the flow of the cooling water from the bypass pipe to the intake path 33 while permitting the flow of the cooling water from the outlet hose to the intake path 33.

[0062] Further, as shown in Fig. 12, a cooling water inlet 1a communicating with the cooling water jacket 1b opens to the cylinder block 1 at the fitting surface 26a, so that, once the third bracket 13 is fastened to the main mount seat 26, the cooling water inlet 1a communicated with the cooling water outlet 34a of the release path 34 at the fitting surface 26a to allow the cooling water released from the cooling water pump P to be supplied to the cylinder block 1.

[0063] Therefore, during operation of the engine E, the cooling water pump P sends pressurized cooling water suctioned from the intake path 33 to the release path 34 in response to rotation of the impeller disposed in the pump chamber 32. The pressurized cooling water sent to the release path 34 flows into the cooling water inlet 1a of the cylinder block 1 communicating with the fitting surface 25a from the cooling water outlet 34a of the release path 34, and flows through the cooling water jacket 1b of the cylinder block 1 while cooling the cylinder block 1, thereafter flows into the cooling water jacket of the cylinder head 2 to cool it. During the warming-up, it flows to the bypass pipe and returns through the thermostat to the intake path 33, and after completion of the warming-up, the cooling water cooled to a low temperature while passing the radiator returns to the intake path 33 through the thermostat. Thus the cooling system circulating the cooling water is established.

[0064] Further referring to Figs. 4 through 6, 8, 7, 10 and 13, the third bracket 13 has a first communication path 37 having one end communicating with the outlet path 34 inside the third bracket 13 and the other end opening at the first fitting surface 21a having a circular outer circumference of the first mount seat to form a housing-side cooling water outlet 37a, and a second communication path 38 having one end communicating with the intake path 33 inside the third bracket 13 and the other end opening at the first fitting surface 21a to form a housing-side cooling water inlet 38a.

[0065] The release path 34 is disposed to overlap the first fitting surface 21a, when viewed from the direction opposed to the first fitting surface 21a, i.e. from the left that is a direction intersecting approximately at a right angle with the first fitting surface 21a in this embodiment (see Fig. 7), and the housing-side cooling water outlet 37a of the first communication path 37 communicates with the release path 34 via a horizontal path section 37b, extending straight without curves, which is formed by drilling to horizontally extend rightward from the housing-side cooling water outlet 37a toward the release path 34 and to open to the release path 34, such that the horizontal path section 37b makes the shortest passage between the housing-side cooling water outlet 37a and the release path 34. On the other hand, as shown in Figs. 4, 5 and 10, the second communication path 38 includes a horizontal path section 38b extending horizontally rightward from the housing-side cooling water inlet 38a toward the release path 34 and terminating at the deepest closed end, and a vertical path section 38c formed by drilling to extend from the bottom surface of the third bracket 13 through the intake path 33 toward the horizontal path section 38b and to open at the horizontal path section 38b near that closed end. The opening at the bottom end of the vertical path section 38c is closed with a plug 39.

[0066] Referring to Fig. 9, a cap 43 is brought into threading engagement with the cylindrical filter case 40 such that a cylindrical filter element 41 made by alternately folding filter paper and held in a holder 42 attached to the cap 43 is accommodated in a receiving chamber 44 defined by the filter case 40. An annular oil path 51 formed, as shown in Fig. 12, along the outer circumference of the filter element 41 inside the receiving chamber 44 communicates with an inflow oil path 50 formed in the third bracket 13 and having an oil inlet 50a opening at the fitting surface 25a of the fixture portion 25, and the inflow oil path 50 extends straight aslant downward and backward from the receiving chamber 44 toward the cylinder block 1. Then, the inflow oil path 50 communicates with a release oil path of the oil pump (not shown) provided in the oil pan 5 and driven by the driving power of the crankshaft 6 via an oil path 1c, formed in the cylinder block 1 and having an oil outlet 1d in communication with the oil inlet 50a at the fitting surface 25a of the fixture portion 25, and an oil path (not shown) formed in the lower block 4.

[0067] A central oil path 52 formed along the inner circumference of the filter element 41 inside the receiving chamber 44 communicates with an outflow oil path 53 formed by drilling in an approximately central position of the third bracket 13 in terms of the left-to-right direction (see Fig. 5) to extend straight aslant downward and backward from the receiving chamber 44 toward the cylinder block 1. The upper part of the outflow oil path 53 constitutes a first supply oil path 54 whereas the lower part of the outflow oil path 53 constitutes a drain path 57 that can communicate with or disconnect from the first supply oil path 54 with the aid of a drain valve 45 provided between them. The drain path 57 has an oil outlet 57a opening at the fitting surface 25a of the fixture portion 25, and the oil outlet 57a communicates with an oil path 1e formed in the cylinder block 1 and opening into the crank chamber 17.

[0068] The drain valve 45 is integrally coupled to the holder 42 via a connection rod 46, and takes its shutting position for blocking passage between the first supply oil path 54 and the drain path 57 when the cap 43 is attached to the filter case 40 and keeps the receiving chamber 44 sealed, whereas the drain valve 45 takes its open position allowing passage between the first supply oil path 54 and the drain path 57 when the sealing of the receiving chamber 44 is released, for example, upon removal of the cap 43 from the filter case 40.

[0069] As a result, when the cap 43 is removed from the filter case 40 for, for example, replacement of the filter element 41, the oil having remained in the receiving chamber 44 flows through the drain path 57 held in communication with the first supply oil path 54 by the drain valve 45 currently taking its open position, without flowing out from the filter case 40 extending forward and upward and opening upward, then flows out into the crank chamber 17 from the oil outlet 57a through the oil path 1e of the cylinder block 1, and returns to the oil pan 5. Therefore, it is prevented that oil spills out from the receiving chamber 44 and soils the floor or ground during, for example, maintenance of the oil filter F.

[0070] In the first supply oil path 54, slightly upstream of the drain valve 45 at its open position, one end of the second supply oil path 55 formed in the third bracket 13 opens, and the other end thereof constitutes a housing-side oil outlet 55a opening at the first fitting surface 21a. Referring to Figs. 4 and 5, the second supply oil path 55 includes a horizontal path section 55b extending straight without curves, which is made by drilling to extend horizontally rightward from the housing-side oil outlet 55a toward the first supply oil path 54 to intersect substantially at a right angle with the first supply oil path 54 and finally open into the first supply oil path 54, such that the horizontal path section 55b makes the shortest passage between the first supply oil path 54 and the housing-side oil outlet 55a.

[0071] The third bracket 13 further has formed a third supply oil path 56 for supplying oil cooled by the oil cooler C to the main gallery 1g via an oil inlet 1f opening at the fitting surface 26a of the cylinder block 1 as shown in Fig. 1. One end of the third supply oil path 56 opens at the first fitting surface 21a to constitute a housing-side oil inlet 56a having a circularly opened configuration, and the other end thereof opens at the fitting surface 25a of the fixture portion 25 to constitute an oil outlet 56b. As shown in Figs. 6 and 11, the third supply oil path 56 includes a first horizontal path section 56c extending horizontally rightward from the housing-side oil inlet 56a toward the release path 34 to terminate at its deepest closed end, and a second horizontal path section 56d that opens into the first horizontal path section 56c near that closed end, extends horizontally toward the fitting surface 25a substantially at a right angle with the first horizontal path section 56c, and defines an oval flow path section to constitute the oil outlet 56b.

[0072] As shown in Figs. 4, 9 and 12, the inflow oil path 50 and the outflow oil path 53 are disposed between the intake path 33 above them and the release path 34 below them to enable heat exchange between the oil flowing in the oil paths 50, 53 and the cooling water flowing in the intake path 33, pump chamber 32 and release path 34 by heat conduction through the third bracket 13 of aluminum alloy. Especially, the inflow oil path 50 is located between the release path 34 and the intake path 33, leftward adjacent to the release path 34 such that the extending direction of the release path 34 and the extending direction of the inflow oil path 50 intersects, as viewed from the direction opposed to the third fitting surface 23a (see Fig. 7), and as shown in Figs. 12 and 13, it is disposed adjacent to a portion of the release path 34 nearer to the intake path 33 via a thinned path wall 34b thereof. Further, a reinforcing rib R12 is formed on the outer surface of the path wall 34b along the inflow oil path 50, and this reinforcing rib R12 also functions as a heat-releasing fin.

[0073] Since the third bracket 13 has formed the pump chamber 32 of the cooling water pump p in addition to the intake path 33 and the release path 34, the third bracket 13 is entirely cooled by a relatively large quantity of cooling water within the pump chamber 32, to hence cool the oil in the inflow oil path 50 and the first to third supply oil paths 54, 55, 56.

[0074] Now referring to Fig. 8, the first fitting surface 21a includes the housing-side cooling water outlet 37a of the first communication path 37, housing-side cooling water inlet 38a of the second communication path 38, housing-side oil outlet 55a of the second supply oil path 55 and housing-side oil inlet 56a of the third supply oil path 56 such that the housing-side cooling water outlet 37a and the housing-side cooling water inlet 38a are substantially in a diametrically opposed relation with respect to the center of the first fitting surface 20a whereas the housing-side oil outlet 55a and the housing-side oil inlet 56a are substantially in a diametrically opposed relation. Therefore, openings of cooling water paths, in form of the housing-side cooling water outlet 37a and the housing-side cooling water inlet 38a, and openings of oil paths, in form of the housing-side oil outlet 55a and the housing-side oil inlet 56a, alternately appear in the circumferential direction of the first fitting surface 21a.

[0075] In the area of the first fitting surface 21a, the housing-side oil outlet 55a is located at a position nearer to the receiving chamber 44 of the oil filter F while the housing-side oil inlet 56a is disposed at a position nearer to the oil outlet 56b of the fitting surface 25a to make a layout shortening the second supply oil path 55 and the third supply oil path 56, respectively, thereby to reduce the flow path resistance. Similarly, the housing-side cooling water outlet 37a is disposed at a position nearer to the cooling water outlet 34a of the release path 34 while the housing-side cooling water inlet 38a is disposed at a position below the housing-side cooling water outlet 37a and nearer to intake path 33 to make a layout shortening the first communication path 37 and the second communication path 38, respectively, thereby to reduce the flow path resistance.

[0076] Referring to Fig. 14 in conjunction, in the first mount seat 21 disposed nearer to the cooling water pump P than the oil filter F in the radial direction of the rotating axis L of the cooling water pump P, a screwed hole 27 is formed at the center of the first fitting surface 21a to assemble the oil cooler C on. A bolt B4 (see Fig. 3) inserted in a through hole 60 formed in the oil cooler C is brought into threading engagement with the screwed hole coaxially with the center axis of the cylindrical oil cooler C having the same outer diameter as the outer circumference of the first fitting surface 21a, thereby to fasten the oil cooler C to the first mount seat 21 in joint with the first fitting surface 21a.

[0077] The fitting surface C1 of the oil cooler C, which is substantially the same in diameter as the first fitting surface for joint therewith, includes a cooler-side cooling water inlet 61 and a cooler-side cooling water outlet 62 diametrically opposed to each other with respect to the center of the fitting surface C1, and includes a cooler-side oil inlet 63 and a cooler-side oil outlet 64 diametrically opposed to each other. In the heat exchange region for carrying out heat exchange inside the oil cooler C, cooling water is guided to flow from the cooler-side cooling water inlet 61, thereafter flow both in the axial direction and in two opposite circumferential directions in form of two oppositely flowing streams along a cylindrical path that combines those circumferential streams from opposite directions, such that the cooling water first flows from the cooler-side cooling water inlet 61, and after heat exchange with oil therein, flows out from the cooler-side cooling water outlet 62 diametrically opposed to the cooler-side cooling water inlet 61. In the cylindrical path, a pipe serving as an oil path is immersed.

[0078] In correspondence with the cooler-side cooling water inlet 61, cooler-side cooling water outlet 62 and cooler-side oil inlet 63, the housing-side cooling water outlet 37a, housing-side cooling water inlet 38a and housing-side oil outlet 55a are shaped in ovals to get into alignment with positions o cooler-side cooling water inlet 61, cooler-side cooling water outlet 62 and cooler-side oil inlet 63 having circular opening shapes. At these oval housing-side cooling water outlet 37a and housing-side cooling water inlet 38a, the horizontal path sections 37b, 38b are disposed nearer to the cooling water pump P, respectively. On the other hand, the cooler-side oil outlet 64 having a circular opening shape meets the circular housing-side oil inlet 56a. Thus, these outlets 37a, 55a and inlets 38a, 56a are surrounded by seal-retaining grooves D1 through D4 having annular shapes corresponding to the opening shapes, and O-rings S1 through S4 as seal members having corresponding shapes are put in the seal retaining grooves D1 through D4, respectively.

[0079] Once the oil cooler C is assembled to the third bracket 13 in joint with the first fitting surface 21a, the housing-side cooling wager outlet 37a communicates with the cooler-side cooling water inlet 61, the housing-side cooling water inlet 38a with the cooler-side cooling water outlet 62, the housing-side oil outlet 55a with the cooler-side oil inlet 63, and the housing-side oil inlet 56a with the cooler-side oil outlet 64, respectively, at the first fitting surface 21a. As a result, as shown by white arrows in figures, the cooling water circulating system of the oil cooler C is established such that part of the pressurized cooling water from the cooling water pump P travels from the outlet path 34 via the first communication path 37, cooler-side cooling water inlet 61, heat exchanger, cooler-side cooling water outlet 62 and second communication path 38 back to the intake path 33.

[0080] Referring to Fig. 6, at the fitting surface 25a of the fixture portion 25, the cooling water outlet 34a of the release path 34 exists near the third fitting surface 23a, the oil inlet 50a of the inflow oil path 50 just below the cooling water outlet 34a, the oil outlet 56b of the third supply oil path 56 near the first fitting surface 21a, and the oil outlet 57a of the drain path 57 next to the oil inlet 50a between the oil inlet 50a and the oil outlet 56b, respectively. Seal retaining grooves D5 through D7 are formed to surround these outlets 34a, 56b, 57a and inlet 50a to retain O-rings as seal members therein.

[0081] On the other hand, the oil drawn from an oil reservoir in the oil pan 5 and released from the oil pump travels, as shown by black arrows in Fir. 12, passing through the oil path of the lower block 4 and the oil path 1c (Fig. 12) of the cylinder block 1, then entering into the inflow oil path 50 from the oil outlet 1d through the oil inlet 50a, further running from the inflow oil path 50 through the annular oil path 51 (Fig. 9) of the oil filter F and through the filter element 41 while being filtered thereby, reaching the central oil path 52, running from the central oil path 52 through the first supply oil path 54 and the second supply oil path 55, then reaching the housing-side oil outlet 55a at the first fitting surface 21a, running from the housing-side oil outlet 55a (Fig. 4) passing through the cooler-side oil inlet 63 (Fig. 14) while undergoing heat exchange with the cooling water, thereafter reaching the housing-side oil inlet 56a via the cooler-side oil outlet 64, then going from the housing-side oil inlet 56a and reaching the third supply oil path 56 and the oil outlet, then flowing through the oil inlet of the cylinder block 1 into the main gallery, feeding various portions to be lubricated inside the crank chamber 17, such as the bearing portion of the crankshaft 6 and slide-fit portions between pistons and cylinders, for example, and feeding various portions to be lubricated in the valve chamber defined by the cylinder head 2 and the head cover 3, such as slide-fit portions of the drive valve system for driving intake and exhaust valves, further feeding other portions to be lubricated, such as the timing chain, and after lubrication, returning through the return oil path back into the oil pan 5. Thus, the lubricant system circulating the oil is established.

[0082] Referring to Fig. 3, the tensioner A attached to the fourth mount seat 24 includes a tensioner main body 70 having a cylindrical stationary portion 71 with a mount flange 71a and a cylindrical movable portion 72 that can rotate relative to the stationary portion 71 via a coil spring contained therein, and an idler pulley 73 pivotally supported on a radially outer end portion of the movable portion 72. The coil spring exerts a twisting spring force to the idler pulley 73 such that the idler pulley 73 rotates about a bolt in a direction applying a tensile force to the endless belt 16 (in the counterclockwise direction in Fig. 1).

[0083] Referring to Fig. 7 in conjunction, the tensioner A is fastened to the fourth mount seat 24 with a bolt inserted in a through hole of the mount flange 71a and brought into threading engagement with a screwed hole of a periphery fastening portion K9 formed at a portion of the fourth mount seat 24 nearer to the filter case 40 and with a bolt B6 passing through a central portion of the tensioner main body 70 and brought into threading engagement with a screwed hole in a central fastening portion K10 disposed in a central location of the fourth mount seat 24. The outer circumferential surface of the peripheral fastening portion K9 is connected to the fourth mount seat 24 and the filter case 40 via three reinforcing ribs R17, R18, R19.

[0084] In this manner, the tensioner A is disposed between the filter case 40 and the cylinder block 1, using a space defined between the filter case 40, extending upward and forward, and the cylinder block 1. Further, since a part of the fourth mount seat 24 nearer to the oil filter F is integrally connected to the filter case 40, thereby to enhance the rigidity of the fourth mount seat 24 with the aid of the filter case 40, the fastening force of the bolts can be increased to firmly fasten the tensioner A.

[0085] Operation and effects of the embodiment having the above-explained configuration will be explained below.

[0086] Among the thermostat case T, oil cooler C and cooling water pump P, the cooling water pump having the largest size is disposed on the right side surface of the third bracket 13, and the oil cooler C is disposed on the left side surface of the third bracket 13. Therefore, a compact layout is achieved. Furthermore, on the left side surface, since the oil cooler C and the thermostat case T are affixed to the fitting surface 21a and the second fitting surface 22a that are on a common plane, they are assembled compactly. Additionally, since the first fitting surface 21a and the second fitting surface 22a are processed to be flush, the bracket 13 can be easily processed without being changed in posture, and productivity of the third bracket 13 is improved accordingly.

[0087] Connection of the fist mount seat 21 and the second mount seat 22 with the reinforcing rib R15 enhances the rigidity of these mount seat 21, 22, and the reinforcing rib R16 additionally enhances the rigidity of these both mount seat 21, 22. Therefore, the oil cooler C, even if relatively heavy, can be affixed firmly. Further, since the reinforcing rib R15 enhances the rigidity of the fastening portion K7 above the second mount seat 22, the thermostat case T can be fixed firmly with a large fastening force. In addition to this, since the reinforcing rib R15 connects the upper fastening portion K7 nearest to the first mount seat 21 and a portion of the first mount seat 21 nearer to the second mount seat 22, its length may be short, and does not invite an increase of weight of the third bracket 13, and hence, of the engine E.

[0088] Because of the positioning of the inflow oil path 50 between the intake path 33 and the release path 34 to enable heat exchange, in particular via the third bracket 13 of aluminum alloy, between oil flowing in the inflow oil path 50 and the cooling water flowing in the intake path 33, pump chamber 32 and release path 34, the embodiment ensures heat exchange of the oil flowing in the inflow oil path 50 not only with the cooling water flowing in the intake path 33 in communication with the pump chamber 32 of the cooling water pump P but also with the cooling water flowing in the release path 34, so as to use heat exchange from opposite sides of the inflow oil path 50, thereby increases the area where heat exchange with cooling water occurs, and increases the heat exchange quantity. Further, since the third bracket 13 includes therein the built-in pump chamber 32 for the cooling water pump P in addition to the intake path 33 and the release path 34, the cooling water in the pump chamber 32 can be also used for heat exchange with the oil.

[0089] As a result, during warming-up of the engine E, since the cooling water passing the bypass pipe circulates, the oil traveling in the inflow oil path 50 and the first to third supply oil paths 54, 55, 56 in the third bracket 13 is warmed by the cooling water traveling through the intake path 33, release path 34 and pump chamber 32 where a relatively large quantity of cooling water exists, and further warmed in the coil cooler C as well. Especially, the oil in the inflow oil path 50 is warmed effectively because it undergoes efficient heat exchange with the cooling water through the thinned passage wall 34b of the release path 34. This configuration of promoting the rise of temperature of the oil supplied to the main gallery of the cylinder block 1 contributes to reducing the output loss that will occur otherwise because of a high viscosity of oil at a low temperature, and thereby improves the specific fuel consumption.

[0090] Once the engine E is warmed up, cooling water cooled by the radiator to a low temperature begins to circulate. Therefore, the oil traveling in the inflow oil path 50 and the first to third supply oil paths 54, 55, 56 in the third bracket 13 is warmed by the cooling water traveling through the intake path 33, release path 34 and pump chamber 32 where a relatively large quantity of cooling water exists, and further warmed in the coil cooler C as well. At that time, unlike the prior art inevitably heating the cooling water because it travels in the engine body upon introduction to and discharge from the cooling water pump P, the embodiment can maintain the cooling water in the release path 34 at a temperature substantially equal to a low temperature of the cooling water cooled by the radiator and introduced into the intake path 33. Additionally, the thinned wall 34b of the release path 34 contributes to more efficient heat exchange of the oil in the inflow oil path 50 with the cooling water. In this manner, the oil supplied to the main gallery 1g is cooled well, and problems caused by oil decreased in viscosity due to heat, such as insufficient lubrication, can be prevented. Thus the configuration of the embodiment can efficiently cool the oil basically in the third bracket before flowing into the oil cooler C and thereafter in the oil cooler C as well, and therefore allows the oil cooler C to be designed compactly.

[0091] The inflow oil path 50 and the outflow oil path 53 are formed by making use of a space between the intake path 33 and the release path 34, the third bracket 13 can be made compact.

[0092] The oil after passing the oil filter F flows into the oil cooler C using the cooling water supplied from the release path 34 of the cooling water pump P and returning to the intake path 33 and cooled there. In this configuration, the oil cooler C, affixed to the first mount seat 21 disposed nearer to the cooling water pump P than the oil filter F in the radial direction with respect to the rotating axis L of the cooling water pump P, results in lying nearer to the cooling water pump P than the oil filter F. Therefore, the passage of cooling water for cooling the oil between the release path 34, intake path 33 and the oil cooler C can be shortened. This results in reducing the flow path resistance, enabling a large quantity of cooling water to be supplied to the oil cooler C without increasing the size of the cooling water pump C, and improving the heat exchange efficiency in the oil cooler C.

[0093] The third bracket 13 having the oil cooler C assembled thereto defines therein the pump chamber 32 of the cooling water pump P, intake path 33 and release path 34, first communication path 37 in communication with the release path 34 within the third bracket 13 and second communication path 38 in communication with the intake path 33 within the third bracket 13 such that cooling water is supplied to and discharged from the oil cooler C through the first and second communication paths 37, 38. Therefore, the passage of cooling water between the cooling water pump P and the oil cooler C is shortened, and the flow path resistance is reduced. This results in enabling a large quantity of cooling water to be supplied to the oil cooler C and improving the heat exchange of the oil cooler C without increasing the size of the cooling water pump P.

[0094] The oil cooler C receives cooling water just after released from the pump chamber 32 before flowing out of the third bracket 13, through the release path 34 and the first communication path 37, and the temperature of the cooling water in the release path 34 is substantially equal to the temperature of the cooling water held cool in the intake path 33 as cooled by the radiator. Therefore, unlike the prior art in which cooling water is inevitably heated when passing trough the engine body upon introduction to and release from the cooling water pump P, the embodiment of the invention can supply the oil cooler C with cooling water held cool, and further improves the cooling efficiency of the oil cooler C.

[0095] Because of the configuration of the first fitting surface 21a for joint with the oil cooler C, including the housing-side cooling water outlet 37a, housing-side cooling water inlet 38a, housing-side oil outlet 55a and housing-side oil inlet 56a, such that communication between the housing-side cooling water outlet 37a and the cooler-side cooling water inlet 61, between the housing-side cooling water inlet 38a and the cooler-side cooling water outlet 62, between the housing-side oil outlet 55a and the cooler-side oil inlet 63, and between the housing-side oil inlet 56a and the cooler-side oil outlet 64 are established by bringing the oil cooler C into joint with the first fitting surface 21a of the third bracket 13, thereby to enable delivery of cooling water and oil at the first fitting surface 21a, the embodiment requires no exterior piping for making communication of the respective inlets and outlets. Accordingly, component parts for assembly of the third bracket 13 having the oil cooler C attached thereto can be decreased, and the cost can be decreased accordingly. Further, since their communication is completed once the oil cooler C is brought into joint with the first fitting surface 21a, the assembling steps can be reduced and shortened. Furthermore, upon maintenance of the oil cooler C, it is sufficient to detach the oil cooler C from the third bracket 13 without the need of detaching such exterior piping for delivering cooling water to or from the oil cooler C as in the prior art. Therefore, maintenance becomes easier.

[0096] Since the release path 34 and the first fitting surface 21a are located to overlap when viewed from the first fitting surface 21a, and the housing-side cooling water outlet 37a of the first communication path 37, in communication with the cooler-side cooling water inlet 61 at the first fitting surface 21a, communicates with the release path 34 via the straight horizontal path section 37b without curves, the release path 34 and the housing-side cooling water outlet 37a can be connected in communication by the shortest passage. Therefore, the flow path resistance in the passage of cooling water supplied to the oil cooler C can be minimized, and the heat exchange efficiency of the oil cooler C is improved more.

[0097] Because of the relatively distant positioning of the housing-side oil outlet 55a for oil before being cooled to flow through and the housing-side oil inlet 56a for cooled oil to flow through on the fist fitting surface 21a at opposite sides of the center thereof, and the circumferentially alternate positioning of housing-side cooling water outlet 37a, opening of the cooling water path as the cooling water inlet, housing-side oil inlet 56a and opening of the oil path as the oil outlet, which results in existence of the housing-side cooling water outlet 37a and housing-side cooling water inlet 38a between two cool and hot oil passages, the invention can prevent transmission of heat from the oil flowing in the housing-side oil outlet 55a to the oil flowing in the housing-side oil inlet 56a, and can maintain the oil after being cooled by the oil cooler C at a lowest possible temperature.

[0098] Because of the configuration of the heat exchanger in the oil cooler C guiding cooling water over the entire circumference of the heat exchanger by first introducing cooling water from the cooler-side cooling water inlet 61, then dividing it at the cooler-side cooling water inlet 61 into axially flowing streams axially flowing through the cylindrical path and opposite circumferential streams flowing in circumferential directions in the cylindrical path to thereafter merge at the cooler-side cooling water outlet 62 diametrically opposite from the cooler-side cooling water inlet 61, the embodiment ensures sufficient heat exchange between the cooling water and the oil introduced into the oil cooler C, and ensures high heat exchange efficiency.

[0099] Because the horizontal path section 55b making communication between the first supply oil path 54 in the third bracket 13 and the housing-side oil outlet 55a has a straight configuration without curves, the horizontal path section 55b can be readily made by drilling, and can minimize the flow path resistance of the passage up to the cooler-side oil inlet 63 in communication with the housing-side oil outlet 55a at the first fitting surface 21a.

[0100] In the embodiment explained with reference to Figs. 1 through 14, the O-ring groove D6 around the oil inlet 50a and the lower extension opening 57a of the oil outflow path 57 encircles them in form of 8 as shown in Fig. 6. However, it may be replaced with separate annular O-ring grooves D61 and D62 that encircle the oil inlet 50a and the lower extension opening 57a of the oil outflow path 57, respectively, as shown in Fig. 15. In this case, commercially available O-rings may be used in the O-ring grooves D61, D62.

[0101] Next explained are other embodiments partly modified from the foregoing embodiment, extracting the modified features.

[0102] Although the foregoing embodiment has been explained as the filter case 40 of the oil filter F being built in the third bracket 13, the filter case 40 may be prepared as a separate member to be assembled to the third bracket. The third bracket 13 may be unprepared for assemblage of one o more of the thermostat case T, tensioner A and alternating-current generator G. The third bracket 13 may be configured to be mount on a surface of the engine body other than the front surface thereof.

[0103] Although the foregoing embodiment is configured to make communication of the first communication path 37 and the second communication path 38 with the cooler-side cooling water inlet 61 and the cooler-side cooling water outlet 62, respectively, at the first fitting surface, at least one of the housing-side cooling water outlet 37a of the first communication path 37 and the housing-side cooling water inlet 38a of the second communication path 38 may be formed to open at an outer surface of the third bracket 13 other than the first fitting surface 21a whereas the cooler-side cooling water inlet 61 and the cooler-side cooling water outlet 62 somewhere other than the fitting surface C1 of the oil cooler C, and their communication may be made with external piping. Here again, the external piping may be shorter than conventional ones, and the flow path resistance is small.

[0104] A unit housing for supporting auxiliary machinery to be detachably attached to an engine body (1) of an engine (E) has a pump case (30) of a cooling water pump (P) and an oil filter case (40) integrally formed therewith. The oil filter case (40) is cylindrical and projects aslant from the unit housing (13). A recess if formed between the pump case (30) and the oil filter case (40), and another auxiliary machinery (G) such as an alternating-current generator is disposed in the recess. The oil filter case (40) has at least one mount portion (24) for mounting another auxiliary machinery (A). Ribs (R7, R15) are formed in the recess to connect the oil filter case (40) and the cooling water pump case (30). With this configuration, restriction in placement with auxiliary machineries can be removed, and it is possible to prevent auxiliary machineries from projecting out from the engine body and thereby disturbing compact design of the entire engine.

Claims

1. A unit housing (13) for supporting auxiliary machinery to be detachably attached to a body (1) of an engine, wherein said unit housing (13) includes a cooling water pump case (30) and an oil filter case (40) integral with said cooling water pump case (30), wherein a fixture surface (25a) for joint with said engine body (1) is disposed between said cooling water pump case (30) and said oil filter case (40), and a recess is formed between said oil filter case (40) and said cooling water pump case (30), and another auxiliary machinery (G) is disposed in said recess, said unit housing defines therein oil paths (50, 53) in communication with an oil filter within said oil filter case (40), an intake path (33) in communication with a pump chamber (32) inside said cooling water pump case (30), and a release path (34) in communication with said pump chamber (32),
characterized in that said cooling water pump case (30) and said oil filter case (40) are connected by a

center portion of the unit housing (13) having said recess and said fixture surface (25a) on opposite sides thereof, wherein said oil paths (50, 53), said intake path (33) and said release path (34) are located adjacent to each other within said center portion to enable heat exchange between oil and cooling water via said center portion of the unit housing (13).

2. The unit housing according to claim 1 wherein an auxiliary machinery (A) other than a cooling water pump (P) and an oil filter (F) is disposed between said cooling water pump case (30) and said oil filter case (40).

3. The unit housing according to claim 2 wherein said oil filter case (40) is cylindrical, and has at least one mount portion (24) for attaching said other auxiliary machinery (A).

4. The unit housing according to claim 1 or 2 wherein said oil filter case (40) is formed to project, and ribs (R7, R12) for connecting said oil filter case (40) and said cooling water pump case (30) are formed in said recess.

5. The unit housing according to claim 1 wherein an oil cooler (C) is provided, and at least one (H5) of a plurality of bolt holes formed in said fixture surface (25a) for joint with said engine body opens at a surface of said unit housing nearer to said oil cooler (C).

6. The unit housing according to claim 1 or 2, said fixture surface (25a) for joint with said engine body (1) having openings (34a, 50a, 56b, 57a) for inflow and outflow of cooling water and oil to and from the engine body; wherein said housing includes: fastening portions (KI, K3, K4) disposed along the circumference of said fixture surface (25a); and ribs (R2, R4, R5) connecting said fixture surface (25a) and said fastening portions (K1, K3, K4).

7. The unit housing according to claim 1 or 2 wherein an oil cooler (C) is mounted between said cooling water pump case (30) and said oil filter case (40), and a fitting surface (25a) for delivery of oil and cooling water to and from said engine body is provided between said cooling water pump case (30) and said oil filter case (40).

8. The unit housing according to claim 1 or 2 wherein an automatic tensioner (A) is attached.

9. The unit housing according to claim 8 wherein said automatic tensioner (A) is attached to a mount seat (2 4) formed between a fixture, surface (25a) of said unit housing for joint with said engine body (1) and another auxiliary machinery (F) to be provided in said unit housing.

10. The unit housing according to claim 8 wherein said automatic tensioner (A) is attached between said oil filter case (40) and a fixture surface (25a) of said unit housing for joint with said engine body (1).

11. The unit housing according to claim 1 wherein said oil paths (50, 53) are located between said intake path (33) and said release path (34).

12. The unit housing according to claim 1 wherein a watertype oil cooler (C) is attached to said housing to permit oil to flow in after passing said oil filter (F), said oil cooler (C) being so configured that oil is cooled by heat exchange with cooling water supplied from said release path (34) and returning back to said intake path (33), and said oil cooler (C) being positioned nearer to the ration axis of said cooling water pump than said oil filter (F).

13. The unit housing according to claim 1 wherein said housing has formed a first mount seat (21) for mounting a cooling water oil cooler (C) supplied with cooling water released from a cooling water pump (P) including said cooling water pump case (30), and a second mount seat (22) for mounting a thermostat case (T), said housing having formed on one side surface thereof a third mount seat (23) for mounting a pump body (31) composing said cooling water pump (P), said first mount seat (21) and said second mount seat (22) being formed on the other surface thereof opposite from said third mount seat (23), and said first mount seat (21) and said second mount seat (22) lying on a common plane.

14. The unit housing according to claim 13 wherein a reinforcing rib (R15) connects said first mount seat (21) and said second mount seat (22).

15. The unit housing according to claim 14 wherein said second mount seat (22) has a plurality of fastening portions (K7, K8) for fastening said thermostat case to said second mount seat, and said reinforcing rib (R15) connects one (K7) of said fastening portions nearest to said first mount seat (21) to a portion of said first mount seat (21) nearer to said second mount seat (22).

Patentansprüche

1. Gehäuseeinheit (13) zum Tragen von Hilfsaggregaten, die an einem Körper (1) eines Motors abnehmbar anzubringen ist, worin die Gehäuseeinheit (13) ein Kühlwasserpumpengehäuse (30) und ein mit dem Kühlwasserpumpengehäuse (30) einstückiges Ölfiltergehäuse (40) enthält,
worin eine Befestigungsoberfläche (25a) zur Verbindung mit dem Motorkörper (1) zwischen dem Kühl-

wasserpumpengehäuse (30) und dem Ölfiltergehäuse (40) angeordnet ist, und eine Vertiefung zwischen dem Ölfiltergehäuse (40) und dem Kühlwasserpumpengehäuse (30) ausgebildet ist, und ein anderes Hilfsaggregat (G) in der Vertiefung angeordnet ist, wobei die Gehäuseeinheit darin Ölwege (50, 53) in Verbindung mit einem Ölfilter innerhalb des Ölfiltergehäuses (40),
einen Einlassweg (33) in Verbindung mit einer Pumpenkammer (32) innerhalb des Kühlwasserpumpengehäuses (30) sowie einen Auslassweg (34) in Verbindung mit der Pumpenkammer (32) definiert, **dadurch gekennzeichnet, dass** das Kühlwasserpumpengehäuse (30) und das Ölfiltergehäuse (40) durch einen Mittelabschnitt der Gehäuseeinheit (13), der an seinen entgegengesetzten Seiten die Vertiefung und die Befestigungsoberfläche (25a) aufweist, verbunden sind, worin die Ölwege (50, 53), der Einlassweg (33) und der Auslassweg (34) innerhalb des Mittelabschnitts einander benachbart angeordnet sind, um einen Wärmeaustausch zwischen dem Öl und dem Kühlwasser über den Mittelabschnitt der Gehäuseeinheit (13) zu ermöglichen.

2. Gehäuseeinheit nach Anspruch 1, worin ein anderes Hilfsaggregat (A) als eine Kühlwasserpumpe (P) und ein Ölfilter (F) zwischen dem Kühlwasserpumpengehäuse (30) und dem Ölfiltergehäuse (40) angeordnet ist.

3. Gehäuseeinheit nach Anspruch 2, worin das Ölfiltergehäuse (40) zylindrisch ist und zumindest einen Montageabschnitt (24) zum Anbringen des anderen Hilfsaggregats (A) aufweist.

4. Gehäuseeinheit nach Anspruch 1 oder 2, worin das Filtergehäuse (40) vorstehend ausgebildet ist, und Rippen (R7, R12) zur Verbindung des Ölfiltergehäuses (40) und des Kühlwasserpumpengehäuses (30) in der Vertiefung ausgebildet sind.

5. Gehäuseeinheit nach Anspruch 1, worin ein Ölkühler (C) vorgesehen ist, und zumindest eines (H5) einer Mehrzahl von Bolzenlöchern, die in der Befestigungsoberfläche (25a) zur Verbindung mit dem Motorkörper ausgebildet sind, sich an einer dem Ölkühler (C) näheren Oberfläche der Gehäuseeinheit öffnet.

6. Gehäuseeinheit nach Anspruch 1 oder 2, worin die Befestigungsoberfläche (25a) zur Verbindung mit dem Motorkörper (1) Öffnungen (34a, 50a, 56b, 57a) für den Einstrom und Ausstrom von Kühlwasser und Öl zu und von dem Motorkörper aufweist; worin das Gehäuse enthält: Befestigungsabschnitte (K1, K3, K4), die entlang dem Umfang der Befestigungsoberfläche (25a) angeordnet sind; sowie Rippen (R2, R4, R5), die die Befestigungsoberfläche (25a) und die Befestigungsabschnitte (K1, K3, K4) verbinden.

7. Gehäuseeinheit nach Anspruch 1 oder 2, worin ein Ölkühler (C) zwischen dem Kühlwasserpumpengehäuse (30) und dem Ölfiltergehäuse (40) angebracht ist, und eine Sitzoberfläche (25a) zum Ausgeben von Öl und Kühlwasser zu und von dem Motorkörper zwischen dem Kühlwasserpumpengehäuse (30) und dem Ölfiltergehäuse (40) vorgesehen ist.

8. Gehäuseeinheit nach Anspruch 1 oder 2, worin ein automatischer Spanner (A) angebracht ist.

9. Gehäuseeinheit nach Anspruch 8, worin der automatische Spanner (A) an einem Montagesitz (24) angebracht ist, der zwischen einer Befestigungsoberfläche (25a) der Gehäuseeinheit zur Verbindung mit dem Motorkörper (1) und einem anderen Hilfsaggregat (F), das in der Gehäuseeinheit vorzusehen ist, ausgebildet ist.

10. Gehäuseeinheit nach Anspruch 8, worin der automatische Spanner (A) zwischen dem Ölfiltergehäuse (40) und einer Befestigungsoberfläche (25a) der Gehäuseeinheit zur Verbindung mit dem Motorkörper (1) angebracht ist.

11. Gehäuseeinheit nach Anspruch 1, worin Ölwege (50, 53) zwischen dem Einlassweg (33) und dem Auslassweg (34) angeordnet sind.

12. Gehäuseeinheit nach Anspruch 1, worin ein Ölkühler (C) vom Wassertyp an dem Gehäuse angebracht ist, um den Einstrom von Öl nach Durchtritt durch den Ölfilter (F) zu erlauben, wobei der Ölkühler (C) so konfiguriert ist, dass das Öl durch Wärmeaustausch mit dem Kühlwasser gekühlt wird, das von dem Auslassweg (34) zugeführt wird und zu dem Einlassweg (33) zurückkehrt, und der Ölkühler (C) der Drehachse der Kühlwasserpumpe näher angeordnet ist als dem Ölfilter (F).

13. Gehäuseeinheit nach Anspruch 1, worin in dem Gehäuse ein erster Montagesitz (21) zum Anbringen eines Kühlwasserölkühlers (C), der mit Kühlwasser versorgt wird, das von einer das Kühlwasserpumpengehäuse (30) enthaltenden Kühlwasserpumpe (P) ausgegeben wird, sowie ein zweiter Montagesitz (22) zum Anbringen eines Thermostatgehäuses (T) ausgebildet ist, wobei an einer Seitenoberfläche des Gehäuses ein dritter Montagesitz (23) ausgebildet ist, um einen die Kühlwasserpumpe (P) aufbauenden Pumpenkörper (31) anzubringen, wobei der erste Montagesitz (21) und der zweite Montagesitz (22) an der von dem dritte Montagesitz (23) entgegengesetzten anderen Oberfläche ausgebildet sind, und der erste Montagesitz (21) und der zweite Montagesitz (22) auf einer gemeinsamen Ebene liegen.

14. Gehäuseeinheit nach Anspruch 13, worin eine Verstärkungsrippe (R15) den ersten Montagesitz (21) und den zweiten Montagesitz (22) verbindet.

15. Gehäuseeinheit nach Anspruch 14, worin der zweite Montagesitz (22) eine Mehrzahl von Befestigungsabschnitten (K7, K8) zum Befestigen des Thermostatgehäuses an dem zweiten Montagesitz aufweist, und die Verstärkungsrippe (R15) einen (K7) der Befestigungsabschnitte, der dem ersten Montagesitz (21) am nächsten ist, mit einem Abschnitt des ersten Montagesitzes (21), der dem zweiten Montagesitz (22) näher ist, verbindet.

Revendications

1. Structure rigide unique (13) destinée à supporter un équipement auxiliaire pouvant être fixé de manière amovible au corps (1) d'un moteur, cette structure rigide unique (13) comprenant un carter de pompe à eau de refroidissement (30) et un carter de filtre à huile (40) intégré audit carter de pompe à eau de refroidissement (30),
dans laquelle une surface de fixation (25a) pour la jonction avec ledit corps de moteur (1) est disposée entre ledit carter de pompe à eau de refroidissement (30) et ledit carter de filtre à huile (40), un renfoncement est formé entre ledit carter de filtre à huile (40) et ledit carter de pompe à eau de refroidissement (30), et un autre équipement auxiliaire (G) est disposé dans ledit renfoncement, ladite structure rigide unique définissant à l'intérieur les trajets d'huile (50, 53) en communication avec un filtre à huile dans ledit carter de filtre à huile (40), un trajet d'entrée (33) en communication avec une chambre de pompe (32) à l'intérieur dudit carter de pompe à eau de refroidissement (30), et un trajet de sortie (34) en communication avec ladite chambre de pompe (32),
caractérisée en ce que ledit carter de pompe à eau de refroidissement (30) et ledit carter de filtre à huile (40) sont reliés par une partie centrale de la structure rigide unique (13), ledit renfoncement et ladite surface de fixation (25a) se trouvant sur des côtés opposés de celle-ci, lesdits trajets d'huile (50, 53), ledit trajet d'entrée (33) et ledit trajet de sortie (34) étant adjacents l'un à l'autre dans ladite partie centrale pour permettre l'échange thermique entre l'huile et l'eau de refroidissement via ladite partie centrale de la structure rigide unique (13).

2. Structure rigide unique selon la revendication 1 dans laquelle un équipement auxiliaire (A) autre qu'une pompe à eau de refroidissement (P) et un filtre à huile (F) est disposé entre ledit carter de pompe à eau de refroidissement (30) et ledit carter de filtre à huile (40).

3. Structure rigide unique selon la revendication 2 dans laquelle ledit carter de filtre à huile (40) est cylindrique et comporte au moins une partie de support (24) pour la fixation dudit autre équipement auxiliaire (A).

4. Structure rigide unique selon la revendication 1 ou 2 dans laquelle ledit carter de filtre à huile (40) est formé de façon à faire saillie, et des nervures (R7, R12) destinées à relier ledit carter de filtre à huile (40) et ledit carter de pompe à eau de refroidissement (30) sont formées dans ledit renfoncement.

5. Structure rigide unique selon la revendication 1 dans laquelle un refroidisseur d'huile (C) est présent, et au moins un (H5), parmi une pluralité de trous de boulons formés dans ladite surface de fixation (25a) pour la jonction avec ledit corps dudit moteur, s'ouvre sur une surface de ladite structure rigide unique proche dudit refroidisseur d'huile (C).

6. Structure rigide unique selon la revendication 1 ou 2, ladite surface de fixation (25a) pour la jonction avec ledit corps de moteur (1) présentant des ouvertures (34a, 50a, 56b, 57a) pour l'admission et l'évacuation de l'eau de refroidissement et de l'huile vers et depuis le corps de moteur ; ladite structure rigide comprenant : des éléments de fixation (K1, K3, K4) disposés le long de la circonférence de ladite surface de fixation (25a) ; et des nervures (R2, R4, R5) reliant ladite surface de fixation (25a) et lesdits éléments de fixation (K1, K3, K4).

7. Structure rigide unique selon la revendication 1 ou 2 dans laquelle un refroidisseur d'huile (C) est monté entre ledit carter de pompe à eau de refroidissement (30) et ledit carter de filtre à huile (40) et dans laquelle est présente une surface de raccordement (25a) pour l'amenée de l'huile et de l'eau de refroidissement vers et depuis ledit corps de moteur, entre ledit carter de pompe à eau de refroidissement (30) et ledit carter de filtre à huile (40).

8. Structure rigide unique selon la revendication 1 ou 2 dans laquelle est attaché un tendeur automatique (A).

9. Structure rigide unique selon la revendication 8 dans lequel ledit tendeur automatique (A) est attaché à un siège de support (24) formé entre une surface de fixation (25a) de ladite structure rigide unique pour la jonction avec ledit corps de moteur (1) et un autre équipement auxiliaire (F) à placer dans ladite structure rigide unique.

10. Structure rigide unique selon la revendication 8 dans laquelle ledit tendeur automatique (A) est attaché entre ledit carter de filtre à huile (40) et une surface de fixation (25a) de ladite structure rigide unique pour la jonction avec ledit corps de moteur (1).

11. Structure rigide unique selon la revendication 1 dans lequel lesdits trajets d'huile (50, 53) sont situés entre ledit trajet d'admission (33) et ledit trajet d'évacuation (34).

12. Structure rigide unique selon la revendication 1 dans laquelle un refroidisseur d'huile du type à eau (C) est fixé à ladite structure pour permettre à l'huile de circuler à l'intérieur, après être passée à travers ledit filtre à huile (F), ledit refroidisseur d'huile (C) étant configuré de telle sorte que l'huile est refroidie par échange thermique avec l'eau de refroidissement transférée par ledit trajet d'évacuation (34) et pour permettre à l'huile de revenir vers ledit trajet d'admission (33), et ledit refroidisseur d'huile (C) étant placé plus près de l'axe de rotation de ladite pompe à eau de refroidissement que ledit filtre à huile (F).

13. Structure rigide unique selon la revendication 1, ladite structure étant formée d'un premier siège de support (21) pour monter un refroidisseur d'huile à eau de refroidissement (C), recevant l'eau de refroidissement évacuée depuis une pompe à eau de refroidissement (P) comprenant ledit carter de pompe à eau de refroidissement (30), et d'un deuxième siège de support (22) pour monter un carter de thermostat (T), ladite structure présentant, formé sur une surface latérale, un troisième siège de support (23) pour monter un corps de pompe (31) constituant ladite pompe à eau de refroidissement (P), ledit premier siège de support (21) et ledit deuxième siège de support (22) étant formés sur l'autre surface de celle-ci à l'opposé dudit troisième siège de support (23), et ledit premier siège de support (21) et ledit deuxième siège de support (22) reposant sur un plan commun.

14. Structure rigide unique selon la revendication 13 dans laquelle une nervure de renforcement (R15) relie ledit premier siège de support (21) et ledit deuxième siège de support (22).

15. Structure rigide unique selon la revendication 14 dans laquelle ledit deuxième siège de support (22) comporte une pluralité d'éléments de fixation (K7, K8) pour fixer ledit carter de thermostat audit deuxième siège de support, et ladite nervure de renforcement (R15) relie l'un (K7) desdits éléments de fixation le plus proche du premier siège de support (21) à une partie dudit premier siège de support (21) plus proche dudit deuxième siège de support (22).

Fig.1

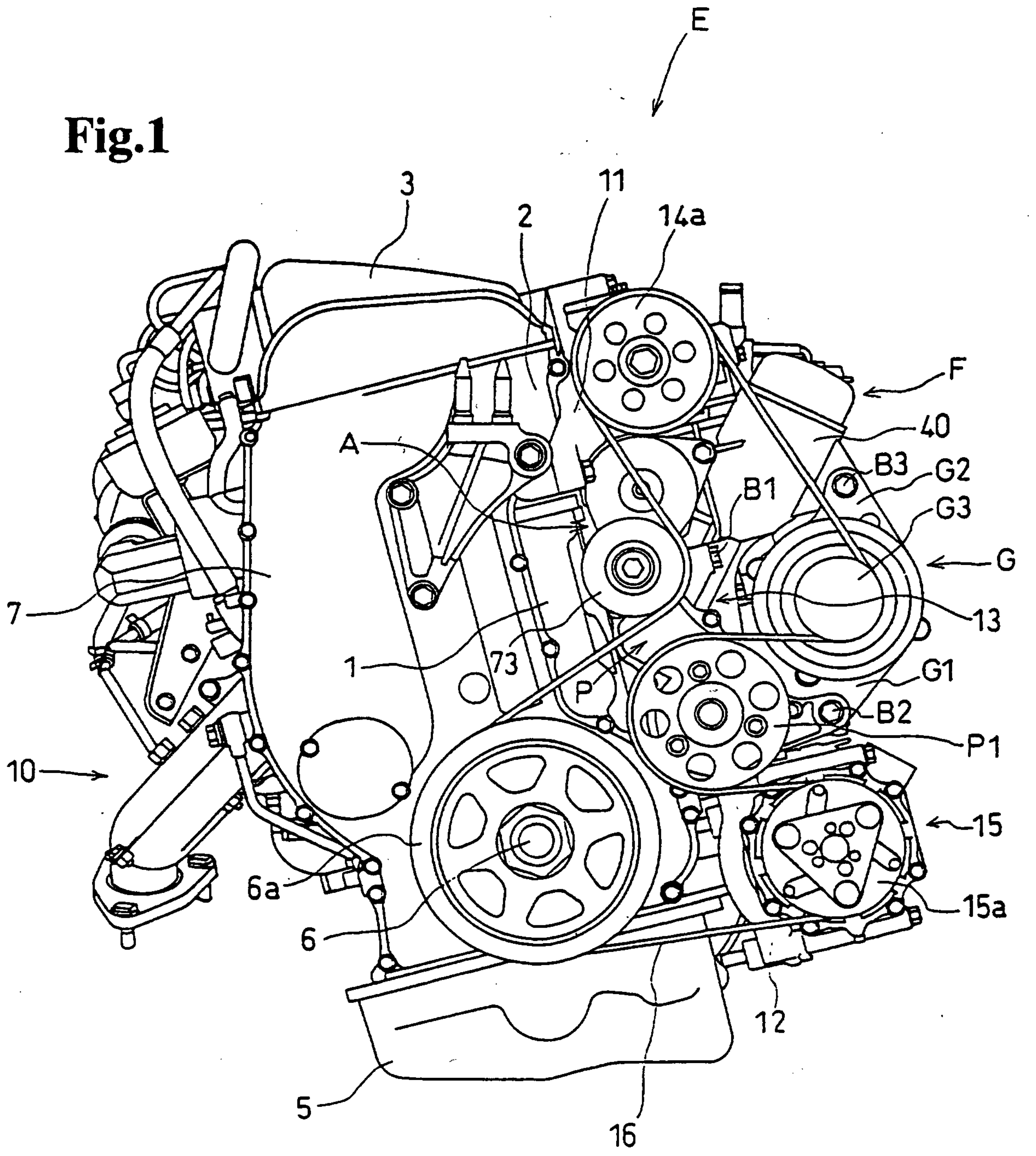


Fig.2

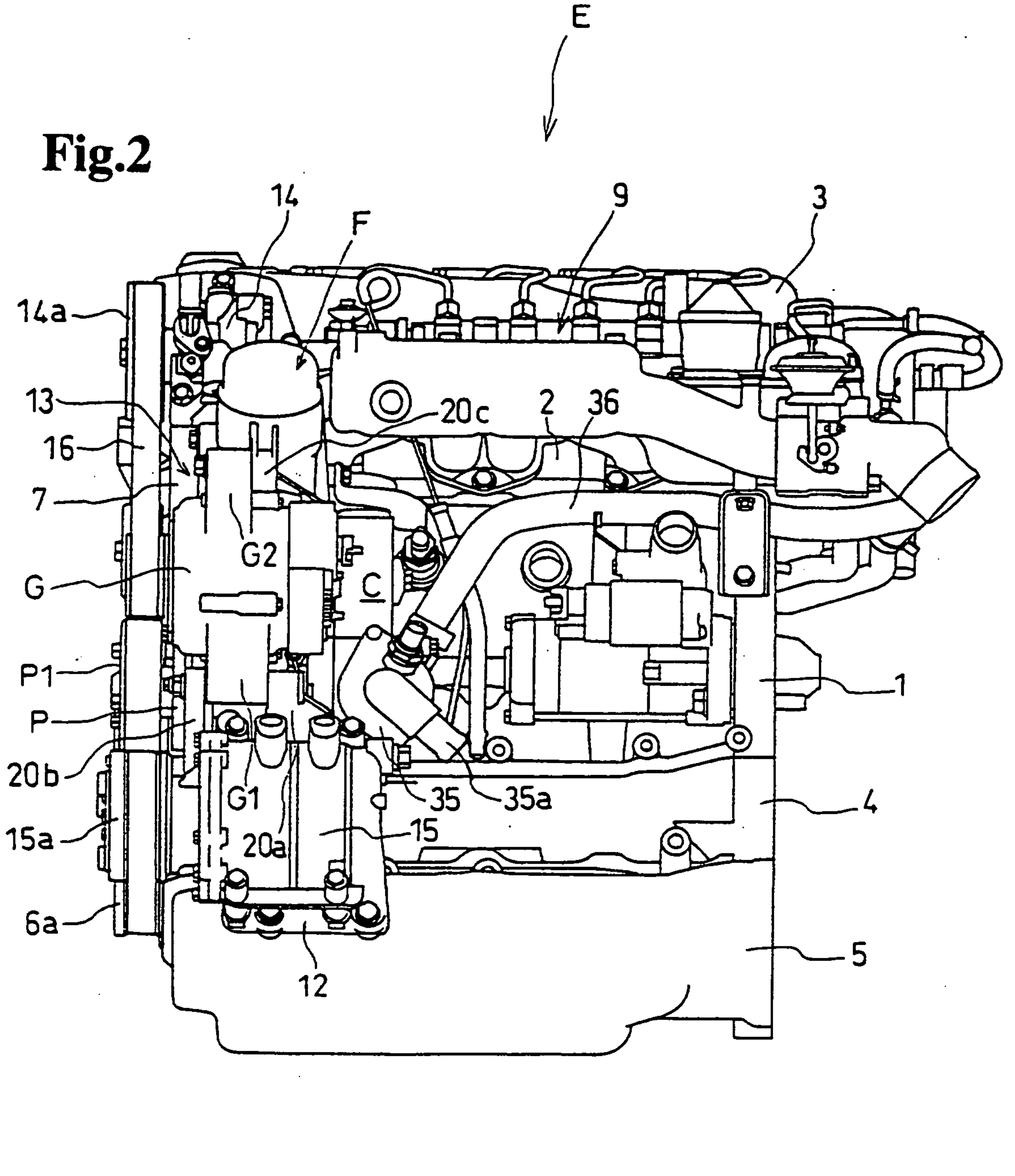
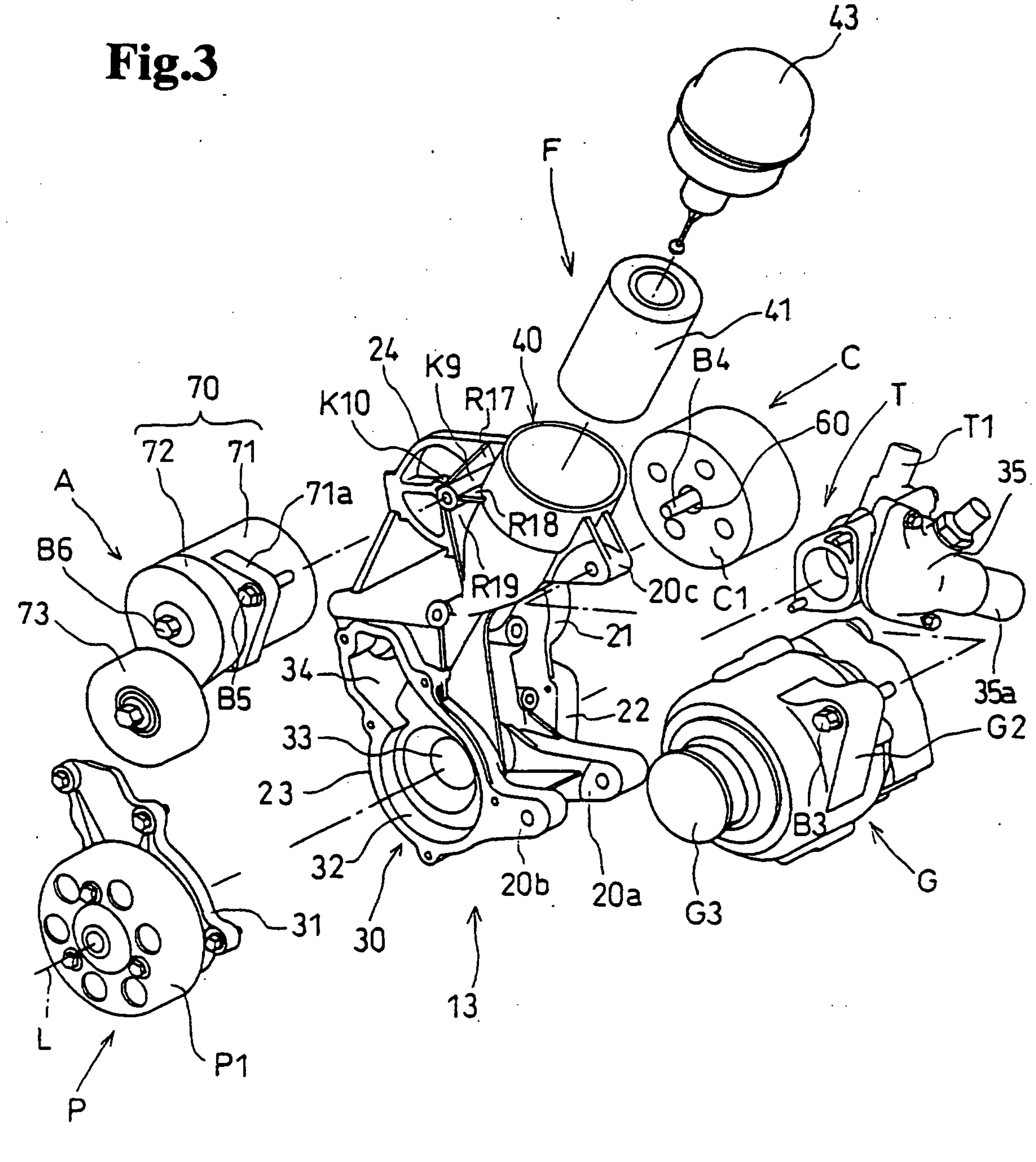
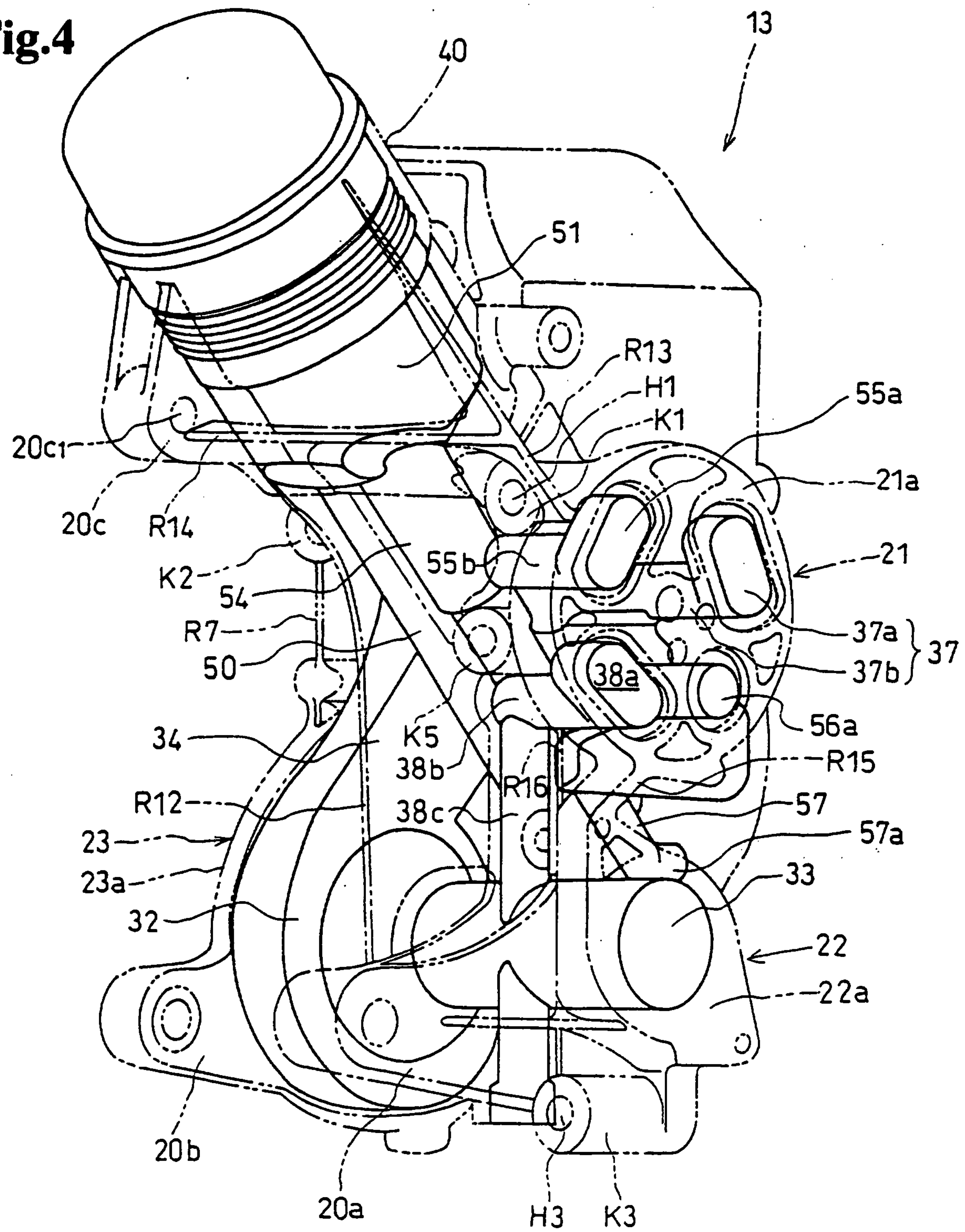

E
14
F
9
3
14a
13
16
7
G
P1
P
20b
15a
6a
20c
2
36
H
G2
C
G1
20a
35
35a
15
12
1
4
5

Fig.3



43
F
41
40
24
K9
B4
C
K10
R17
60
T
T1
70
72
71
71a
A
R18
35
B6
R19
20c
C1
73
21
34
B5
22
35a
G2
33
23
B3
32
20b
20a
G3
G
31
30
13
L
P1
P

Fig.4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40
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R13
H1
K1
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21a
21
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20c
R14
K2
54
55b
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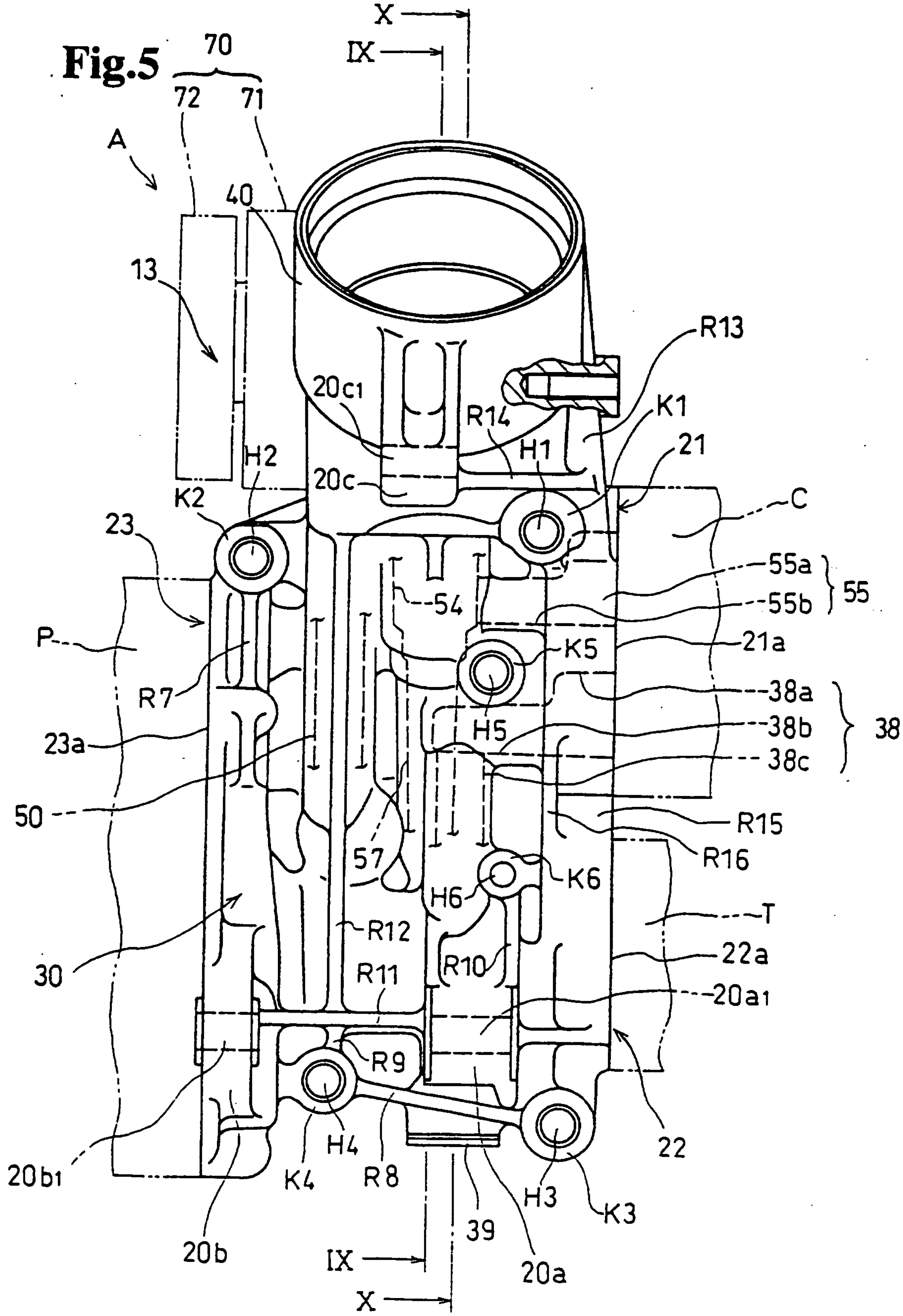
37a
37
37b
38a
56a
34
K5
38b
R15
R16
R12
38c
57
57a
23
23a
33
32
22
22a
20b
20a
H3
K3

Fig.5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H1
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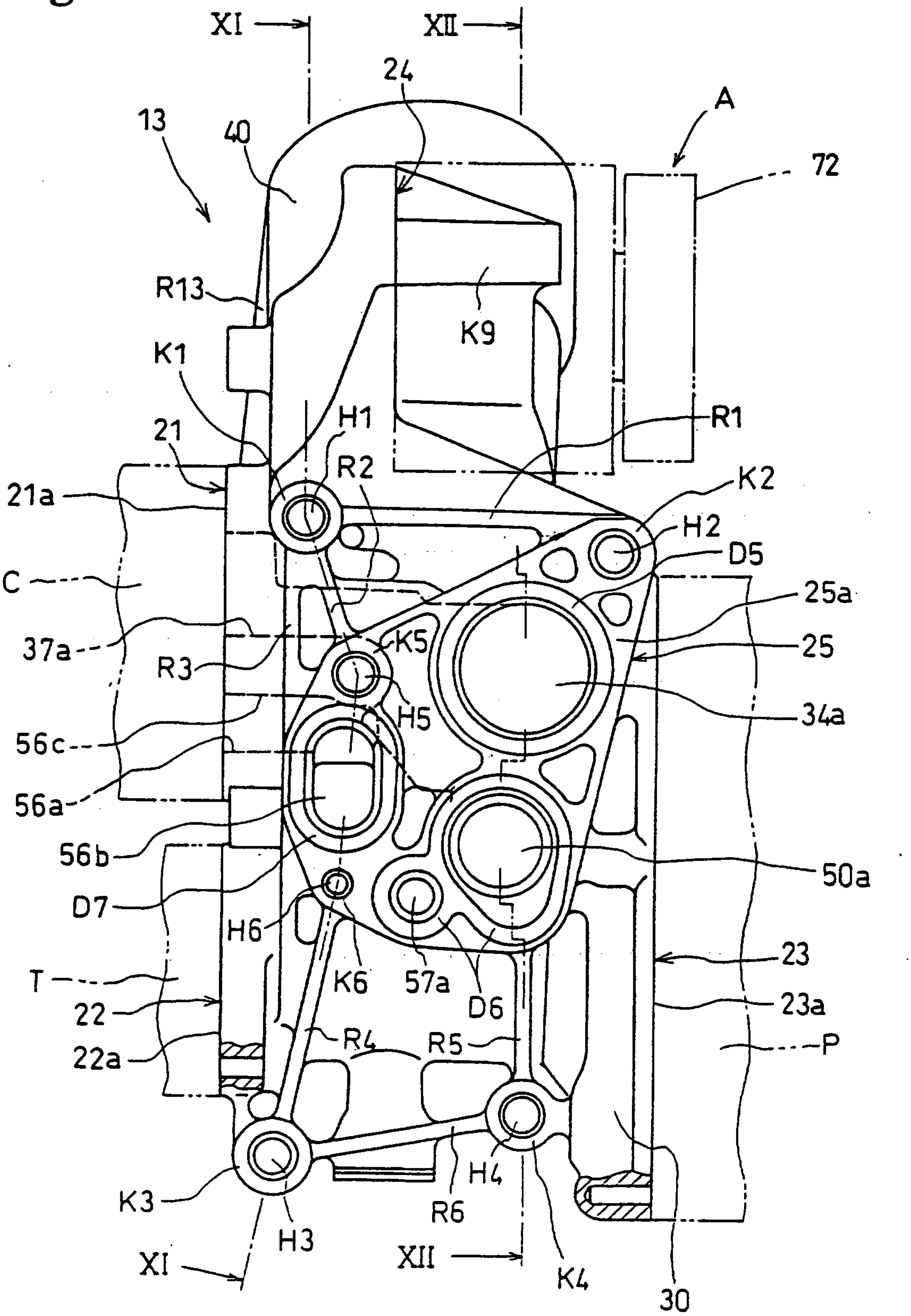
H2
20c
K2
C
23
55a
55
55b
54
P
21a
K5
R7
38a
38
38b
H5
23a
38c
50
R15
R16
57
K6
H6
T
R12
22a
R11
R10
20a1
30
R9
20b1
K4
H4
R8
H3
K3
22
39
20b
20a

Fig.6


XI
XII
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13
40
72
R13
K9
K1
R1
H1
21
R2
K2
21a
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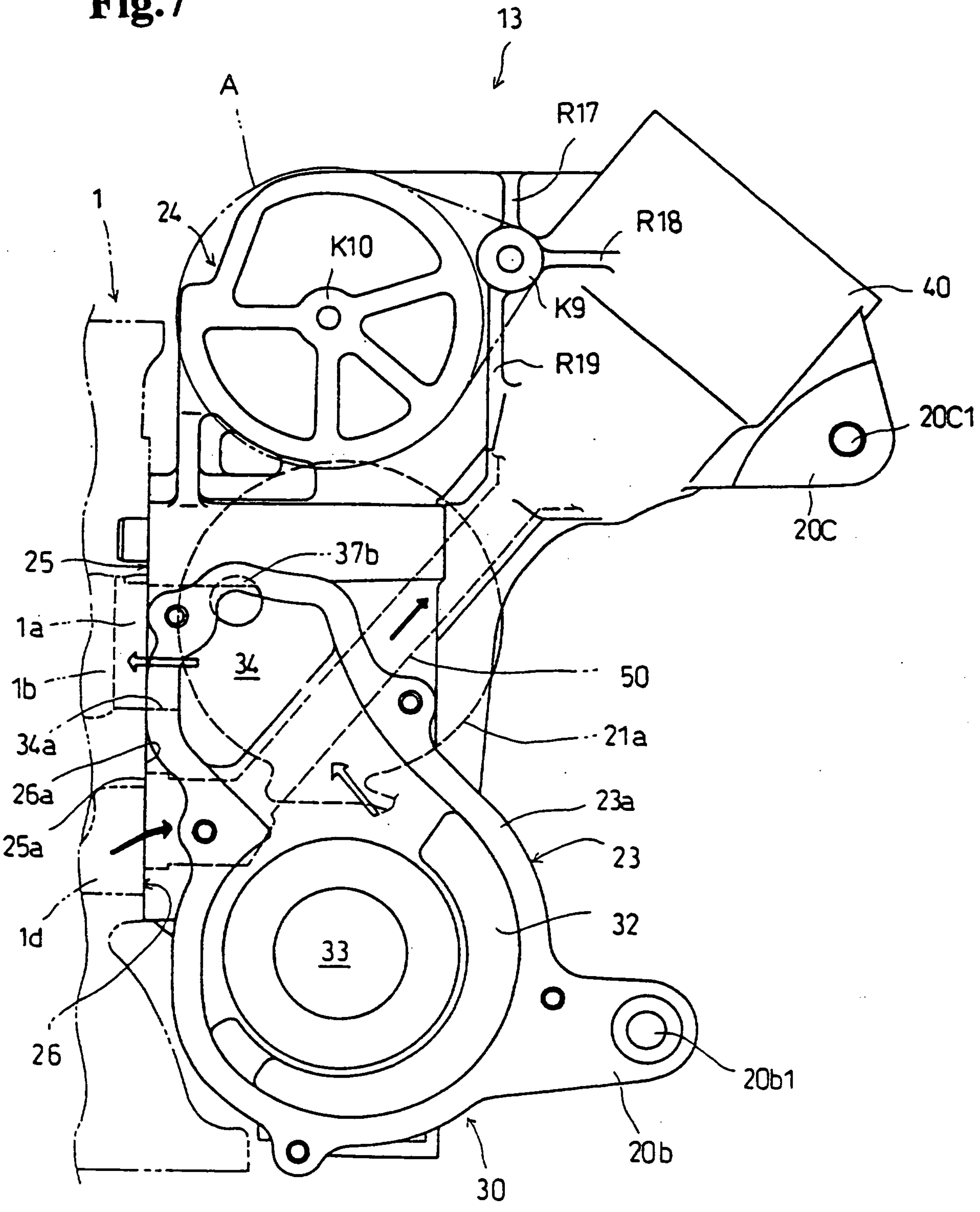
D5
C
25a
37a
K5
25
R3
H5
34a
56c
56a
56b
50a
D7
H6
T
K6
57a
23
D6
22
23a
22a
R4
R5
P
K3
H4
H3
R6
XI
XII
K4
30

Fig.7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A
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K10
K9
40
R19
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20C
25
37b
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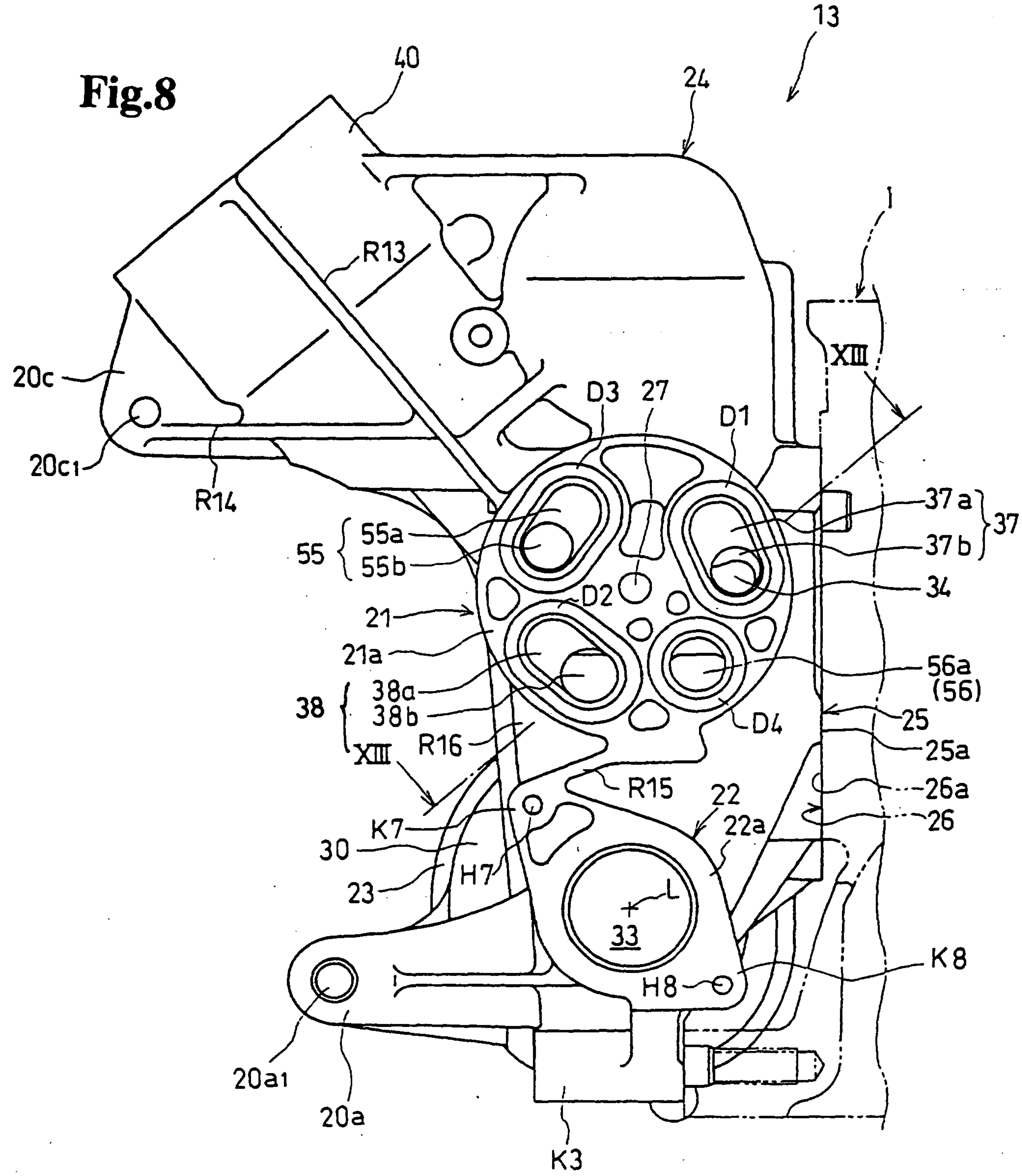
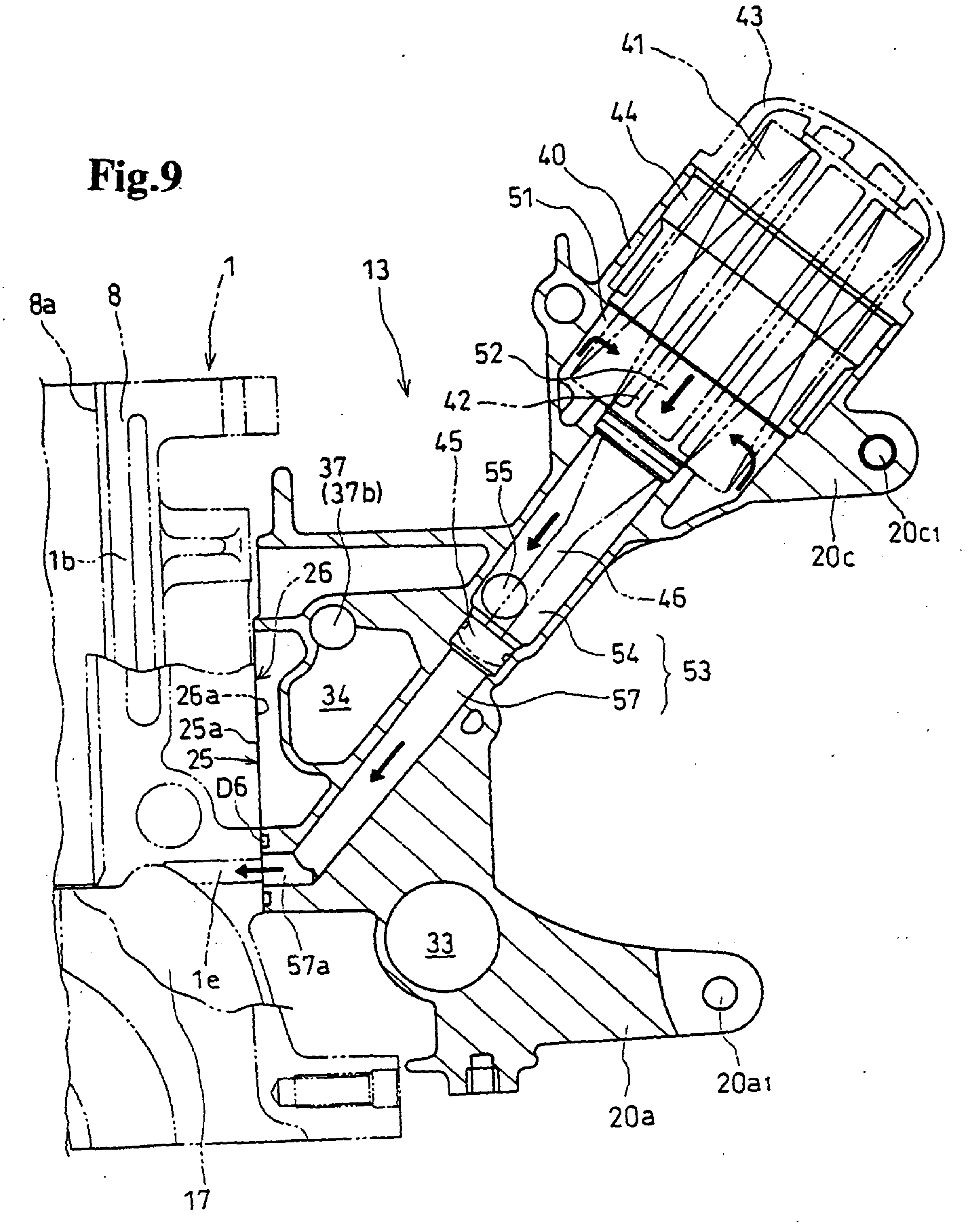
50
34
1b
21a
34a
26a
23a
25a
23
1d
32
33
26
20b1
20b
30

Fig.8



13
40
24
R13
I
XIII
20c
20c1
R14
D3
27
D1
37a
37
37b
55
55a
55b
34
D2
21
21a
56a
(56)
38
38a
38b
D4
25
R16
25a
XIII
R15
26a
22
26
K7
22a
30
H7
23
L
33
K8
H8
20a1
20a
K3

Fig.9



43
41
44
40
51
1
13
8a
8
52
42
45
37
(37b)
55
20c1
20c
46
1b
26
54
53
26a
34
57
25a
25
D6
33
57a
1e
20a1
20a
17

Fig.10

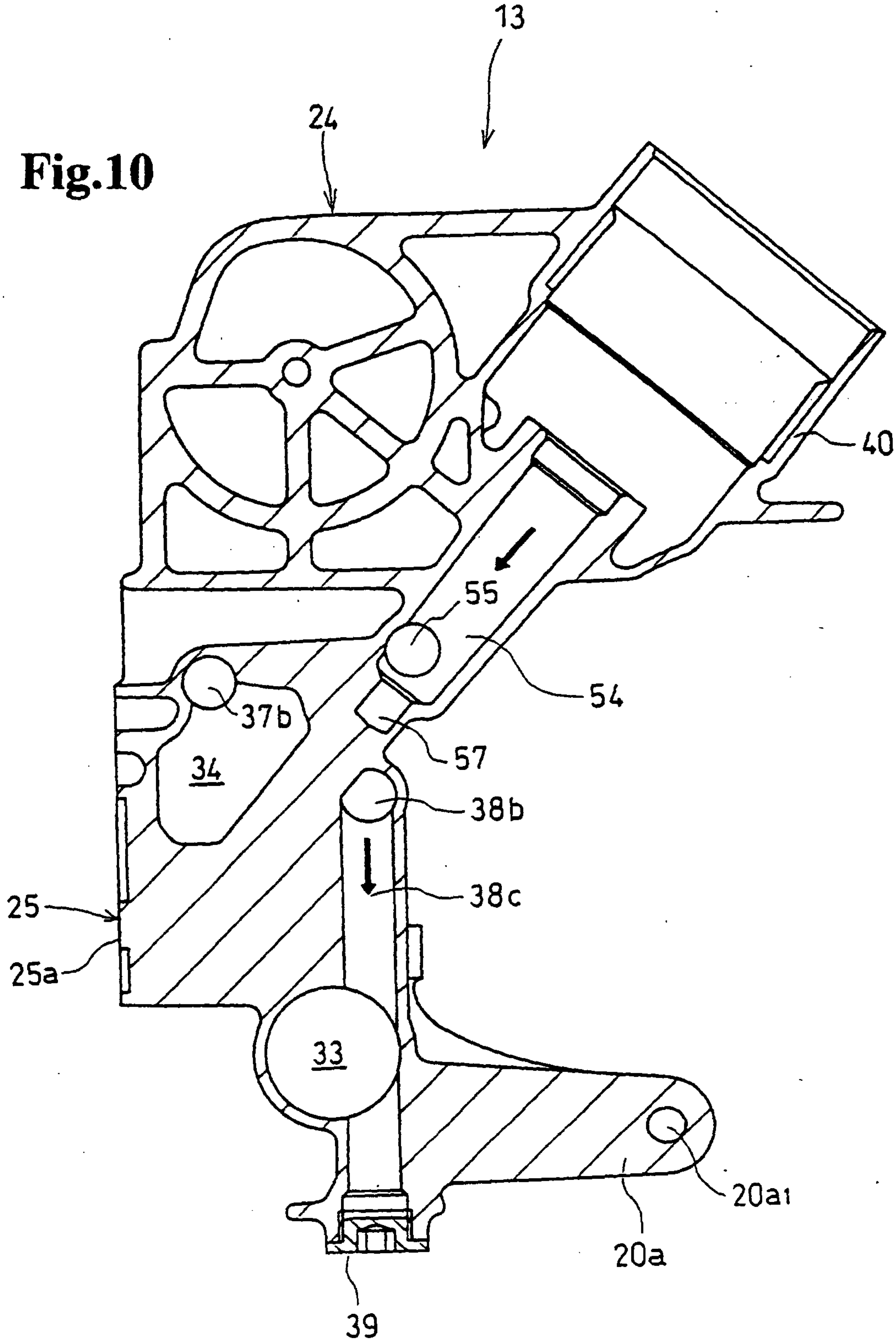


Fig.11

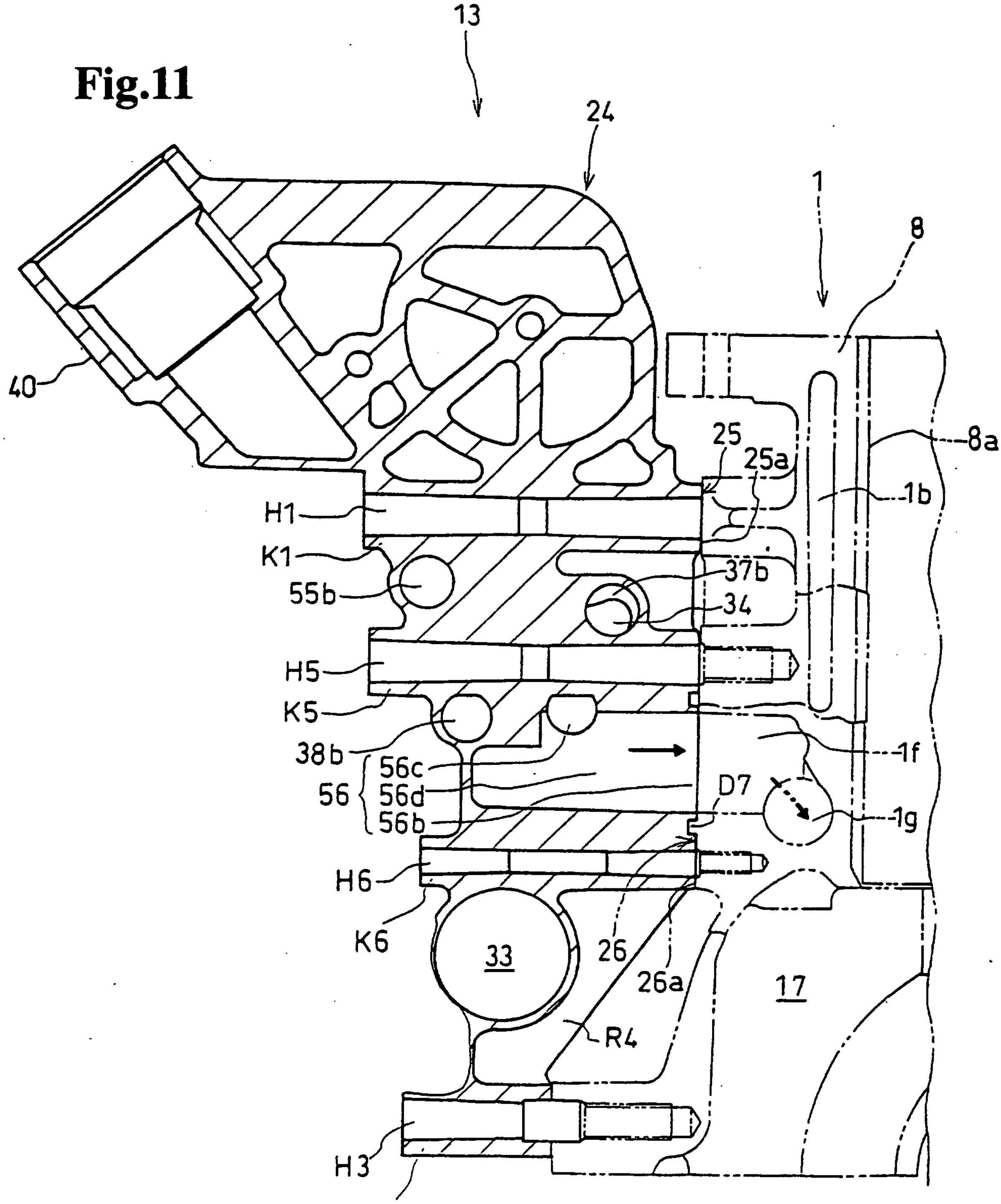
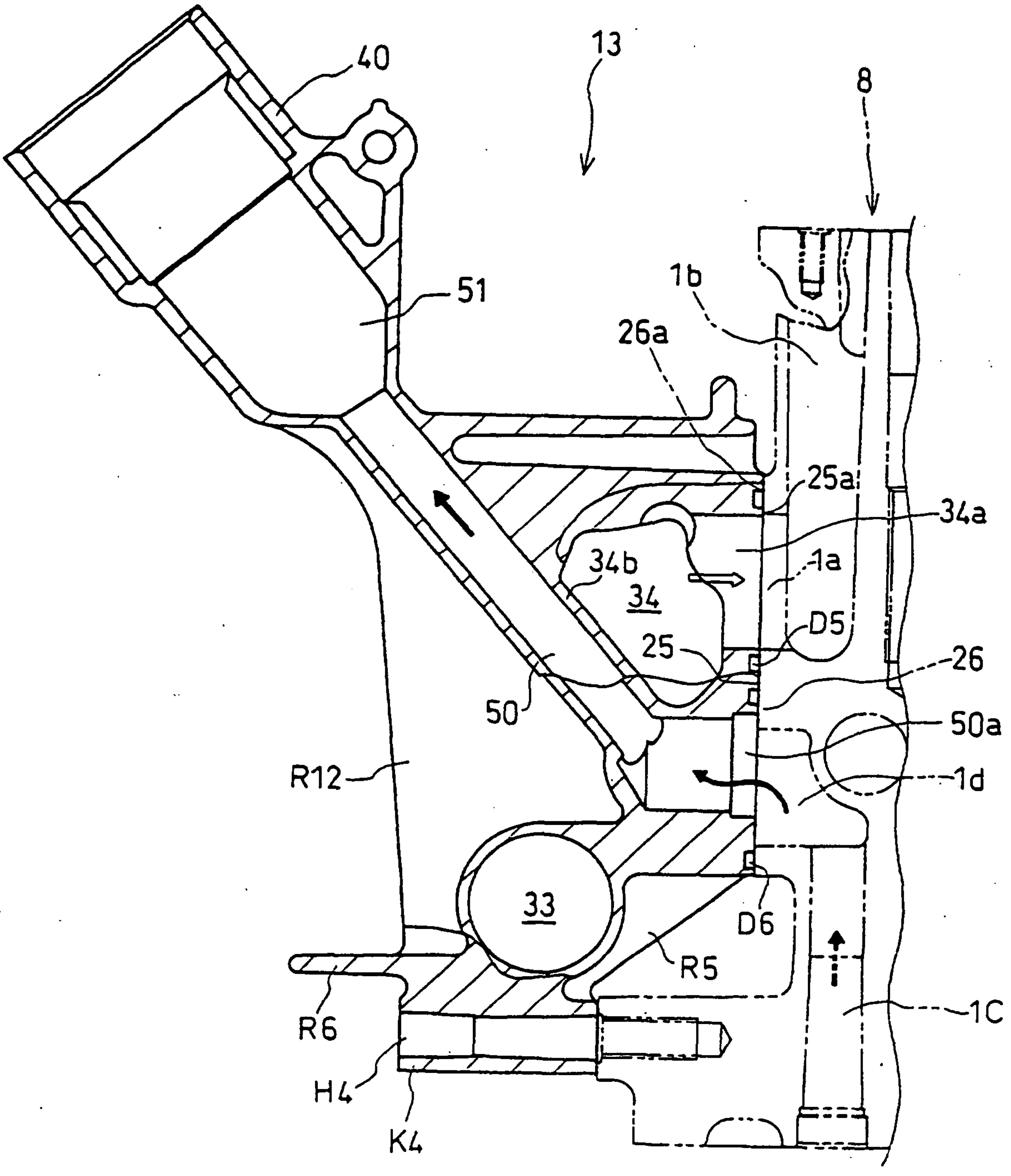

13
24
1
8
8a
40
25
25a
1b
H1
K1
37b
55b
34
H5
K5
1f
38b
56c
56
56d
D7
56b
1g
H6
K6
26
33
26a
17
R4
H3
K3

Fig.12



40
13
8
51
1b
26a
25a
34a
34b
1a
34
D5
25
26
50
50a
R12
1d
33
D6
R5
1C
R6
H4
K4

Fig.13

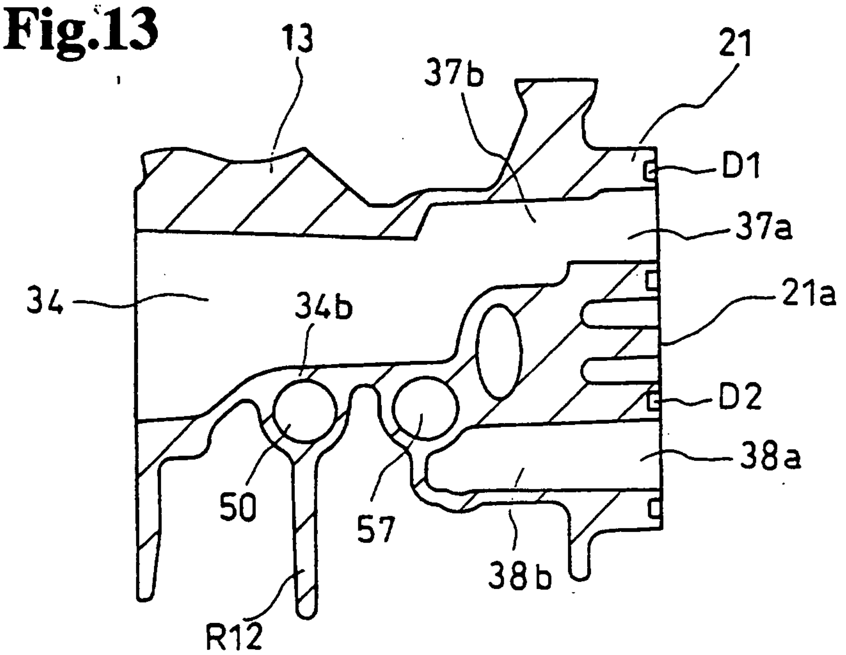


Fig.14

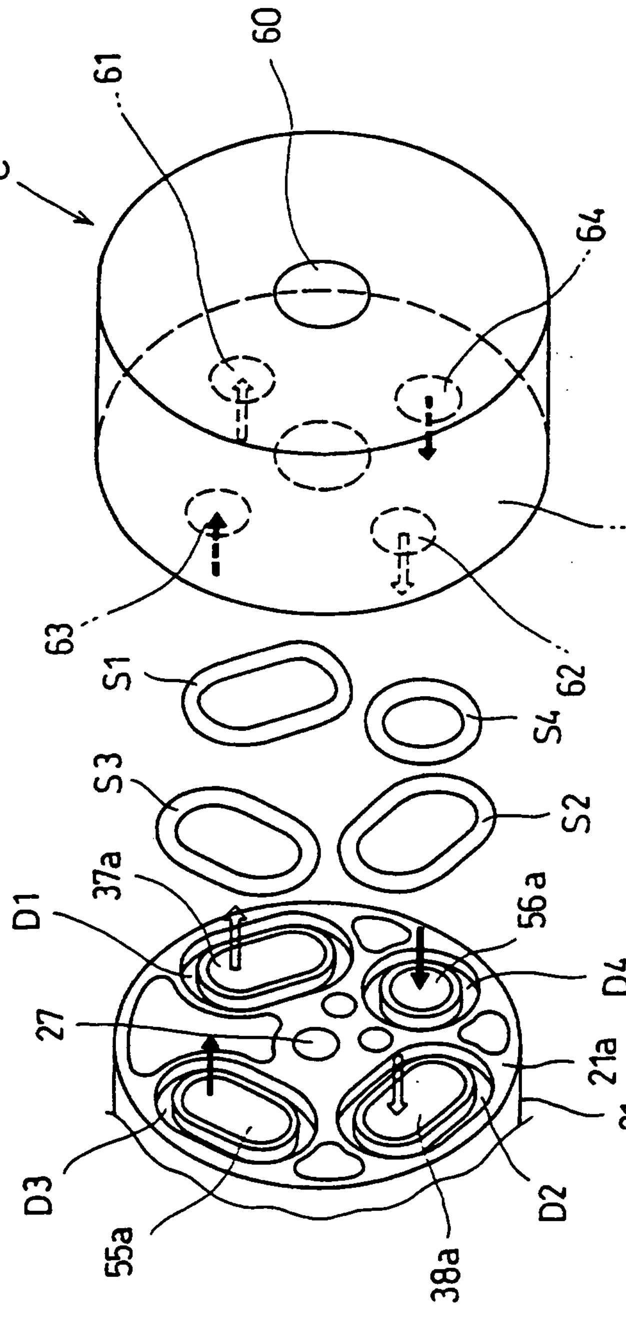
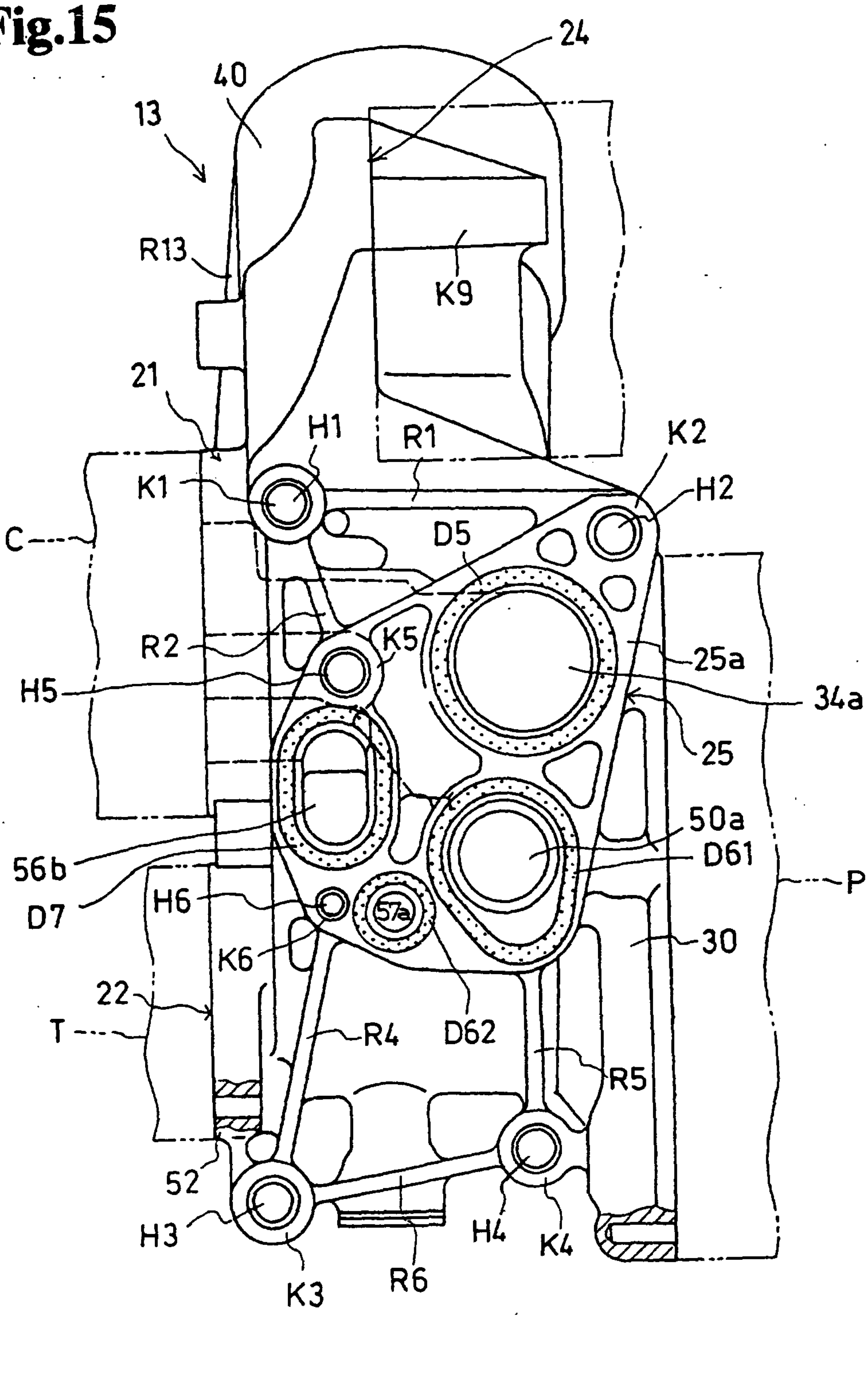


Fig.15



24
40
13
R13
K9
21
H1
R1
K2
K1
H2
C
D5
R2
K5
25a
H5
34a
25
50a
56b
D61
P
D7
H6
57a
K6
30
22
T
R4
D62
R5
52
H3
H4
K4
K3
R6