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

(11) Publication number: **0 406 697 A1**

# (12) EUROPEAN PATENT APPLICATION

(21) Application number: **90112310.9**

(51) Int. Cl.5: **F01L 1/02**

(22) Date of filing: **27.06.90**

The title of the invention has been amended (Guidelines for Examination in the EPO, A-III, 7.3).

(30) Priority: **23.08.89 JP 216994/89**
**06.07.89 JP 174675/89**

(43) Date of publication of application:
**09.01.91 Bulletin 91/02**

(84) Designated Contracting States:
**DE ES FR GB IT**

(71) Applicant: **YAMAHA HATSUDOKI KABUSHIKI KAISHA**
**2500 Shingai**
**Iwata-shi Shizuoka-ken, 438(JP)**

(72) Inventor: **Okui, Kaoru**
**161-158 Toshin-cho**
**Iwata-shi, Shizuoka-ken 438(JP)**
Inventor: **Kobayashi, Manabu**
**4-1-3 Fujimi-cho**
**Iwata-shi, Shizuoka-ken 438(JP)**

(74) Representative: **Patentanwälte Grünecker, Kinkeldey, Stockmair & Partnerner**
**Maximilianstrasse 58**
**D-8000 München 22(DE)**

## (54) Automotive internal-combustion engine with camshaft drive system.

(57) The present invention relates to an automotive internal combustion engine comprising a crankshaft (6), an output shaft (30) above said crankshaft and a countershaft (31) for transmitting the output power of the crankshaft to a plurality of camshafts (37) disposed at the top of the engine with the improvement that the countershaft is supported rotatably on the cylinder head (11) of the engine disposing the transmission elements which are adapted to transmit drive energy from the output shaft (30) to the camshafts (37) at accommodation openings of the cylinder head resulting in a compacted structure of the engine.

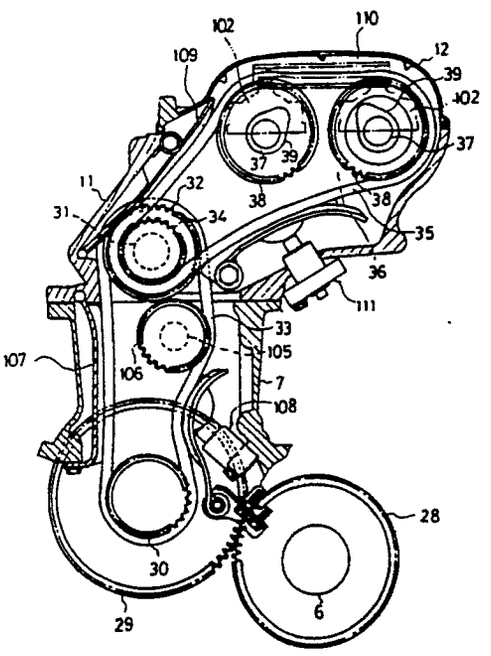


FIG. 8

EP 0 406 697 A1

# AUTOMOTIVE INTERNAL COMBUSTION ENGINE

The present invention relates to an internal combustion engine for automotive vehicles as indicated in the preamble portion of Claim 1. Specifically, the present invention relates to an internal combustion engine having its camshafts for operating the intake and exhaust valves disposed on the cylinder head above the combustion chambers of the engine.

In a well-known type of vehicle engines in which intake and exhaust valves are operated through camshafts journalled on the cylinder head, the sprocket wheel for driving the camshafts through a wrapping transmission member is mounted on the crankshaft. Moreover, it is common that the clutch, such as a single-disc dry friction clutch for a manual transmission or a torque converter for an automatic transmission having a relatively large diameter, is mounted on one end of the crankshaft.

In case the drive sprocket wheel for driving the camshafts is mounted on the crankshaft the overall length of the engine unit tends to be increased in the direction of the crankshaft axis.

In increased engine design there is a tendency to render the engine as light and compact as possible and, therefore, it is undesirable to increase the overall length of the internal combustion engine more than necessary. In particular, for transverse engines, i.e. internal combustion engines which are accommodated in an engine compartment in transverse direction, having the crankshaft axis to extend substantially perpendicularly to the travelling direction of the vehicle, the overall length of the laterally extending engine should not be unnecessarily increased.

In order to approach said objectives it has already been deliberated to arrange an output shaft which is disposed slightly above the crankshaft for distributing the output power of the crankshaft to the clutch and associated transmission and, moreover, transferring drive energy to auxiliary equipment as well as to the camshafts of the engine. Accordingly, a countershaft is located above the output shaft with a first wrapping transmission means provided for drivingly connecting the countershaft with the output shaft and a second wrapping transmission means for connecting the camshafts with the countershaft. Adopting such a layout may facilitate the assembly of the internal combustion engine on the body frame of the vehicle disposing the sprocket for driving the wrapping transmission means at a position thus that said sprocket will not axially overlap with the crankshaft, resulting that the overall length of the engine at its lower portion thereof is reduced in axial direction of the crankshaft.

As indicated above it is common to mount the clutch, which has a relatively large diameter, on one end of the crankshaft. In that case drawbacks have been encountered in that the clutch projects downwards from the oil pan causing the engine height to increase and the distance to the ground to be undesirably lowered. Again, selecting a concept in which the clutch is supported by the output shaft disposed above the crankshaft, the afore-indicated problem can be eliminated raising the mounting position of the clutch. Nonetheless, in cases where the clutch has such a considerable diameter that the clutch may overlap axially with the crankshaft, the clutch may interfere with the countershaft disposed above the output shaft, as mentioned above, thus preventing the clutch from being mounted sufficiently higher resulting in an undesirable bulky engine structure. Moreover, the room available for design considerations rendering the engine more compact cannot be used as desired.

Finally, a more upwardly shifted journalling of the countershaft may provoke difficulties with respect to the layout of the drive mechanism for rotating the camshafts as then, said drive mechanism tends to interfere with the cylinder head structure.

Accordingly, the present invention aims to acquire a compacted engine design preventing a clutch on an output shaft from interfering with a second transmission means adapted to drive camshafts of the engine, even if that clutch is disposed on a relatively high position.

The afore-identified objective is accomplished in that the countershaft is journalled on the cylinder head of the engine and, in turn, supports a pair of transmission elements which form part of the first and second wrapping transmission means wherein at least one of said transmission elements being projected into an accommodation opening of the cylinder head formed in between intake ports of adjacent cylinders.

In such a manner, the countershaft can be located at a sufficiently elevated level journalled on the cylinder head of the engine enabling the clutch means to be supported on the output shaft, enabling the clutch to overlap axially with the crankshaft without interfering with the countershaft or a second drive means transmitting the rotational power of the countershaft to the camshafts at the top of the engine. Further preferred embodiments of the present invention are laid down in the subclaims.

Further objectives, features and advantages of the present invention will become more apparent

from the following description of specific embodiments of the present invention in conjunction with the associated drawings, wherein:

Fig. 1 is a side view showing the assembled state of an internal combustion engine according to an embodiment of the present invention.

Fig. 2 is a plan view of Fig. 1.

Fig. 3 is another side view of the internal combustion engine of Fig. 1 from the opposite side.

Fig. 4 is a front view of the internal combustion engine of Fig. 1.

Figs. 5 and 6 are partially broken away side views of the internal combustion engine according to the embodiment shown in Fig. 1.

Fig. 7 is a sectional view along the line VII-VII in Fig. 4 with a manual transmission for transmitting output power to the wheel shafts.

Fig. 8 is a side view showing the mechanism for transmitting the output power of the engine from the crankshaft to the camshafts.

Fig. 9 is a sectional view along the line IX-IX in Fig. 6.

Fig. 10 is an view along the arrow B in Fig. 6 showing the arrangement of the countershaft and the first and second wrapping transmission means associated thereto.

Fig. 11 is a plan view similar to the view of Fig. 10.

Fig. 12 is a partial sectional view similar to the right-hand side of Fig. 7 but with an automatic transmission associated to an output shaft of the engine.

In Figs. 1 and 2, the reference number 1 denotes the engine compartment of an automobile formed above and between the right and left front wheels 3 connected through front wheel shafts 2. Within this engine compartment 1 is mounted an engine unit 4 having a 4-stroke 6-cylinder internal combustion engine with its radiator 5 arranged in front of this engine unit 4. The engine compartment 1 has been made smaller by disposing the engine crankshaft 6 laterally of the vehicle to make the passenger compartment as spacious as possible.

The engine crankshaft 6 is journalled between the cylinder block 7 and the bearing case 8 as shown in Figs. 5 to 7, and is connected with each piston 9 in the respective cylinder formed within the cylinder block 7 through the respective connecting rod 10.

On the cylinder block 7 is mounted a cylinder head 11 constituting the engine E, on which cylinder head 11 is provided a head cover 12, and each cylinder is provided with an ignition plug 13.

The bearing case 8 is provided with an oil pan 14 connected with an oil tank 15.

As shown in Figs. 5 and 6, the cylinder bank of the engine is inclined from the verticality backward of the vehicle. An output shaft 16 for taking out the output power of the crankshaft 6 is disposed in parallel with the crankshaft 6 and further, as shown in Fig. 5, is disposed slantly forwardly above the crankshaft 6. The oil tank 15 reserving engine oil is located slantly forwardly under the crankshaft 6 and the power output shaft 16 is thus faced forwardly of the vehicle as shown by the arrow mark FWD in Figs. 3, 5 and 6. By positioning the power output shaft 16 in such a manner that the angle $\alpha$ formed between the cylinder axis plane L1 and the plane L2 including both of the crankshaft 6 axis and the output shaft 16 axis may be an acute angle, the distance between the output shaft 16 and the front wheel shafts 2 can be reduced, and thus the engine width can be reduced longitudinally of the vehicle.

The oil pan 14 has a pair of oil passages 17 formed vertically as shown in Fig. 5, and the engine oil collected in the oil pan 14 is sucked in through the inlet port 17a at the bottom of the oil passage 17 and is sent to the oil tank 15 by discharge pumps 18 and 19 mounted on the power output shaft 16. The oil pan 14 and the oil tank 15 is partitioned by a wall provided with oil passages 17.

The oil reserved in the tank 15 is sucked through a strainer 25 and a pipe 26 disposed at the bottom of tank 15 and then is fed to various lubricating points in the engine by the oil pump 24 provided on the output shaft 16 through an oil cooler 22 and an oil filter 23. This flow of oil is shown by arrows in Fig. 5.

As shown in Figs. 7 through 9, the crankshaft 6 has a gear 28 formed around one of its crankarms, and this gear 28 is in engagement with the gear 29 mounted on the power output shaft 16. The reduction ratio from the crankshaft 6 to the power output shaft 16 through gears 28 and 29 is 0.8.

Power transmission from the crankshaft 6 to the output shaft 16 is not limited to through gears 28 and 29 as described above, but may be through a chain, and the gears or the chain may be arbitrarily positioned at one end of the crankshaft or midway of it.

A countershaft 31 is journalled on the cylinder head 11 on one side of the cylinder block 7, and the gear 30 provided on the power output shaft 16 is connected to the gear 32 on the countershaft 31 through a first chain 33, a first wrapping transmission means, with a reduction ratio of, e.g., 0.9. Further, the gear 34 mounted on this countershaft 31 is connected to the gears 38 on the camshafts 37 for the valve operating mechanism 36 through a second chain 35, a second wrapping transmission means, with a reduction ratio of, e.g., 0.7, so that the camshafts 37 may be rotated by the rotation of the crankshaft 6.

Since the rotation of the crankshaft 6 is trans-

mitted to the camshafts 37 through three steps of speed reduction, that is through gears 28 and 29, through the first chain 33 and through the second chain 35 as described above, the diameter of the gears 38 on camshafts 37 can be reduced. The cams 39 formed integrally with the camshafts 37 are rotated together with the camshafts 37 and operate the intake and exhaust valves 100 and 101 to open/close the intake and exhaust passages 11a and 11b formed through the cylinder head with predetermined timings. The reference number 103 denotes a fuel injector.

The first chain 33 is engaged also with a gear 106 on the drive shaft 105 journalled on the cylinder block 7 for driving the water pump 104 as shown in Fig. 9. The first chain 33 is prevented from swinging by a chain guide 107 and a chain tensioner 108 provided on the cylinder block 7 as shown in Fig. 8. Similarly, the second chain 35 is prevented from swinging by a chain guide 109 provided on the cylinder head 11, a chain guide 110 mounted on the cam cap 102 and a chain tensioner 111 provided on the cylinder head 11.

The countershaft 31 is journalled on the cylinder head 11 above the power output shaft 16 and under the intake passage 11a and an intake pipe 41 leading from this intake passage 11a to a surge tank 42. The first chain 33 is extended along the cylinder axes, and further, as shown in Figs. 9 through 11, is positioned between the cylinders X1 and X2 on one side of the cylinder X1. The second chain 35 is positioned on the other side of the cylinder X1 on one side of the engine.

Although the countershaft 31 may be positioned above the intake pipe 41, the engine width can be further reduced axially of the crankshaft by positioning the countershaft 31 under the intake pipe 41 as with this embodiment, because, while the second chain 35 is positioned on one side of the engine, the first chain 33 is prevented from passing between intake pipes for adjacent cylinders.

In the case where the exhaust pipe 40 is provided at the position of the intake pipe 41, the countershaft 31 is positioned under the exhaust pipe 40.

As shown in Figs. 9 and 10, since the gear 32 and the swelling 115 provided on the cylinder head 11 to cover the gear 32 are positioned between intake ports 11c for adjacent cylinders X1 and X2, the mounting distance between intake pipes 41 will not be enlarged although the countershaft 31 is journalled on the cylinder head 11.

The place for the first and the second chains 33 and 35 to be positioned is not particularly limited, but the first chain, for example, may be positioned between the cylinders X2 and X3. Further, it is possible to extend the first chain 33 along the second chain 35 or to dispose the first chain 33 on the opposite side of the second chain 35.

In the case of an automobile, although its body frame usually passes under and beside the engine, since the power for driving the camshafts 37 through the chains 33 and 35 is taken out by the power output shaft 16 positioned above the crankshaft 6, the engine width at its lower portion axially of the crankshaft can be reduced making it possible to mount the engine unit without interference with the body frame.

Further, since the countershaft 31 is provided on the cylinder head 11, it is only necessary to remove the first chain 33 to dismount the cylinder head 11 for engine maintenance, and since the second chain 35 may be left wrapped around the countershaft 31 and camshafts 37, the cam positions of the intake camshaft and the exhaust camshaft will not be altered by dismounting causing cam timing discrepancy, which makes the engine maintenance work easier.

Further, the cylinder head 11 supporting the countershaft 31 has accommodation openings 112 and 113 formed for accommodating gears 32 and 34 both mounted on the countershaft 31, and covered by a cap 114 and a cover 116, respectively.

The accommodation opening 112 on the side to which is connected the first chain 33 is opened slantly upward, so that the gear 32 on the countershaft 31 and the first chain 33 may be easily mounted or dismounted using tools inserted from top.

As shown in Fig. 7, on one end of the output shaft 16 is provided a flywheel 45 and a single-disc dry friction clutch 400 for a manual transmission in such a manner that it overlaps with the crankshaft 6 axially of the crankshaft, so that the power may be transmitted to the front wheel shafts 2 for front wheels 3 through a transmission 47. "With the crankshaft 16" means, not with the domain D1 formed by the journal portion 6a of the crankshaft 6 journalled on the cylinder block 7, but with the domain D2 formed by the rotation of the crankarm 6b of the crankshaft 6.

The friction clutch 400 has a structure shown in Fig. 7, in which a pressure plate 402 is supported by a clutch cover 401 movably back and forth, and this pressure plate 402 is moved back and forth by a spring 403. When this pressure plate 402 presses the clutch disc 404 against the flywheel 45, the clutch is engaged to transmit the turning effort of the power output shaft 16 to the transmission 47 through the transmission input shaft 405.

By mounting the flywheel 45 and the friction clutch 400 with a large diameter on the power output shaft 16 as mentioned above, the engine height can be reduced as compared with the case where they are mounted on the crankshaft 6. Fur-

ther, since the countershaft 31 provided above the power output shaft 16 is journalled on the cylinder head 11, the power output shaft 16 can be journalled at a higher position by bringing the friction clutch 400 near the countershaft 31, thus the friction clutch 400 with a large diameter will not project downward lower than the oil pan 14, which makes it possible further to reduce the engine height.

The primary side of the transmission 47 is disposed on the power output shaft 16, and the secondary side is disposed on a countershaft 48 to rotate the front wheel shaft 2 through a gear 49 provided on the wheel shaft 2.

The friction clutch 400 and the transmission 47 is covered by a transmission case 406 which is provided in connection with one side of the cylinder block 7, and the second chain 35 is provided in such a manner that it covers the transmission case 406 from top.

On the other end of the power output shaft 16 is provided an auxiliary drive pulley 50 as shown in Fig. 5, and a belt 55 is wrapped around this auxiliary drive pulley 50 and the auxiliary pulleys for auxiliaries such as alternator 52, power steering pump 53, air compressor 54, etc. The reference number 92 denotes an idler pulley.

Fig. 12 is a sectional view of a vehicle engine unit showing another embodiment of this invention.

While the first embodiment shown in Figs. 1 through 11 is for the vehicle engine unit provided with a manual transmission, the embodiment shown in Fig. 12 is for the vehicle engine unit provided with an automatic transmission and the description for the rest is not repeated because the rest is constructed in the same manner as the first embodiment above.

On one end of the power output shaft 16 is secured a drive plate 500 through bolts 501, and on this drive plate 500 is fixed, through bolts 504, a pump impeller 503 for the torque converter 502 constituting this automatic transmission. Opposite to this pump impeller 503 is disposed a turbine runner 505, which is spline-engaged with a transmission input shaft 506, and a stator 507 is provided on the stator shaft 509 through a one-way clutch 508.

Accordingly, the rotation of the crankshaft 6 is transmitted to the output shaft 16 through gears 28 and 29, and then to the torque converter 502 through the drive plate 500. Here, the turning effort of the pump impeller 503 is transmitted to the turbine runner 505 through fluid, through which the transmission input shaft 506 is rotated and transmits the rotation to the front wheel shaft through a planetary gear unit not shown, thus the torque converter 502 constitutes a clutch.

As mentioned above, since the vehicle engine unit according to this invention has an output shaft disposed slantly above and in parallel with the crankshaft for transmitting the output power of the crankshaft, a countershaft located above the output shaft and journalled on its cylinder head, a first wrapping transmission means for connecting the countershaft with the power output shaft, and a second wrapping transmission means for connecting its camshafts for operating its intake and exhaust valves with the countershaft, the output of the crankshaft can be derived at a position higher than the crankshaft and not overlapping with the crankshaft, and therefore the engine unit length at its lower portion can be reduced longitudinally of the crankshaft, which facilitates the assembly of the engine unit on the body frame.

Further, since the clutch can be located higher because the output shaft is disposed slantly above the crankshaft and the clutch is mounted on this ouput shaft in such a manner that the clutch may overlap with the crankshaft axially of the crankshaft, and, moreover, since the output shaft can be journalled at a higher position by approaching the clutch close to the countershaft because the countershaft provided above the output shaft is journalled on the cylinder head, the clutch with a large diameter will not project downward lower than the oil pan, which makes it possible to further reduce the engine height. As the transfer gears mounted on the countershaft are permitted to project into accommodation openings of the cylinder head, the countershaft can suitably be journalled on the cylinder head without the clutch means interfering with the countershaft or the associated gears of the second drive chain even though said elements are disposed on the same front side of the engine facing laterally with respect to the travelling direction of the vehicle.

## Claims

1. An automotive internal combustion engine comprising a crankshaft, a cylinder bank, an output shaft disposed slightly above and in parallel with the crankshaft for transmitting the output power of the crankshaft and an idler countershaft which forms part of a first and a second wrapping transmission means to drive camshafts from the output shaft, which are supported at the cylinder head, **characterized in that**, said countershaft (31) is journalled on the cylinder head (11) of the engine and in turn supports a pair of transmission elements (32, 34) the one of which forming part of the first wrapping transmission means (33) whereas the other one forms part of the second wrapping transmission means (35), and in that the transmission element (32) of at least one of the wrapping transmission means (33) projects into an opening (112)

of the cylinder head (11) formed in between intake ports (11c) of adjacent cylinders (X1, X2).

2. An automotive internal combustion engine as claimed in Claim 1, **characterized in that**, said first and second wrapping transmission means comprise a first and second chain drive (33, 35) transmitting the drive power of the output shaft (16) to a first countershaft gear (32) and through a second countershaft gear (34) to a pair of gears (38) on camshafts (37) of a valve operating mechanism (36).

3. An automotive internal combustion engine as claimed in Claim 2, **characterized in that**, the cylinder head (11) supporting the countershaft (31) has accommodation openings (112, 113) formed for accommodating the gears (32, 34) affixed to the countershaft (31), said gears (32, 34) are covered by a cap (114) and a cover (116).

4. An automotive internal combustion engine as claimed in Claim 3, **characterized in that**, the accommodation opening (112) associated to the first chain drive (33) opens slightly upwards in order to facilitate access to the gear (32) on the countershaft (31) and the first chain drive (33).

5. An automotive internal combustion engine as claimed in at least one of the preceding Claims 1-4, **characterized in that**, the second drive chain (35) is disposed at the same side as a clutch (400) thus avoiding any interference with the output shaft (16).

6. An automotive internal combustion engine as claimed in at least one of the preceding Claims 1-5, **characterized in that**, the cap (114) is detachable in order to gain access to gears (32) and (106) of the first drive chain (33) as well as to the countershaft (31).

7. An automotive internal combustion engine as claimed in at least one of the preceding Claims 1-6, **characterized in that**, the cover (116) of the second drive chain (35) connecting the countershaft (31) to the camshaft (37) is disposed on the same side as the case of the transmission (47) of the engine.

8. An automotive internal combustion engine as claimed in at least one of the preceding Claims 1-7, **characterized in that**, the output shaft (16) of the engine is disposed slightly forwardly above the crankshaft (6) in such a manner that the plane (L2) including both the axis of the crankshaft (6) and the axis of the output shaft (16) intersects with a plane (L1) including the cylinder axis of the cylinder bank at an acute angle ( ).

9. An automotive internal combustion engine as claimed in at least one of the preceding Claims 1-8, **characterized in that** said second drive chain (35) is disposed above the transmission case (406).

10. An automotive internal combustion engine as claimed in at least one of the preceding Claims 1-9, **characterized in that**, a fly wheel (45) and a single disc drive action clutch (400) for a manual transmission (47) is disposed on one end of the output shaft (16) in a manner axially overlapping the crankshaft (6).

11. An automotive internal combustion engine as claimed in Claim 10, **characterized in that**, the friction clutch (400) and the transmission (47) are encased by a transmission case (406) which is provided in connection with one side of the cylinder block (7), whereas the second drive chain (35) is provided in such a manner that it covers the transmission case (406) from the top.

12. An automotive internal combustion engine as claimed in at least one of the preceding Claims 1-11, **characterized in that**, an automatic transmission (500) is disposed on one end of the output shaft (16) overlapping with the crankshaft (16) in axial direction.

13. An automotive internal combustion engine as claimed in at least one of the preceding Claims 1 to 12, **characterized in that**, the eng.ne is accommodated in an engine compartment in transverse direction with the cylinder bank being inclined rearwards and the transmission means (32,34) being disposed slightly rearwardly above the output shaft (16).

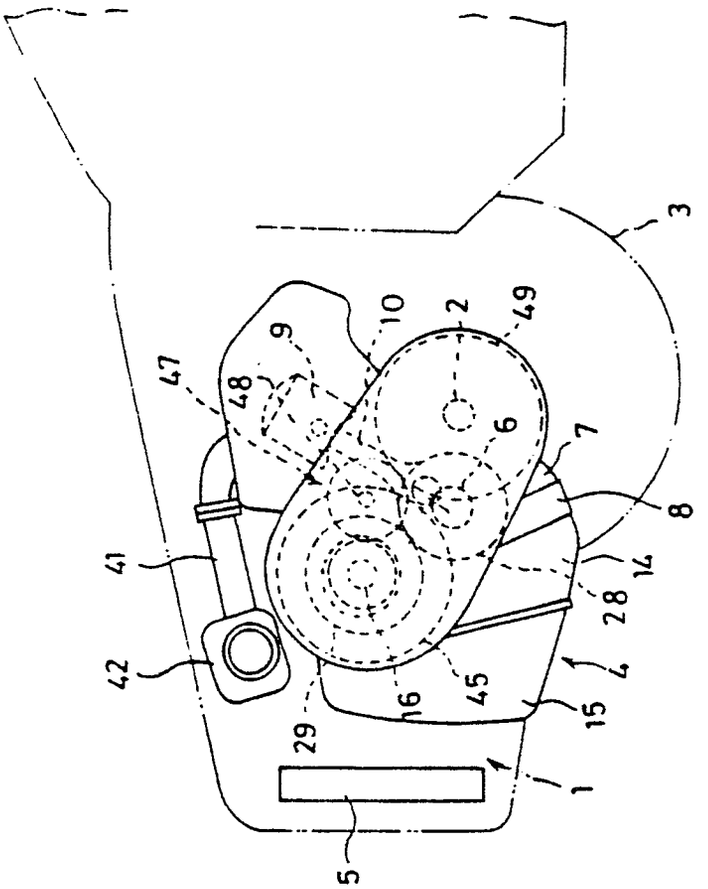


FIG. 1

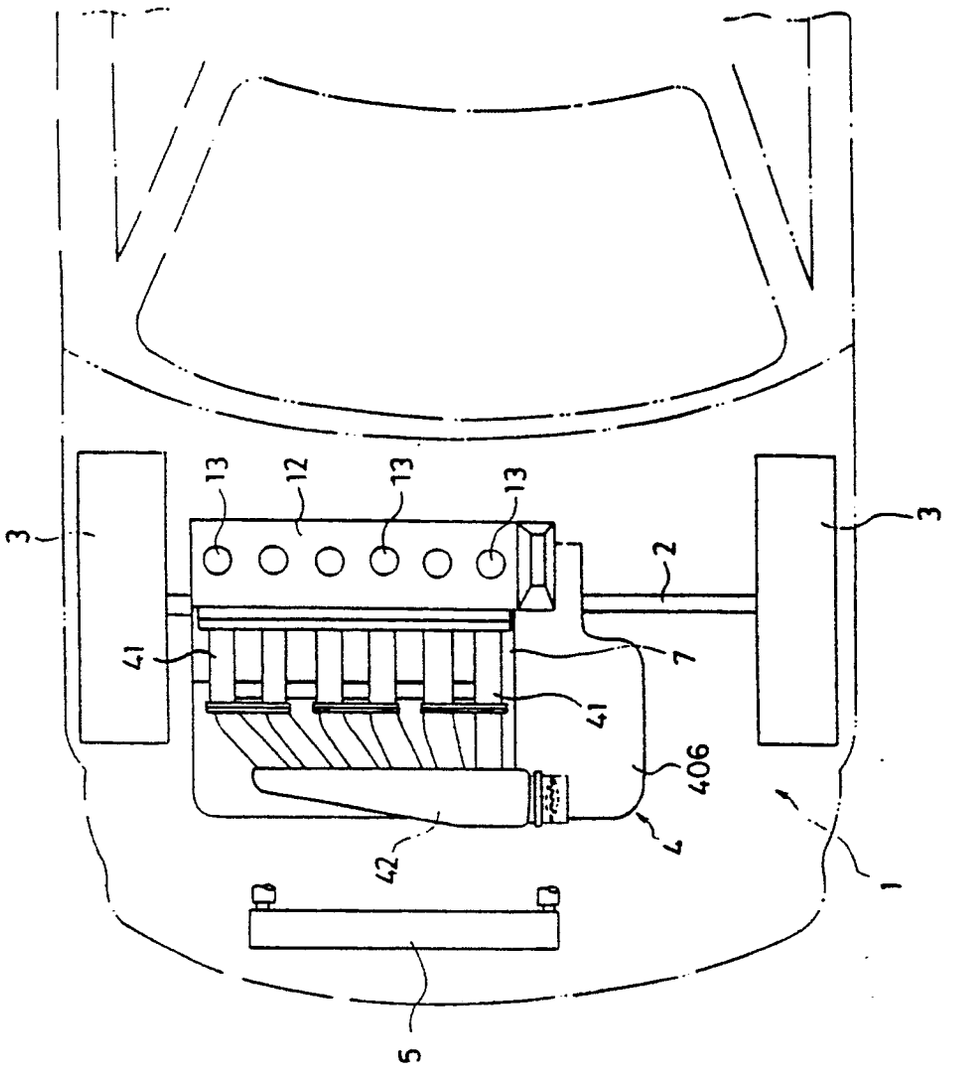


FIG. 2

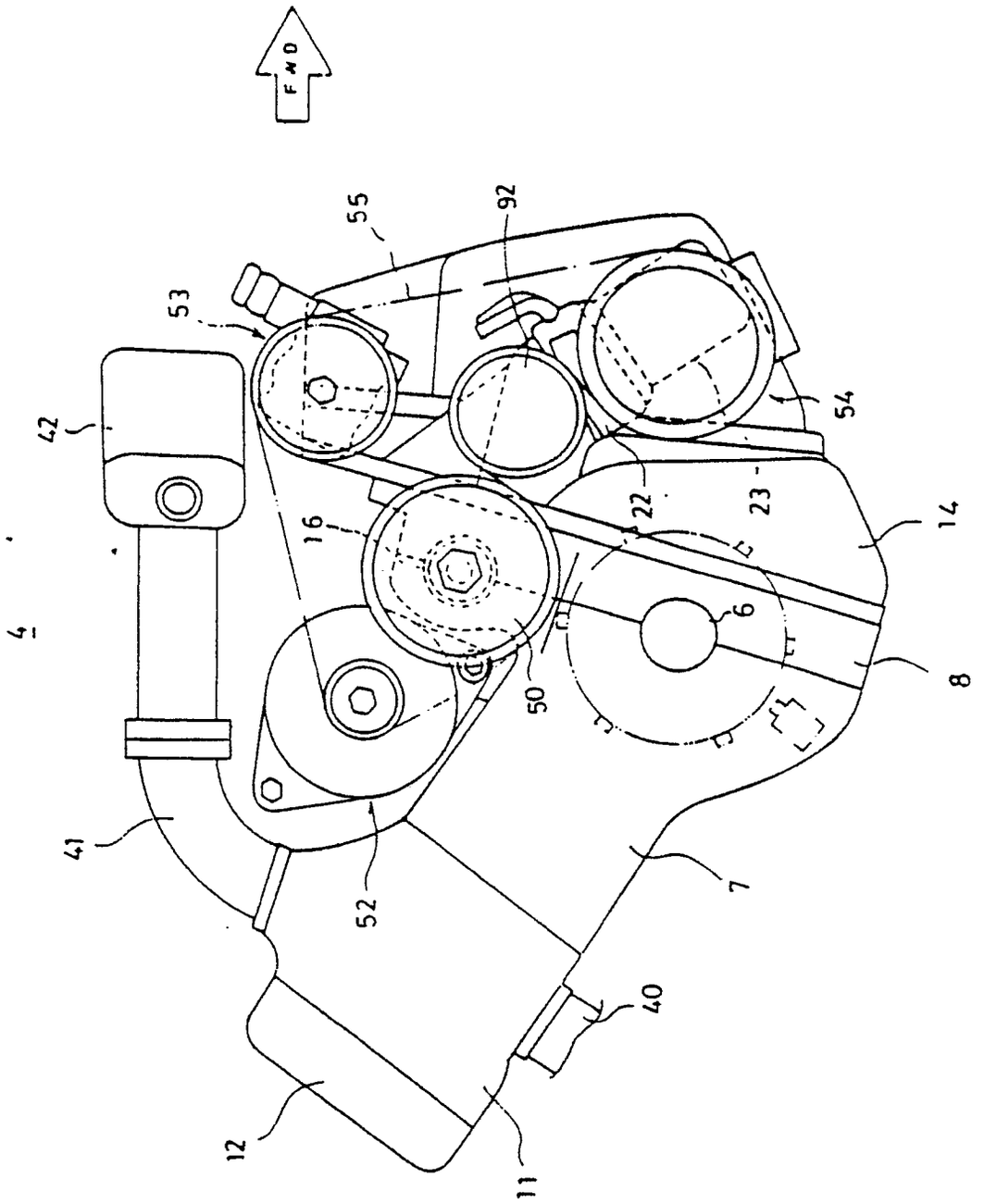


FIG. 3

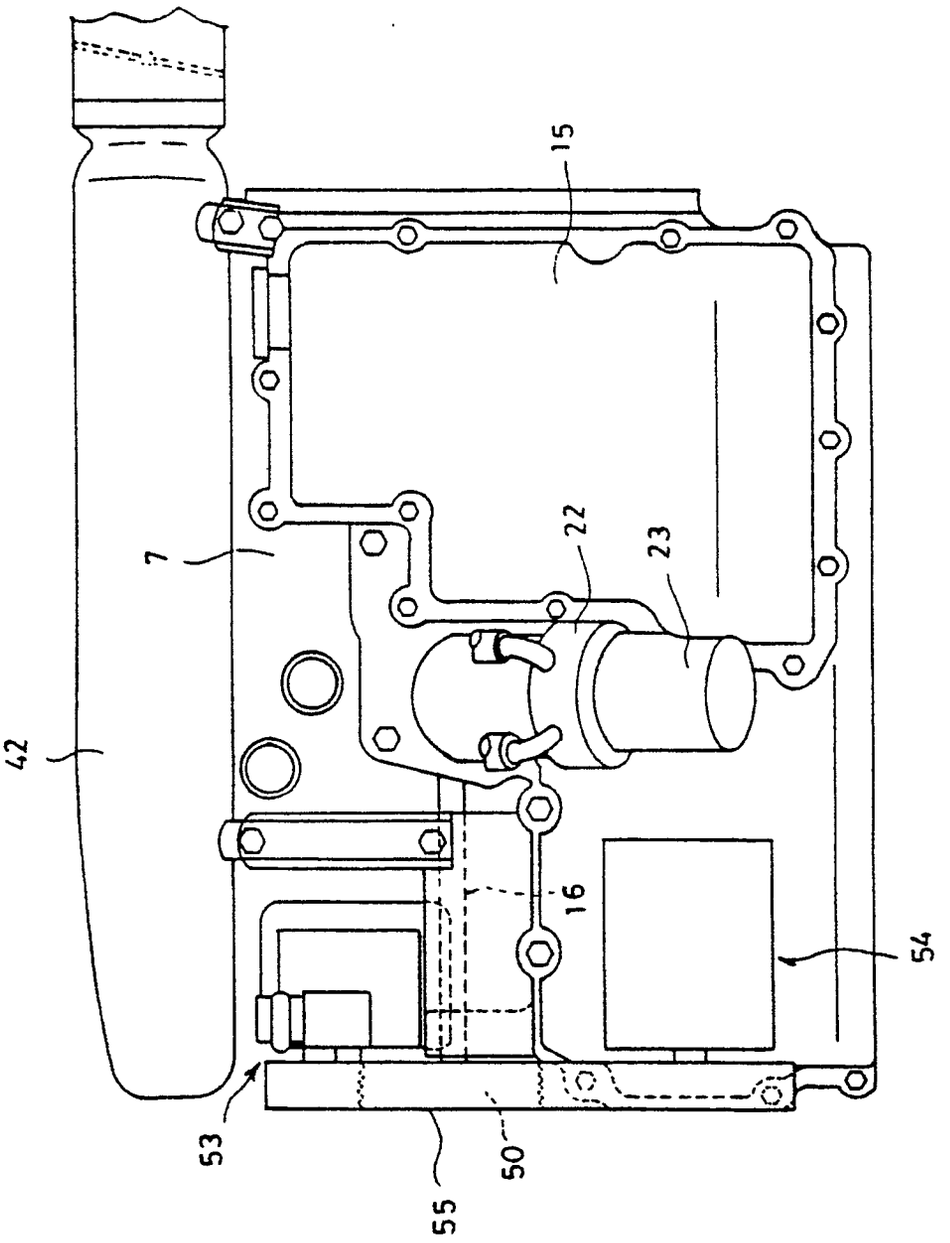


FIG. 4

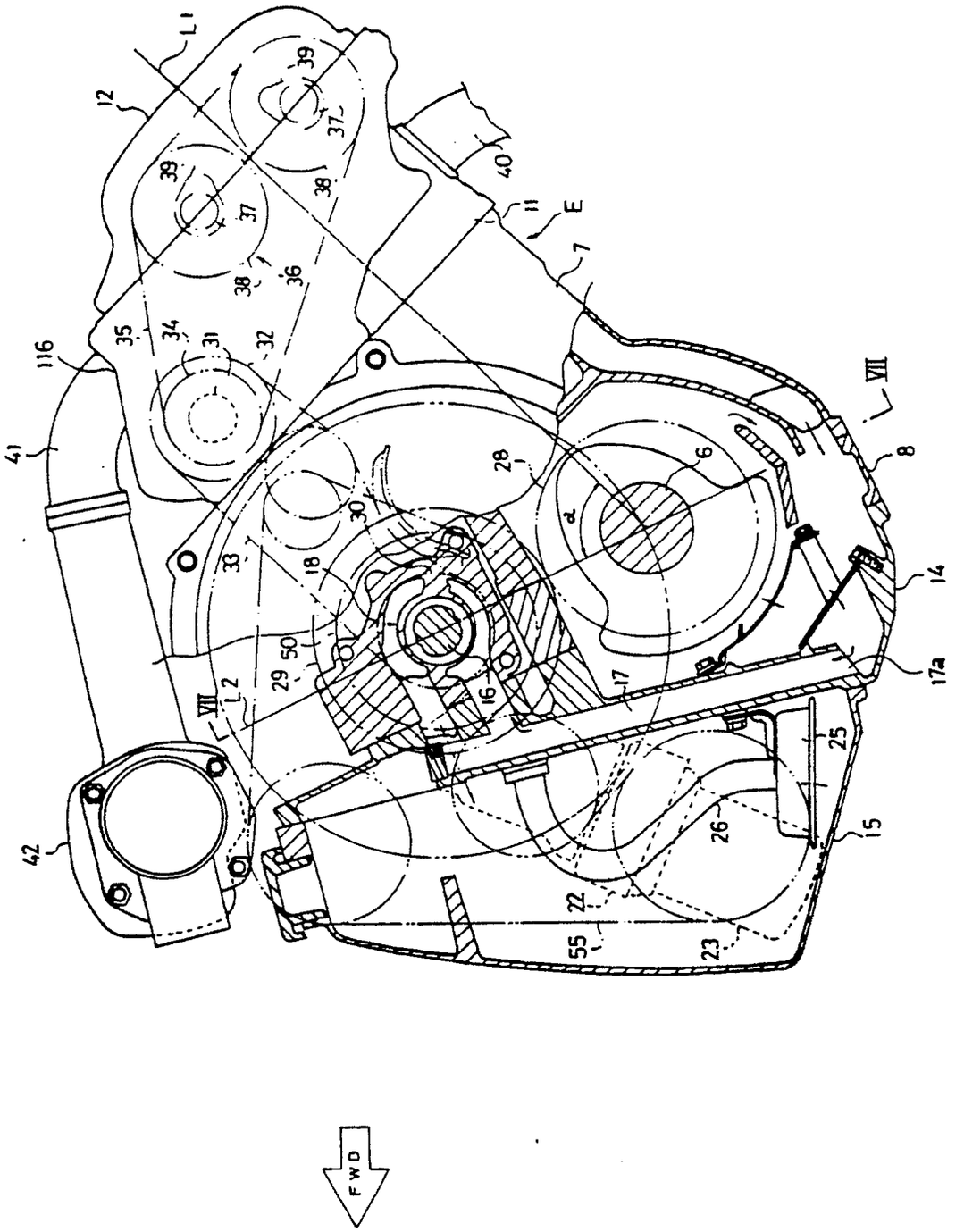
4
L1
12
39
37
40
11
E
7
38
36
35
34
31
32
116
41
VII
8
28
6
30
33
18
14
50
29
L2
16
17
17a
25
26
15
42
22
55
23
FWD

FIG. 5

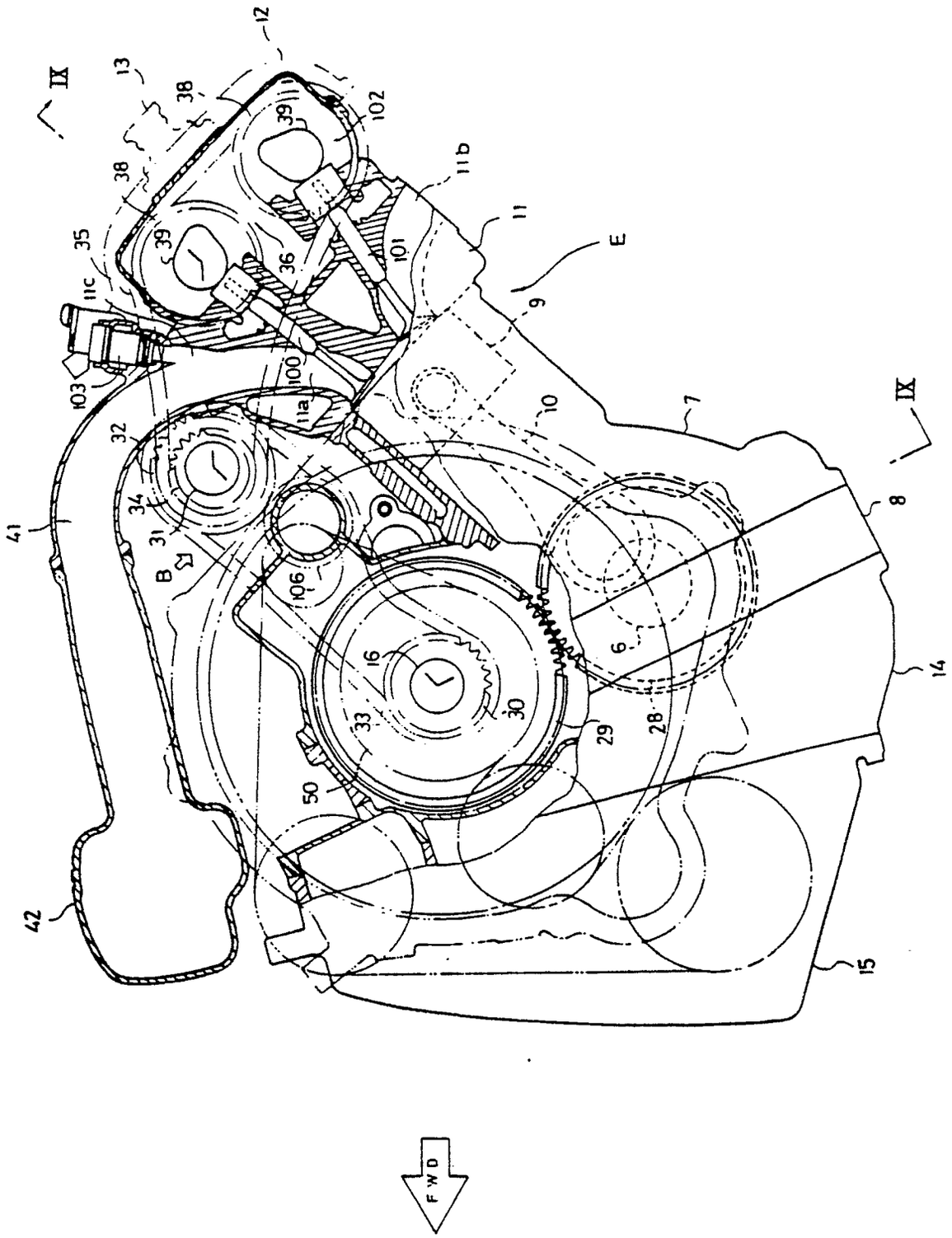
IX
IX
12
13
38
38
39
102
11b
11
E
35
39
36
101
11c
9
103
100
11a
10
7
32
34
31
B
41
106
8
16
6
33
30
29
28
14
50
42
15
FWD

FIG. 6

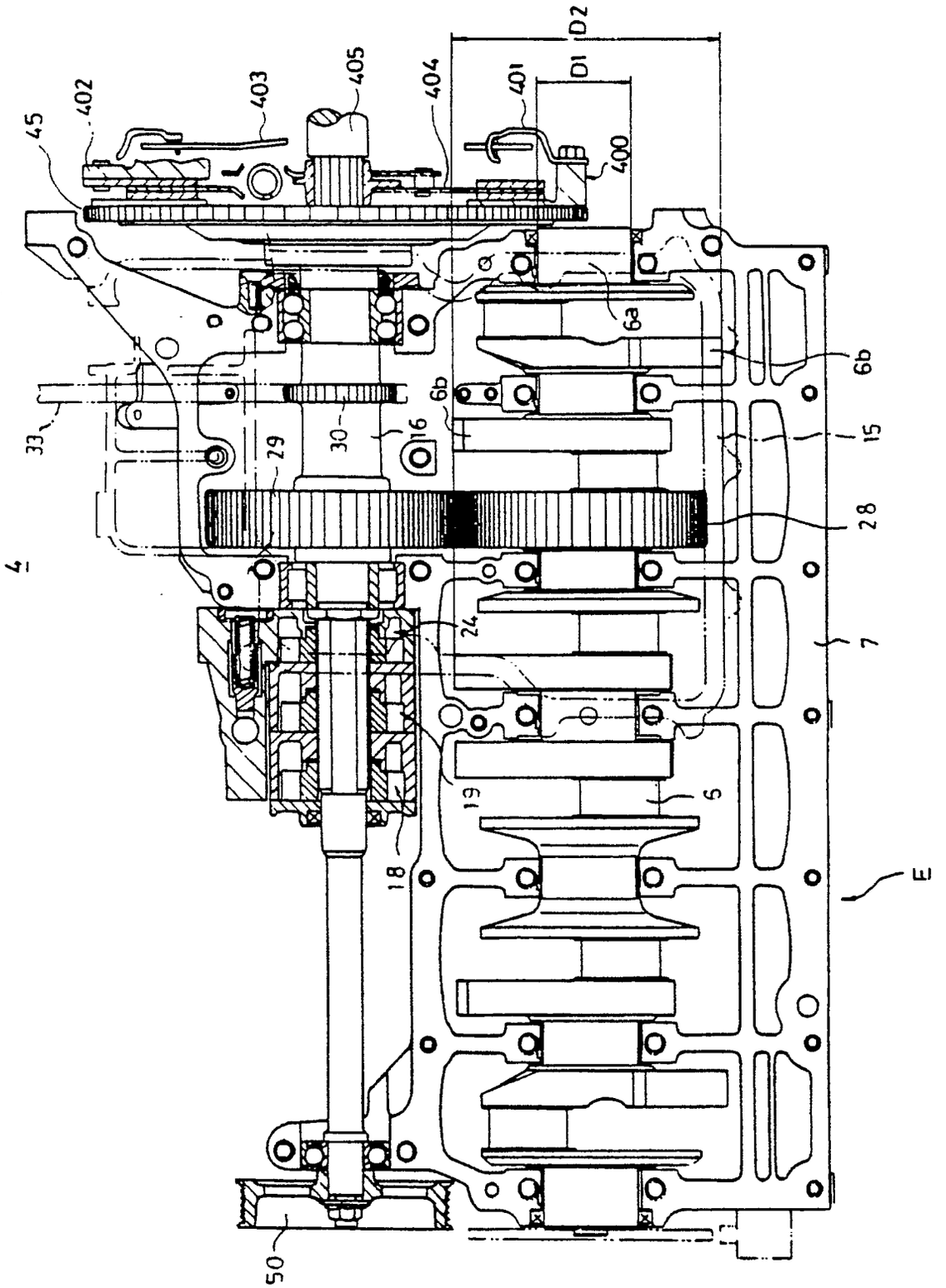
D2
D1
401
405
404
403
402
45
400
6a
6b
33
29
30
16
15
28
24
7
19
5
18
E
50
4

FIG. 7

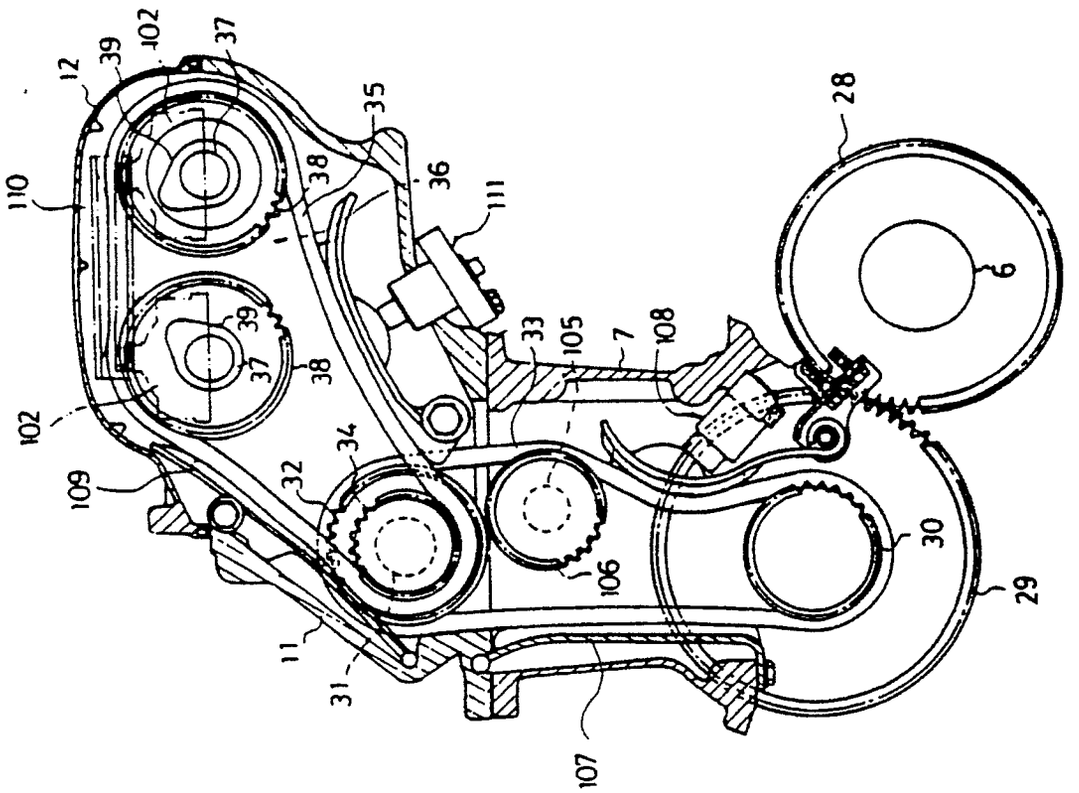
110
12
39
102
37
35
38
36
111
28
6
33
105
7
108
102
109
32
34
106
30
29
11
31
107

FIG. 8

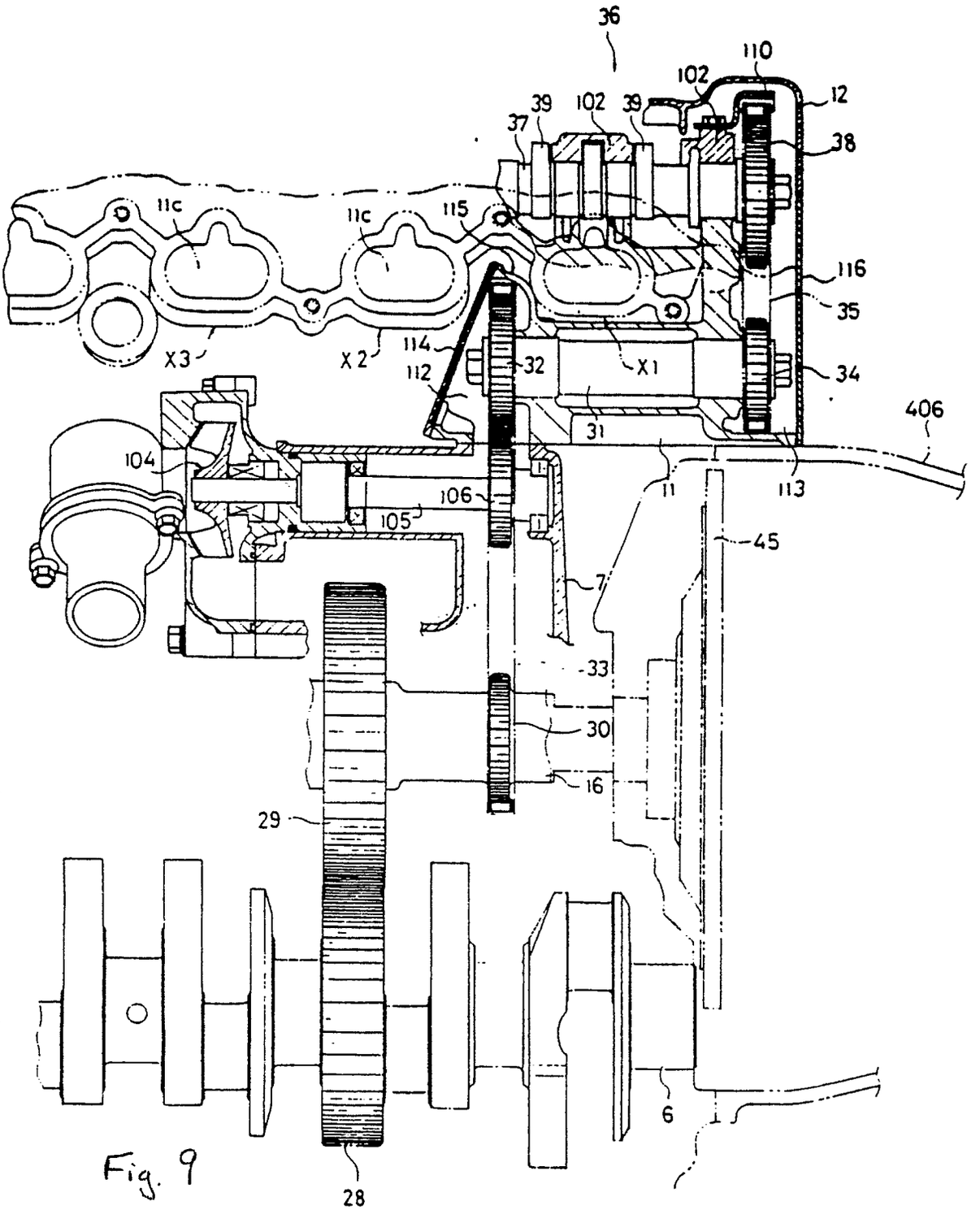
36
110
102
12
39
102
39
37
38
11c
11c
115
116
35
X3
X2
114
112
32
X1
34
406
31
104
106
11
113
105
45
7
33
30
16
29
6
28

Fig. 9

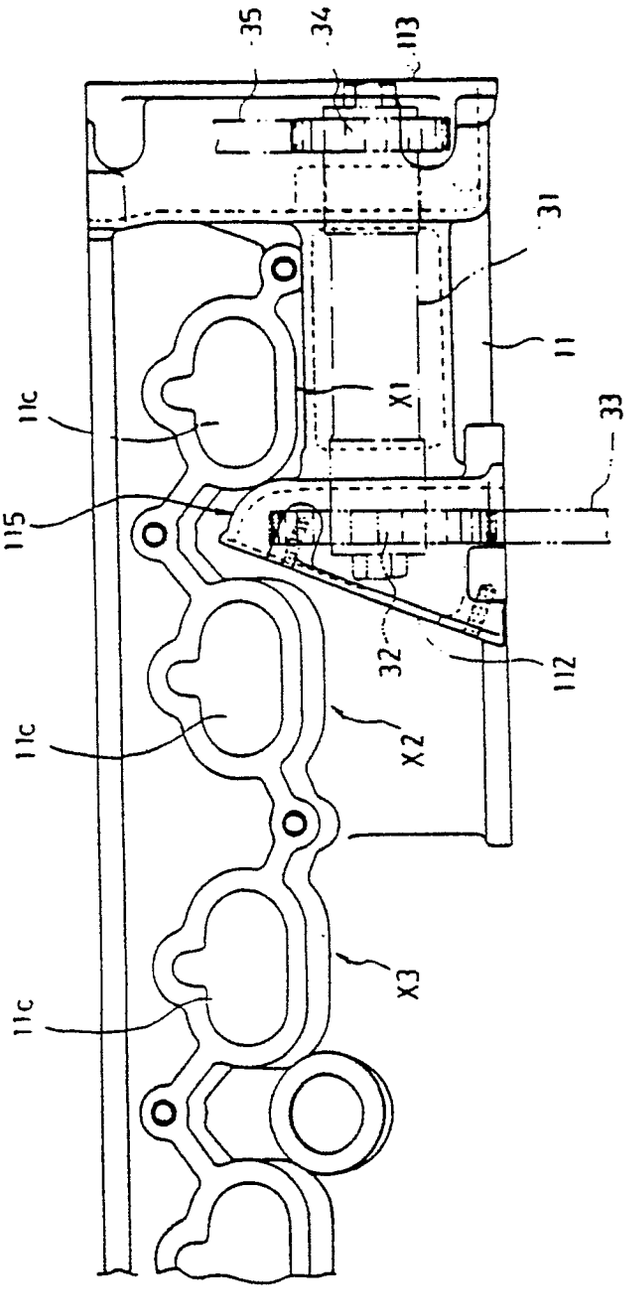


FIG. 10

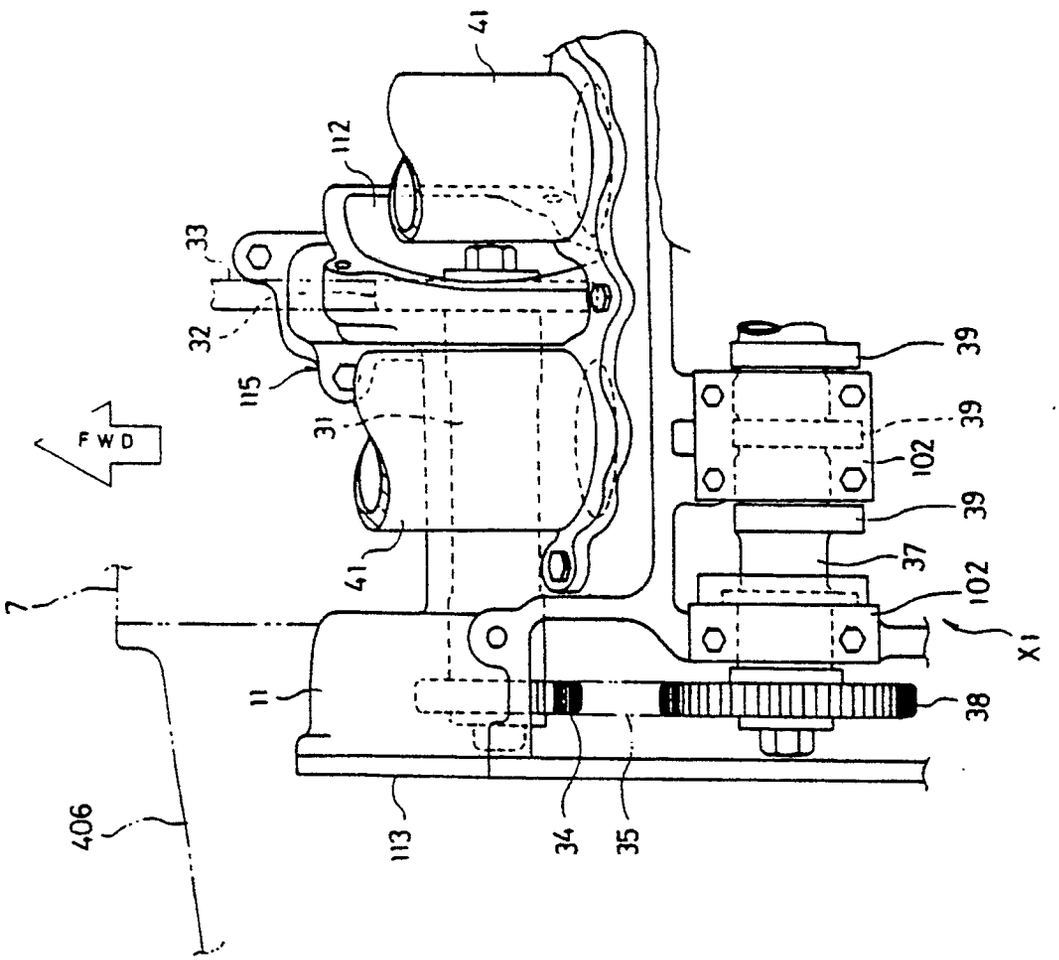
41
112
33
32
115
31
41
7
11
406
113
34
35
39
39
102
39
37
102
X1
38
FWD

FIG. 11

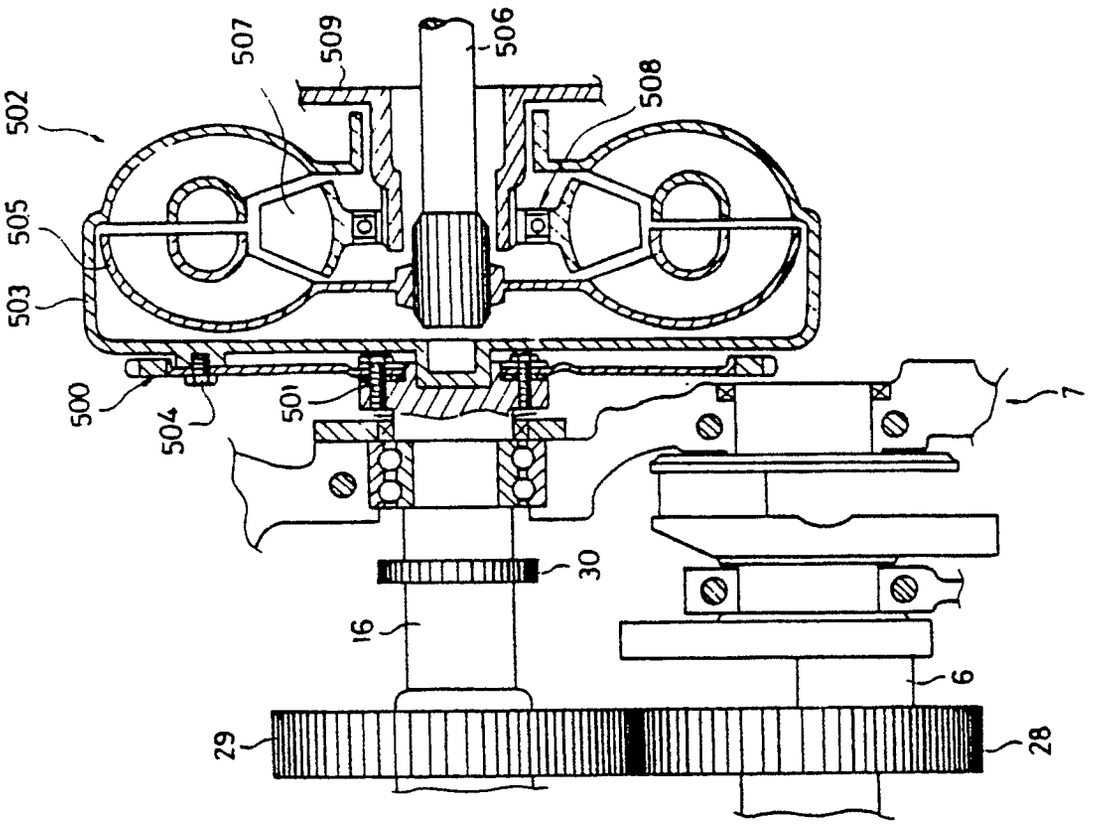


FIG. 12

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number

EP 90 11 2310

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.5) |
|---|---|---|---|
| A | GB-A-421359 (ASHCROFT)<br>* page 3, line 25 - page 3, line 55 *<br>* line 13 - page 4, line 21; figures * | 1, 2, 3, 6 | F01L1/02 |
| A | US-A-4745887 (HONDA)<br>* column 4, line 16 - column 4, line 55; figures 4, 5 * | 1 | |
| A | PATENT ABSTRACTS OF JAPAN<br>vol. 9, no. 183 (M-400)(1906) 30 July 1985,<br>& JP-A-60 50208 (MAZDA) 19 March 1985,<br>* the whole document * | 1, 2 | |

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F01L

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 28 SEPTEMBER 1990 | MOUTON J.M.M.P. |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)