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

(11) **EP 2 182 192 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.05.2010 Bulletin 2010/18

(51) Int Cl.:
F02B 61/02 *(2006.01)*

(21) Application number: **09013525.2**

(22) Date of filing: **27.10.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
AL BA RS

(30) Priority: **28.10.2008 JP 2008277266**

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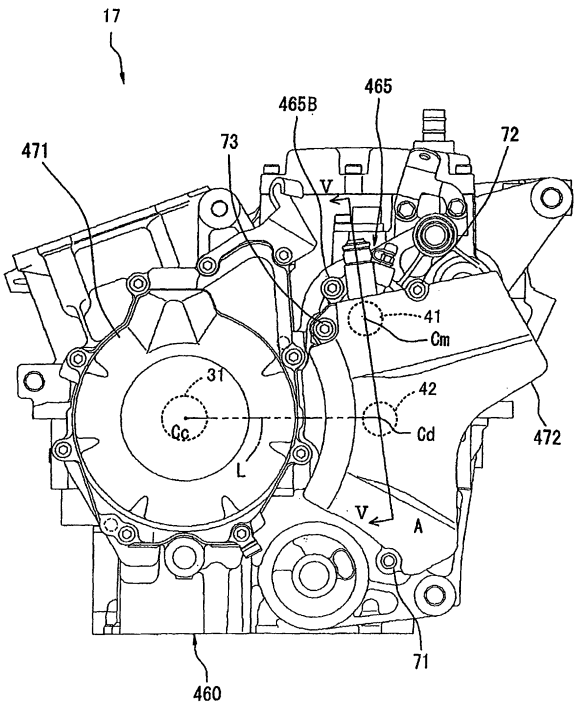
(54) **Engine and motorcycle including the same**

(57) An engine (17) for use in a motorcycle (100) includes a crankcase (460), a crankshaft (31), a main shaft (41), a clutch (44), a push rode (461), a clutch release cylinder (465), a drive shaft (42), a transmission (43), a drive sprocket (426), a protector (466), and a sprocket cover (472). The crankshaft, the main shaft and the drive shaft are provided along the widthwise direction of the motorcycle. The main shaft is provided above the drive shaft. The push rod is inserted into the through hole (41G) of the main shaft. The clutch release cylinder is arranged to release the clutch by pushing the push rod and is provided to overhang the drive sprocket and overlap the drive sprocket. The protector is provided between the crankcase and the clutch release cylinder and around the projection portion (461B) of the push rod projecting from the main shaft. The sprocket cover is provided to cover the drive sprocket and the protector.

FIG.2



EP 2 182 192 A2

Description

BACKGROUND OF THE INVENTION

Field of the invention

[0001] The present invention relates to an engine and a motorcycle including the same, and more specifically to an engine having a clutch release cylinder and a motorcycle including the same.

Description of the Background Art

[0002] JP 2007-69638 A discloses a motorcycle including a clutch release cylinder. The motorcycle further includes a crankshaft, a main shaft, a push rod, and a clutch. The clutch release cylinder releases the clutch by pushing the push rod by hydraulic pressure.

[0003] JP 2003-65064 A discloses a parallel 4-cylinder engine provided in a motorcycle. The motorcycle includes a crankcase, a crankshaft, a counter shaft, a push rod, a transmission device, a clutch device, a clutch operation mechanism, a drive shaft, and a drive sprocket. The crankcase is divided into an upper case and a lower case. The crankshaft is supported rotatably in the widthwise direction of the vehicle. The counter shaft is a hollow shaft and the push rod is slidably inserted into the hollow part. The clutch operation mechanism releases the clutch device by pushing the push rod by hydraulic pressure.

[0004] JP 58-121327 A discloses a clutch release device for use in a motorcycle. The motorcycle includes a crankcase, a crankshaft, a main shaft, a push rod for clutch release, a gear transmission, a clutch, a hydraulic cylinder for push rod operation, a drive shaft, and a sprocket. The push rod is passed through the hollow space of the main shaft having a tubular shape. The hydraulic cylinder releases the clutch by pushing the push rod. The motorcycle further includes a cover and a partition. The sprocket is covered with the cover. The partition prevents a chain and the push rod from contacting each other.

SUMMARY OF THE INVENTION

[0005] In the motorcycle disclosed by JP 2007-69638 A, the crankshaft and the main shaft are provided flush with each other. In the motorcycle disclosed by JP 2003-65064 A, the crankshaft, the counter shaft, and the drive shaft are all supported at the divisional surfaces of the upper case and the lower case. In the motorcycle disclosed by JP 58-121327 A, the crankshaft, the main shaft and the drive shaft are all provided in the same horizontal surface. Therefore, the disclosed engines are all elongated in the lengthwise direction of the motorcycle.

[0006] It is an object of the present invention to provide an engine for use in a motorcycle including a hydraulic cylinder used to continue/discontinue a clutch, an engine having a reduced length in the lengthwise direction of the motorcycle, and a motorcycle including such an engine.

[0007] An engine for use in a motorcycle according to the present invention includes a crankshaft, a main shaft, a clutch, a push rod, a clutch release cylinder, a drive shaft, and a transmission. The crankshaft, the main shaft and the drive shafts are provided along the widthwise direction of the motorcycle. The main shaft has a through hole. The through hole is formed in the axial direction. The clutch is provided at one end side of the main shaft and between the crankshaft and the main shaft. The push rod is inserted into the through hole of the main shaft. The clutch release cylinder is provided at the other end side of the main shaft to release the clutch by pushing the push rod. The transmission is provided between the main shaft and the drive shaft. The main shaft is positioned above a plane including the crankshaft and the drive shaft.

[0008] According to the present invention, the main shaft is provided above the plane including the crankshaft and the drive shaft, and therefore the length of the engine along the lengthwise direction of the motorcycle is reduced.

[0009] In embodiments of the invention, an angle between the plane including the crankshaft and the drive shaft and a plane including the main shaft and the drive shaft is substantially 90°. In embodiments of the invention, this angle is in a range between 75° and 90°.

[0010] The engine preferably further includes a drive sprocket. The drive sprocket is fixed to one end of the drive shaft. The clutch release cylinder is arranged to overhang the drive sprocket. Therefore, the drive sprocket does not protrude beyond the clutch release cylinder. The clutch release cylinder is arranged to overhang the drive sprocket but it is provided above the plane including the crankshaft and the drive shaft, so that a large angle can be secured for the bank angle of the motorcycle.

[0011] Other features, elements, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of preferred embodiments of the present invention with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 is a side view of the outer structure of a motorcycle according to a preferred embodiment of the present invention.

Fig. 2 is a side view of an engine (with a sprocket cover) provided in the motorcycle shown in Fig. 1.

Fig. 3 is a side view of the engine (without the sprocket cover) shown in Fig. 2.

Fig. 4 is a partly sectional view showing the general structure of the engine shown in Fig. 3.

Fig. 5 is a sectional view taken along line V-V in Fig. 2.

Fig. 6 is a sectional view taken along line VI-VI in

Fig. 3.

Fig. 7 is a perspective view of a protector and its periphery when seen from VII in Fig. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] A preferred embodiment of the present invention will be described in detail in conjunction with the accompanying drawings in which the same or corresponding elements are designated by the same reference characters and their description will not be repeated.

OVERALL STRUCTURE OF MOTORCYCLE

[0014] Referring to Fig. 1, a motorcycle 100 according to a preferred embodiment of the present invention includes a head pipe 1, a main frame 2, a seat frame 3, a steering mechanism 4, a handle 5, a clutch lever 6, a front fork 7, a front wheel 8, a front disk rotor 9, a front caliper 10, a pivot shaft 11, a swing arm 12, a rear wheel 13, a rear sprocket (driven sprocket) 14, a drive chain 15, a fuel tank 16, an engine 17, a muffler 18, and a seat 19.

[0015] The front end part of the main frame 2 is connected to the head pipe

1. The main frame 2 is formed to extend obliquely downward to the back. The seat frame 3 is connected to the back part of the main frame 2. The seat frame 3 extends obliquely upward to the back. The steering mechanism 4 is rotatably provided to the head pipe 1. The handle 5 and the clutch lever 6 are attached above the steering mechanism 4. The clutch lever 6 is provided on the left side of the handle 5. The front fork 7 is provided under the steering mechanism 4. The front wheel 8 is rotatably attached at the lower end of the front fork 7. The front disk rotor 9 is attached to the front wheel 8 so that it rotates together with the front wheel 8. The front caliper 10 is attached to the front fork 7 to hold the front disk rotor 9 therein.

[0016] The front end part of the swing arm 12 is attached to the rear end part of the main frame 2 through the pivot shaft 11. The rear wheel 13 is attached rotatably at the rear end part of the swing arm 12. A rear sprocket 14 used to drive the rear wheel 13 is attached to the rear wheel 13. The drive chain 15 is extended around the rear sprocket 14. The fuel tank 16 is provided above the main frame 2. The engine 17 is provided at the lower part of the main frame 2. The engine 17 is held at the main frame 2. The muffler 18 is connected to the engine 17. The seat 19 is provided above the seat frame 3.

[0017] The engine 17 includes a drive sprocket 426. The drive chain 15 is extended between the drive sprocket 426 and the rear sprocket 14. The driving force of the engine 17 is transmitted to the rear wheel 13 through the drive chain 15. In this way, the rear wheel 13 rotates around the rear end part of the swing arm 12. A rubber drive belt may be used instead of the drive chain 15.

GENERAL STRUCTURE OF ENGINE

[0018] Referring to Fig. 2, the engine 17 further includes a crankshaft 31, a main shaft 41, a drive shaft 42, a crankcase 460, a clutch release cylinder 465, a crank cover 471, and a sprocket cover 472.

[0019] The crankshaft 31, the main shaft 41 and the drive shaft 42 are arranged along the widthwise direction of the motorcycle 100. Therefore, the crankshaft 31, the main shaft 41, and the drive shaft 42 are arranged substantially parallel to one another. The main shaft 41 is provided above a plane L including the crankshaft 31 and the drive shaft 42. More specifically, the main shaft 41 is provided above the drive shaft 42, about directly above it, to be exact.

[0020] The sprocket cover 472 is attached by bolts 71 to 73. A part of the clutch release cylinder 465 is exposed above the sprocket cover 472. When the sprocket cover 472 is removed, the drive sprocket 426 and the clutch release cylinder 465 are exposed as shown in Fig. 3. The drive sprocket 426 is fixed at one end of the drive shaft 42. The clutch release cylinder 465 is attached to the crankcase 460 by two bolts 70 and the bolt 73 shown in Fig. 2.

[0021] The engine 17 further includes a protector 466. The protector 466 is attached around the push rods (that will be described later) arranged above the drive sprocket 426 to protect the push rod and guide the drive chain 15 shown in Fig. 1.

INTERNAL STRUCTURE OF ENGINE

[0022] Referring to Fig. 4, the engine 17 includes a clutch 44, the push rods 461 and 455, and a transmission 43.

[0023] The main shaft 41 has a cylindrical shape and a through hole 41G. The through hole 41G is formed in the axial direction. More specifically, the clutch 44 is provided on one end side of the main shaft 41, in other words, on the right end side in Fig. 4 and between the crankshaft 31 and the main shaft 41. The push rods 461 and 455 are inserted into the through hole 41G of the main shaft 41. A ball 459 is provided between the push rods 461 and 455 in the through hole 41G. The push rods 461 and 455 and the ball 459 may be formed integrally. Stated differently, a single push rod may be used in place of the push rods 461 and 455 and the ball 459.

[0024] The clutch release cylinder 465 is provided on the other end of the main shaft 41, in other words, on the left end side in Fig. 4 to push the push rods 461 and 455 and the ball 459 and thus release the clutch 44. The transmission 43 is provided between the main shaft 41 and the drive shaft 42.

[0025] The crankshaft 31 is rotated according to the reciprocal movement of a piston (not shown) in the cyl-

inder (not shown). The driving force of the crankshaft 31 is transmitted to the main shaft 41 through the clutch 44. When the clutch release cylinder 465 pushes the push rod 461, the push rod 461 moves toward the clutch 44 in the axial direction in the through hole - 41G. In this way, the clutch 44 is released, and the driving force of the crankshaft 31 is not transmitted to the main shaft 41. The main shaft 41 is coupled to the drive shaft 42 through the transmission 43. The transmission 43 decreases the rotation speed of the crankshaft 31 at a desired transmission gear ratio.

[0026] The engine 17 further includes a clutch actuator 60 and an oil hose 470q. As shown in Fig. 1, the clutch actuator 60 is provided under the main frame 2. The clutch actuator 60 is connected to the clutch release cylinder 465 through the oil hose 470q. The clutch 44 is driven by the clutch actuator 60 by hydraulic pressure.

STRUCTURE OF CLUTCH

[0027] The clutch 44 is a multi-disk friction clutch. More specifically, the clutch 44 includes a clutch housing 443, a plurality of friction disks 445, a clutch boss 447, a plurality of clutch plates 449, a tension coil spring 450, and a pressure plate 451. The plurality of friction disks 445 are provided integrally with the clutch housing 443. The plurality of clutch plates 449 are coupled with the clutch boss 447. The clutch boss 447 is fixed to the main shaft 41 and rotates together with the main shaft 41. The clutch housing 443 is coupled rotatably with the main shaft 41. The torque of the crankshaft 31 is transmitted to the clutch housing 443 through the gears 310 and 441. The tension coil spring 450 biases the push plate 451 in the direction in which the clutch 44 is connected. The pressure plate 451 is coupled with one end of the push rod 455 through a bearing 457 (on the right side in Fig. 4). The pressure plate 451 is coupled rotatably with the push rod 455 and the main shaft 41. The clutch 44 may be a centrifugal clutch having a weight.

TRANSMISSION

[0028] The transmission 43 is a stepped transmission. The transmission 43 includes a plurality of transmission gears 49 and a plurality of transmission gears 420 corresponding to these gears. The plurality of transmission gears 49 are mounted around the main shaft 41. The plurality of transmission gears 420 are mounted around the drive shaft 42. A pair is selected from the plurality of transmission gears 49 and the plurality of transmission gears 420 and engaged with each other. At least the rest of the plurality of transmission gears 49 or the rest of the plurality of transmission gears 420 that are unselected are rotatably supported at the main shaft 41 or the drive shaft 42. At least the unselected transmission gears 49 or the unselected transmission gears 420 are arranged to idle with respect to the main shaft 41 or the drive shaft 42. Therefore, the driving force of the main shaft 41 is transmitted to the drive shaft 42 only through the pair of transmission gears 49 and 420 selected and engaged with each other.

[0029] The pair of transmission gears 49 and 420 is selected by a shift cam 421. A plurality of cam grooves 421a are formed at the outer circumferential surface of the shift cam 421. A shift fork 422 is mounted at each of the cam grooves 421a. The shift forks 422 are each coupled with a prescribed transmission gear 49 or 420 at the main shaft 41 or the drive shaft 42. When the shift cam 421 is rotated by a transmission mechanism 425, the shift forks 422 are each guided to a cam groove 421a and moved along the main shaft 41. In this way, a pair of transmission gears 49 and 420 is selected. More specifically, only a pair of transmission gears 49 and 420 is fixed to the main shaft 41 and the drive shaft 42 by a spline depending on the rotation angle of the shift cam 421. In this way, the transmission gear position is determined.

CLUTCH ACTUATOR

[0030] The engine 17 further includes an ECU (Electric Control Unit) 30. The clutch actuator 60 is driven by the ECU 30. The clutch actuator 60 includes an electric motor 60a, an output shaft 60g, and a hydraulic cylinder 470. The hydraulic cylinder 470 includes a cylinder 470k, a piston 470p, and an oil chamber 470n. The driving force of the electric motor 60a is amplified by the hydraulic cylinder 470 and transmitted to the clutch 44.

STRUCTURE OF CLUTCH RELEASE CYCLINDER

[0031] Referring to Fig. 5, the clutch release cylinder 465 includes a piston 463 and a compression coil spring 464. The piston 463 is guided by the clutch release cylinder 465 and provided slidably in the direction of the main shaft 41. A space 467 is formed between the piston 463 and the clutch release cylinder 465. Oil is enclosed in the space 467. The compression coil spring 464 is provided in the space 467 and biases the piston 463 in the direction of the main shaft 41.

[0032] The push rod 461 projects from the end of the main shaft 41. The tip end 461A of the push rod projected from the main shaft 41 is inserted in the clutch release cylinder 465 and coupled with the piston 463. When the oil pressure in the clutch release cylinder 465 is raised, the piston 463 moves to the right in Fig. 5, and the push rods 461 and 455 shown in Fig. 4 also move to the right accordingly. As a result, the pressure plate 451 also moves to the right and the clutch 44 is released. The elastic force of the compression coil spring 464 is smaller than the elastic force of the tension coil spring 450 of the clutch 44. When the oil pressure in the clutch release cylinder 465 is low, the pressure plate 451 is urged by the tension coil spring 450 to the left in Fig. 4, so that the clutch 44 is connected.

OPERATON OF CLUTCH

[0033] Now, the operation of releasing the clutch 44 will be described.

[0034] When the clutch lever 6 shown in Fig. 1 is clutched, the ECU 30 shown in Fig. 4 drives the actuator 60. More specifically, the electric motor 60a moves the output shaft 60g to the left in Fig. 4. The piston 470p of the hydraulic cylinder 470 is pushed to the left accordingly. When the piston 470p is pushed, oil in the oil chamber 470n is supplied to the clutch release cylinder 465 through the oil hose 470q.

[0035] Since the oil is supplied to the space 467 of the clutch release cylinder 465, the oil pressure in the clutch release cylinder 465 is raised. When the oil pressure exceeds the elastic force of the tension coil spring 450, the piston 463 moves to the right in Fig. 5. The push rods 461 and 455 are in turn pushed to the right in Fig. 4 in the through hole 41G of the main shaft 41. As a result, the pressing portions 451B of the pressure plate 451 move away from the friction disks 445, and the friction disks 445 move away from the clutch plates 449. In other words, the clutch 44 is released.

[0036] An operation of connecting the clutch 44 will be described.

[0037] When the clutch lever 6 shown in Fig. 1 is released, the ECU 30 shown in Fig. 4 stops driving the clutch actuator 60, which lowers the oil pressure in the clutch release cylinder 465. When the oil pressure is lower than the elastic force of the tension coil spring 450, the pressure plate 451 pushes the push rods 461 and 455 and the piston 463 back to the left in Figs. 4 and 5. As a result, the friction disks 445 contact the clutch plates 449. In other words, the clutch 44 is connected.

POSITION OF CLUTCH RELEASE CYLINDER

[0038] The clutch release cylinder 465 is arranged to overhang the drive sprocket 426 as shown in Fig. 5 and overlap the drive sprocket 426 when seen from the side surface of the motorcycle 100 as shown in Fig. 3.

[0039] The clutch release cylinder 465 is arranged independently from the crankcase 460 and projects to the left from the crankcase 460. As shown in Figs. 3, 6 and 7, the clutch release cylinder 465 is provided with legs 465A, 465B and 465C. The legs 465A, 465B and 465C each have an approximately circular column shape.

[0040] As shown in Fig. 6, the leg 465A has a through hole 465Af and the leg 465B has a through hole 465Bf. Similarly, as shown in Fig. 3, the leg 465C has a through hole 465Cf. The through holes 465Af, 465Bf and 465Cf are all formed along the main shaft 41. The part of the crankcase 460 in contact with the clutch release cylinder 465 has a screw hole 460a corresponding to the leg 465A and a screw hole 460b corresponding to the leg 465B. Similarly, a screw hole (not shown) corresponding to the leg 465C is also formed. The three screw holes are all non-through holes and formed along the main shaft 41. The centers of the three screw holes coincide with the centers of the through holes 465Af, 465Bf, and 465Cf. Bolts 70 are inserted into the through holes 465Af and 465Bf and screwed on the screw holes 460a and 460b. The bolt 73 shown in Fig. 2 is inserted in the through hole 465Cf and screwed on the corresponding screw hole. In this way, the clutch release cylinder 465 is detachably attached to the crankcase 460. A sheet-metal part 458 is placed between the crankcase 460 and the clutch release cylinder 465.

[0041] A bearing 456 is provided at a left end part of the main shaft 41 in Fig. 6. A through hole 460G is formed at the left side part of the crankcase 460 in Fig. 6. An oil seal 454 is provided at a part of the through hole 460G. The push rod 461 is supported by the crankcase 460 by the bearing 456. The push rod 461 is inserted into the through hole 460G.

[0042] The push rod 461 includes a projection portion 461B including a tip end 461A and a coupling portion 461C. The projection portion 461B projects from the main shaft 41 and is exposed between the clutch release cylinder 465. The coupling portion 461C is stored in the main shaft 41.

[0043] However, the projection portion 461B and the coupling portion 461C may be formed integrally. The legs 465A, 464B and 465C may be formed integrally with the clutch release cylinder 465.

DRIVE SPROCKET

[0044] The drive sprocket 426 shown in Fig. 3 is provided around one end 42E of the drive shaft 42 as shown in Fig. 5. A bearing 453 is provided to the crankcase 460. The bearing 453 is coupled to the crankcase 460 through a key 452. The key 452 has an annular shape. The drive shaft 42 is supported at the crankcase 460 by the bearing 453. One end 42E of drive shaft 42 projects from the crankcase 460. The drive sprocket 426 rotates together with the drive shaft 42.

[0045] A collar 424 is provided between the crankcase 460 and the drive sprocket 426. The collar 424 has a substantially cylindrical shape and is proved around the end 42E of the drive shaft 42. A nut 423 is provided at the tip end of the drive shaft 42 projecting from the drive sprocket 426. The nut 423 is screwed at the tip end of the drive shaft 42. A washer 428 is provided between the nut 423 and the drive sprocket 426. In this way, the drive sprocket 426 is fixed to the drive shaft 42.

PROTECTOR

[0046] Referring back to Fig. 3, the protector 466 is provided behind the clutch release cylinder 465. The protector 466 extends to the back of the motorcycle 100 through the upper part of the drive sprocket 426 from the front part of the drive sprocket 426. As shown in Fig. 5, the protector 466 is provided between the crankcase 460 and the clutch release cylinder 465. The protector 466 is

provided substantially flush with the drive sprocket 426. The protector 466 is provided independently from the crankcase 460 and the clutch release cylinder 465. The protector 466 has a through hole 466R. The push rod 461 is inserted in the through hole 466R. In this way, the push rod 461 is protected by the protector 466. More specifically, the protector 466 can prevent the drive chain 15 rotated at high speed from interfering the push rod 461. The protector 466 can also prevent pebbles or the like kicked up while the motorcycle 100 is driving from striking the push rod 461.

[0047] As shown in Fig. 5 and 7, the protector 466 includes a guide surface 466D and a guide rail 466E. The guide surface 466D is formed along the drive chain 15 wound round the drive sprocket 426. The guide rail 466E is formed on the substantially central line of the guide surface 466D and projects from the guide surface 466D. The guide rail 466E has a raised shape and is opposed to the recess part 15A of the drive chain 15. The protector 466 guides the drive chain 15 so that the drive chain 15 does not come off from the drive sprocket 426.

[0048] As shown in Figs. 6 and 7, the protector 466 has through holes 466A and 466C in addition to the through hole 466R. The leg 465A of the clutch release cylinder 465 is inserted into the through hole 466A. The leg 465C of the clutch release cylinder 465 is inserted into the through hole 466C.

[0049] A member having a protection function only for the push rod 461 may be provided instead of the protector 466 having both the protection function for the push rod 461 and the guide function for the drive chain 15. Such a member has a cylindrical shape for example and the projection portion 461B of the push rod 461 is inserted through the cylinder.

SPROCKET COVER

[0050] The sprocket cover 472 shown in Fig. 2 partly covers the drive sprocket 426, the protector 466 and the clutch release cylinder 465 shown in Fig. 3. The sprocket cover 472 is attached to the crankcase 460 by the bolt 73 together with the clutch release cylinder 465.

[0051] When the bolts 71 to 73 are removed, the sprocket cover 472 can be removed. When the sprocket cover 472 is removed from the crankcase 460 as shown in Fig. 3, the entire clutch release cylinder 465 is exposed. Then, when the bolts 70 are removed, the clutch release cylinder 465 can be removed.

POSITIONAL RELATION OF SHAFT

[0052] Referring back to Fig. 2, the crankshaft 31 and its periphery are covered with the crank cover 471. The straight line L is a virtual line connecting the center Cc of the crankshaft 31 and the axial center Cd of the drive shaft 42. The center Cm of the main shaft 41 is not on an extension of the straight line L but is positioned above the straight line L. When seen from the side of the motorcycle 100, the center Cd of the drive shaft 42 and the center Cc of the crankshaft are substantially at the same height. The center Cm of the main shaft 41 is positioned higher than the center Cd of the drive shaft 42. An approximate right triangle is formed by a virtual line connecting the center Cc of the crankshaft 31, the center Cm of the main shaft 41 and the center Cd of the drive shaft 42. The center Cc of the crankshaft 31 may be positioned higher than the center Cm of the main shaft Cm. Again in this case, the center Cm of the main shaft 41 is not on an extension of the straight line L but is positioned above the straight line L.

EFFECT OF PREFFERED EMBODIMENT

[0053] According to the present preferred embodiment, the main shaft 41 is positioned above the plane L including the crankshaft 31 and the drive shaft 42, about directly above the drive shaft 42, to be exact, and therefore the length of the engine 17 along the lengthwise direction of the motorcycle 100 is reduced.

[0054] Since the clutch release cylinder 465 is positioned to overhang the drive sprocket 426, the drive sprocket 426 does not project beyond the clutch release cylinder 465. The clutch release cylinder 465 overhangs the drive sprocket 426 while the cylinder is provided above the plane L including the crankshaft 31 and the drive shaft 42, so that a sufficient angle can be secured for the bank angle of the motorcycle 100.

[0055] When seen from the side of the motorcycle 100, the clutch release cylinder 465 is positioned to overlap the drive sprocket 426, so that the height of the engine 17 can be kept from increasing.

[0056] Since the protector 466 is provided around the projection portion 461B of the push rod 461, the push rod 461 can be prevented from being interfered by the drive chain 15 and colliding against splashed pebbles.

[0057] Since the protector 466 includes the guide surface 466D formed along the drive sprocket 426, the drive chain 15 can be guided smoothly. The protector 466 further includes the guide rail 466E formed on the substantially central line of the guide surface 466D and projecting from the guide surface 466D, and therefore the drive chain 15 can be guided more smoothly.

[0058] Since the sprocket cover 472 is provided to cover the drive sprocket 426 and the protector 466, the drive sprocket 426 and the protector 466 can be prevented from contacting moisture, dust and the like.

[0059] Since the protector 466 is provided independently from the crankcase 460, the protector 466 is detachable. Therefore, the protector 466 can be replaced easily for repairing.

[0060] Since the clutch release cylinder 465 is provided independently from the crankcase 460 and detachable, the hydraulic clutch release cylinder 465 can be replaced easily by a mechanical clutch release device depending on the kind of the motorcycle 100 (such as a racer replica, a scooter, a moped, and a motocrosser)

and the rider's liking.

[0061] While preferred embodiments of the present invention have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing the scope and spirit of the present invention. The scope of the present invention, therefore, is to be determined solely by the following claims.

Claims

1. An engine (17) for use in a motorcycle (100), comprising:

a crankshaft (31) provided along a widthwise direction of the motorcycle;
a main shaft (41) provided along the widthwise direction of the motorcycle and having a through hole (41G) formed in an axial direction thereof;
a clutch (44) provided at one end side of the main shaft and between the crankshaft and the main shaft;
a push rod (461) inserted into the through hole of the main shaft;
a clutch release cylinder (465) provided at the other end side of the main shaft to release the clutch by pushing the push rod;
a drive shaft (42) provided along the widthwise direction of the motorcycle; and
a transmission (43) provided between the main shaft and the drive shaft,
the main shaft being positioned above a plane (L) including the crankshaft and the drive shaft.

2. The engine according to claim 1, wherein the main shaft is positioned above the drive shaft.

3. The engine according to claim 1 or 2, wherein the clutch release cylinder is detachable.

4. The engine according to any one of claims 1 to 3, further comprising a drive sprocket (426) fixed at one end (42E) of the drive shaft,

the clutch release cylinder being provided to overhang the drive sprocket.

5. The engine according to claim 4, wherein the clutch release cylinder is provided to overlap the drive sprocket when seen from a side of the motorcycle.

6. The engine according to claim 4 or 5, wherein

the push rod includes a projection portion (461B) projecting from the main shaft and exposed between the clutch release cylinder and the main shaft,
the engine further comprising:
a crankcase (460); and
a protector (466) provided between the crankcase and the clutch release cylinder and around the projection portion of the push rod.

7. The engine according to claim 6, wherein the protector comprises a guide surface (466D) formed along the drive sprocket.

8. The engine according to claim 7, wherein the protector further comprises a guide rail (466E) formed on a substantially central line of the guide surface and projecting from the guide surface.

9. The engine according to any one of claims 6 to 8, further comprising a cover (472) attached to cover the drive sprocket and the protector.

10. A motorcycle comprising the engine according to any one of claims 1 to 9.

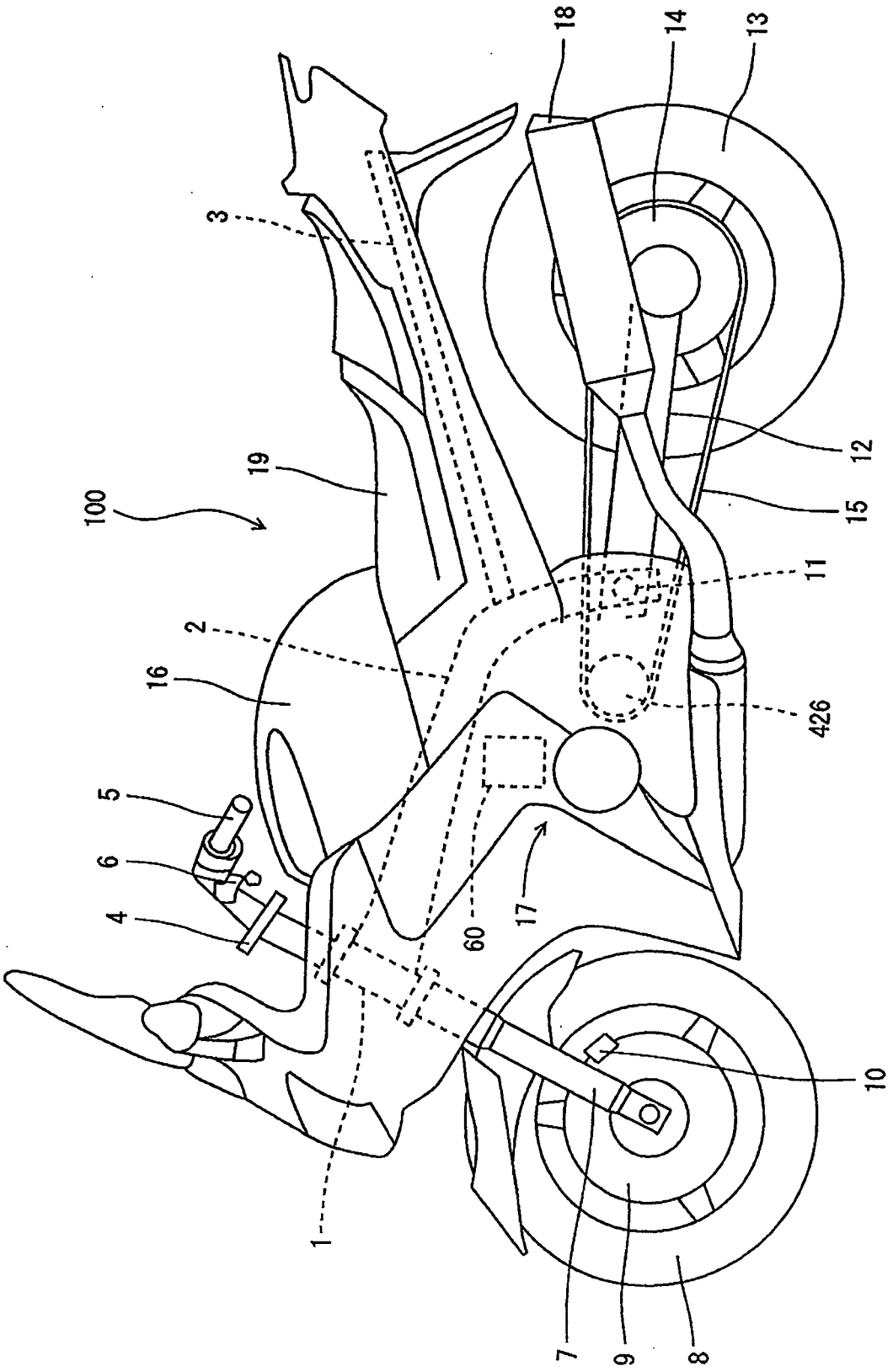


FIG. 1

FIG.2

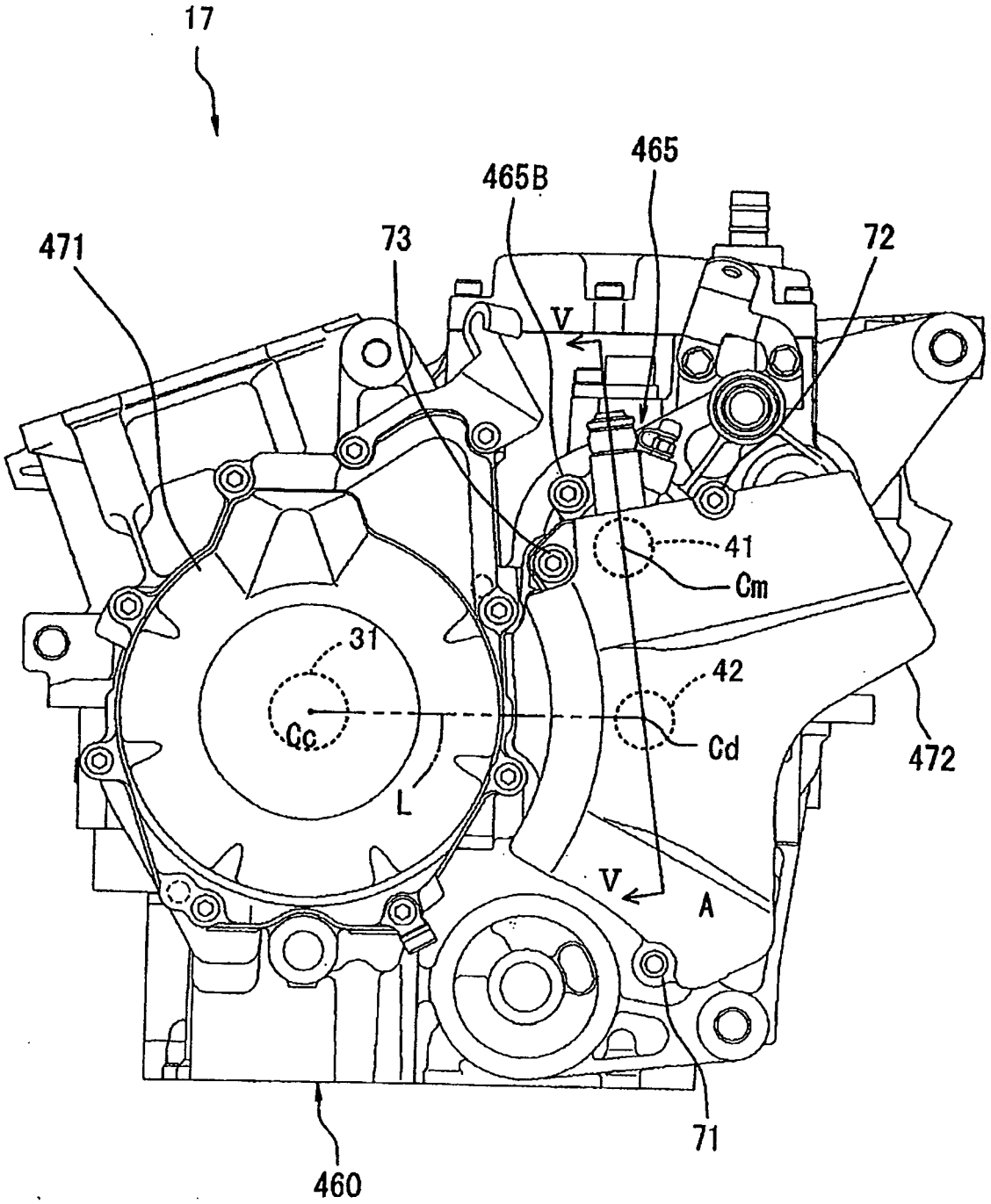


FIG. 3

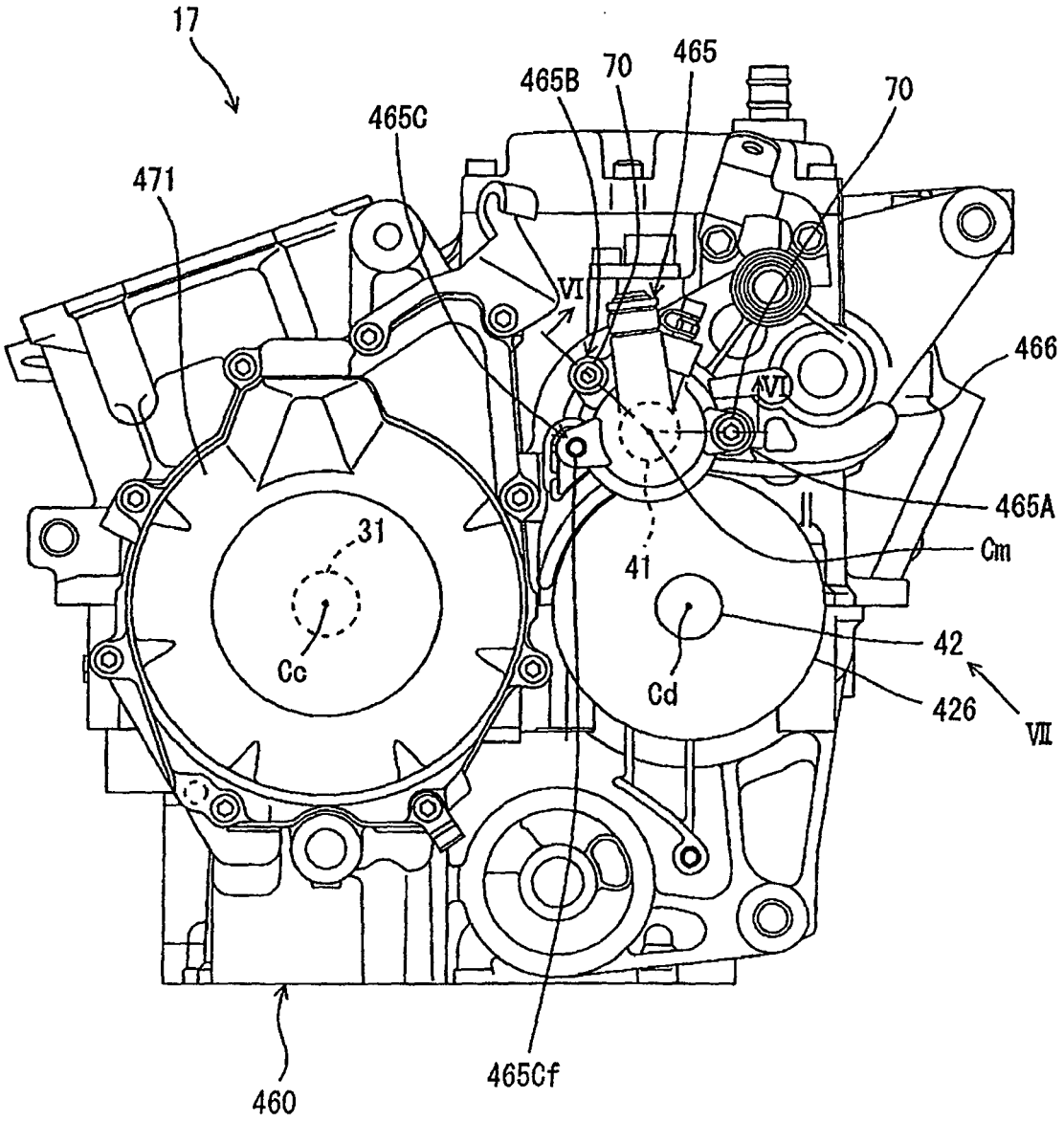

17
465B
70
465
70
465C
471
VI
VI
466
465A
31
Cc
41
Cm
42
Cd
426
VII
460
465Cf

FIG.4

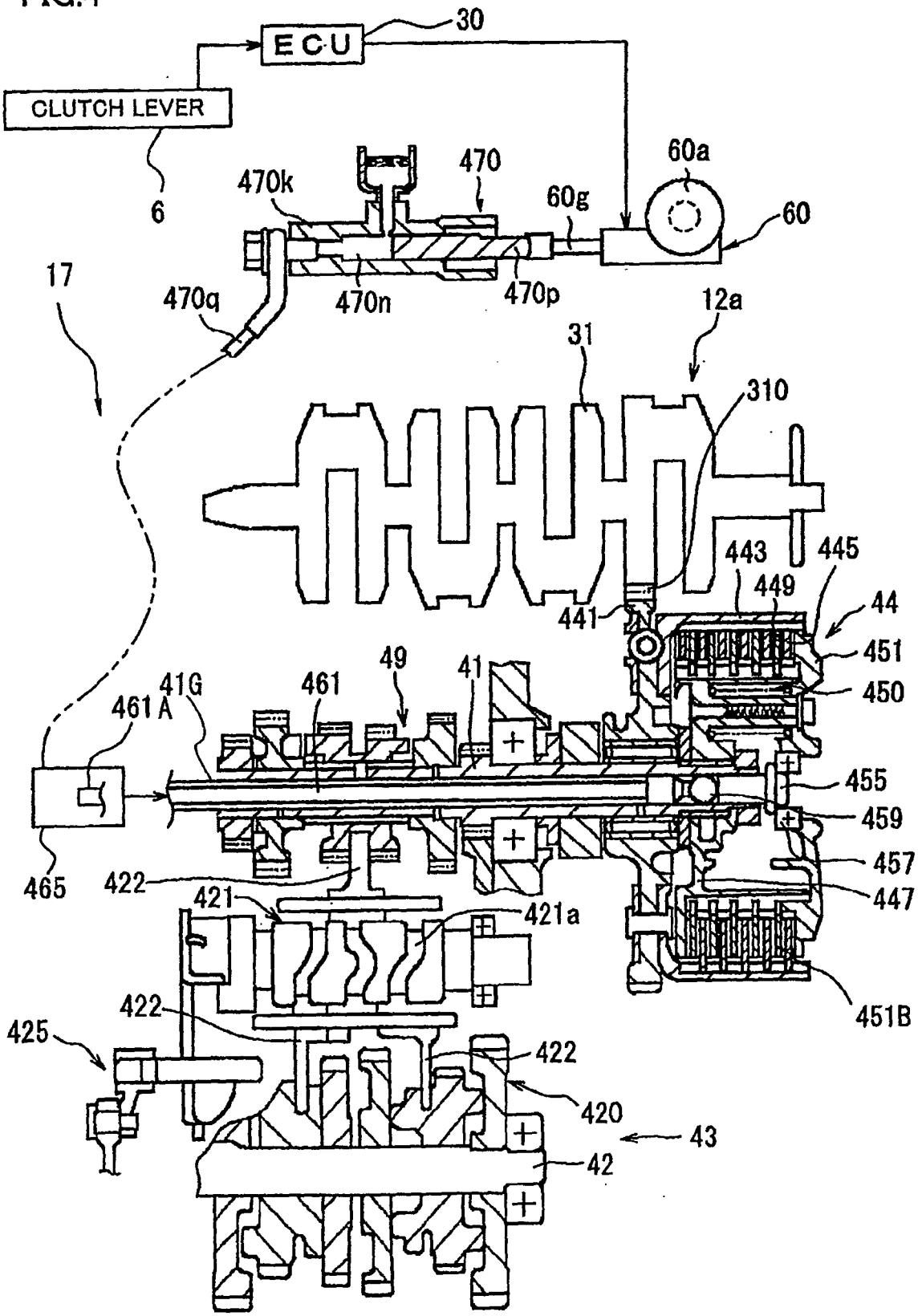

ECU
30
CLUTCH LEVER
6
470k
470
60a
60g
60
17
470q
470n
470p
12a
31
310
443
445
449
44
441
451
450
49
41
41G
461
461A
455
459
457
447
465
422
421
421a
451B
425
422
420
43
42

FIG.5

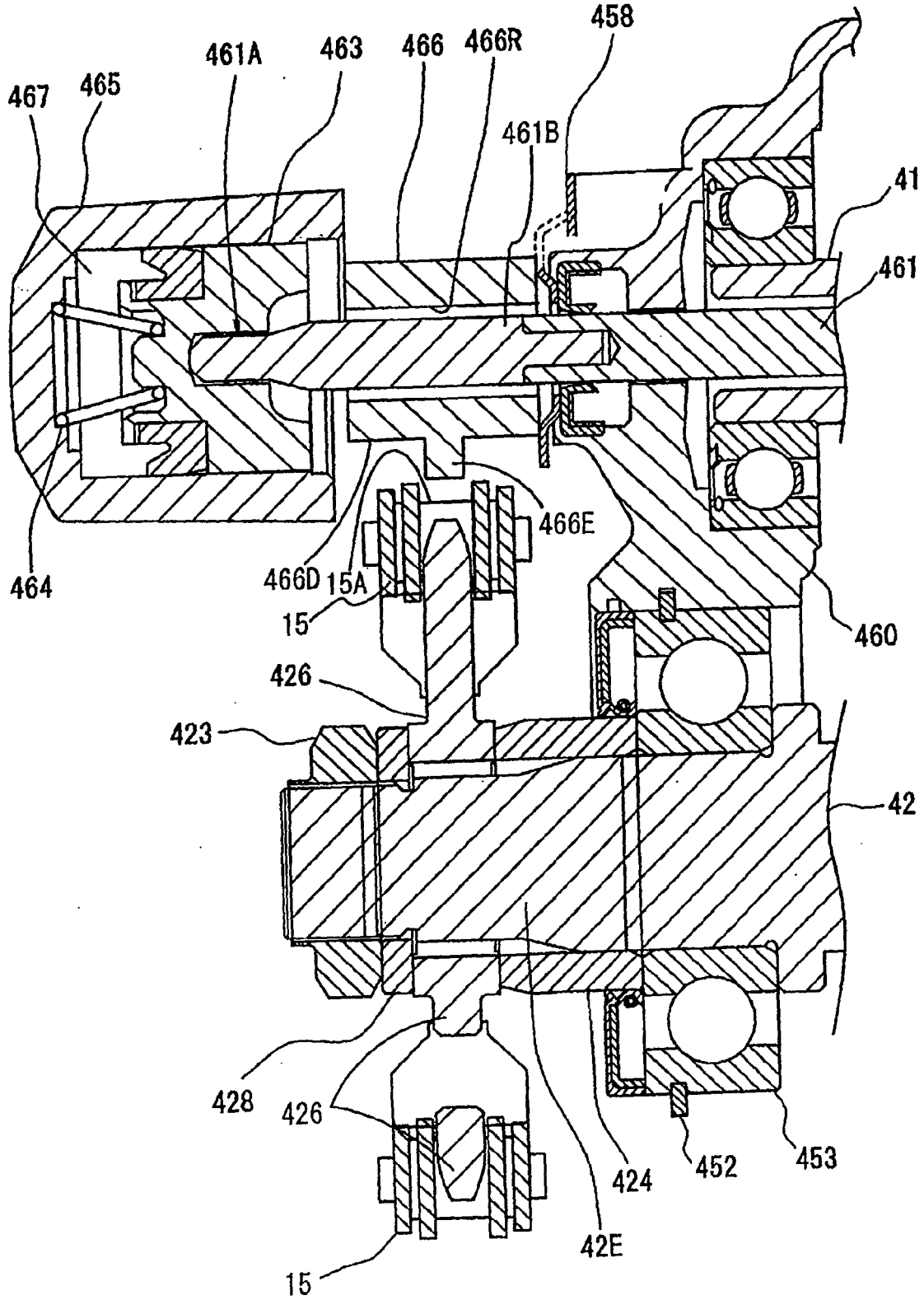

458
461A
463
466
466R
467
465
461B
41
461
466E
464
466D
15A
15
460
426
423
42
428
426
424
452
453
42E
15

FIG. 6

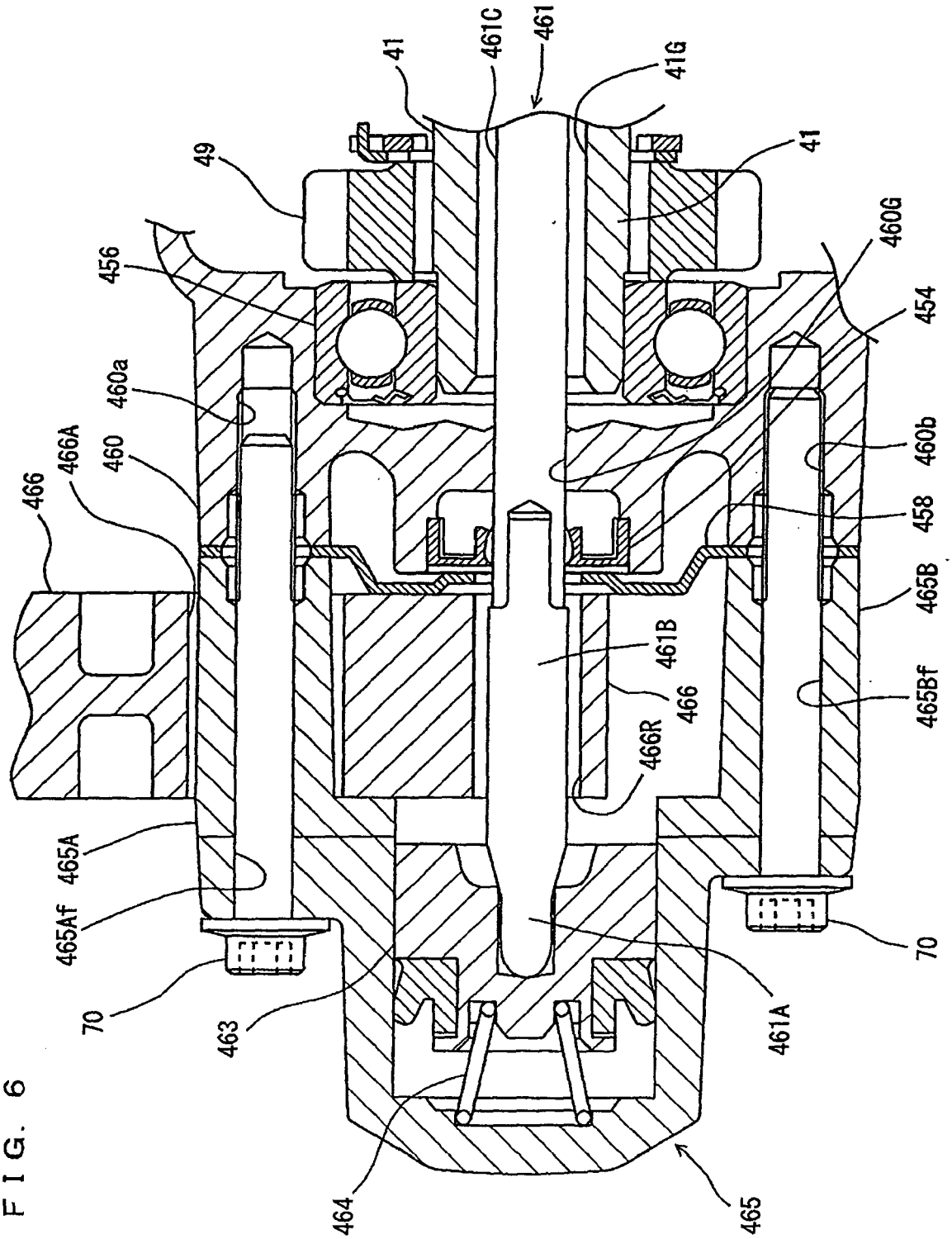
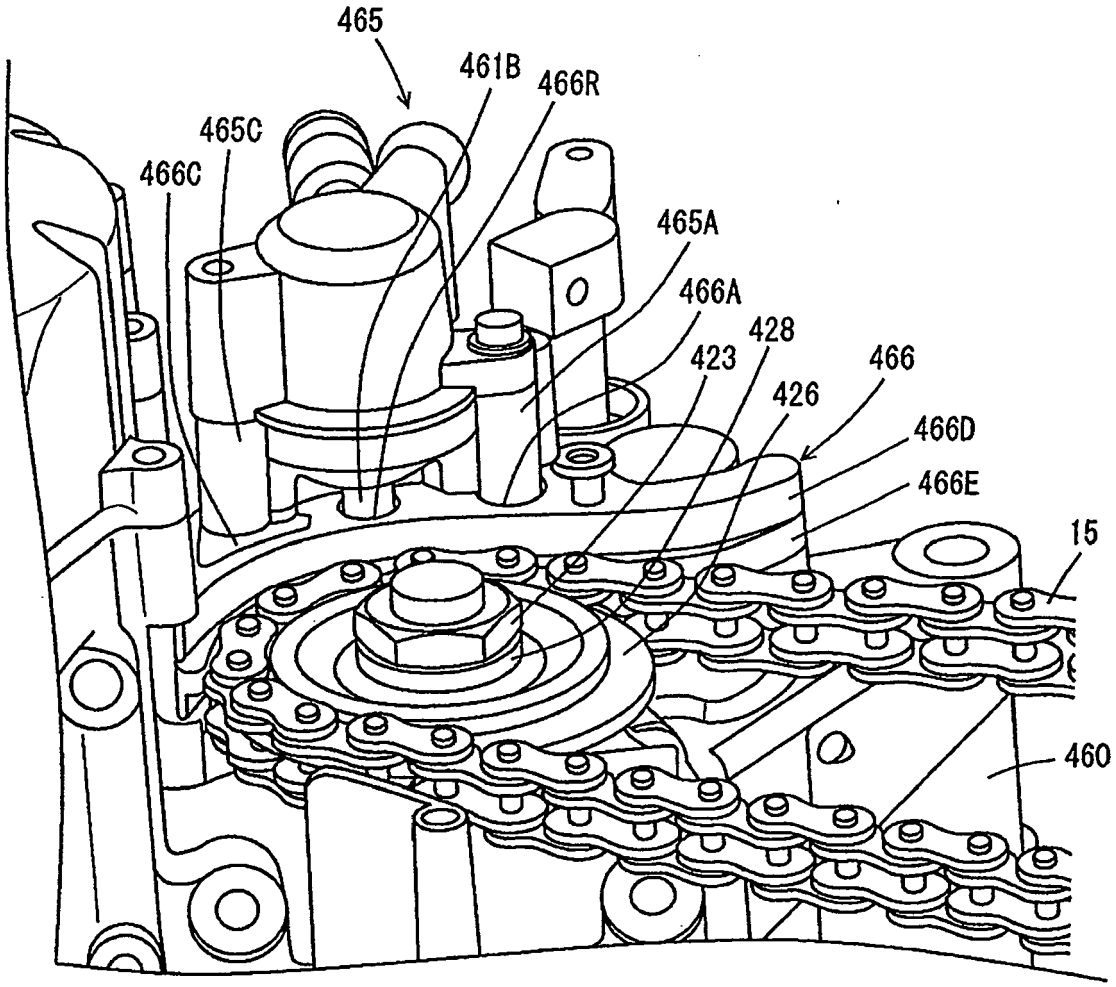

41
461C
461
41G
49
41
460G
456
454
460a
460b
466A
460
458
466
465B
461B
465Bf
466
466R
465A
465Af
70
70
463
461A
464
465

FIG. 7


465
461B
466R
465C
466C
465A
466A
428
423
466
426
466D
466E
15
460

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- JP 2003065064 A **[0003] [0005]**
- JP 58121327 A **[0004] [0005]**