EUROPEAN PATENT SPECIFICATION

(54) V-type internal combustion engine for motorcycle
    Motorradbrennkraftmaschine in V-Bauart
    Moteur à combustion interne à cylindres en V pour un motocycle

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    US-A- 4 497 293
    US-A- 4 903 483
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Description

[0001] The present invention relates to a motorcycle having a V-type internal combustion engine, and particularly to an improved V-type internal combustion engine in which a front bank and a rear bank are disposed fore and aft in such a manner as to cross each other in a V-shape centered at a crank shaft disposed laterally in a state that the crank shaft is mounted on a body frame, and a mission case body for containing a transmission is integrally provided on a rear portion of a crank case for containing the crank shaft.

Prior Art

[0002] The V-type internal combustion engine for a motorcycle of this type has been widely known as an engine for a motorcycle (for example, see Japanese Patent laid-open No. Hei-173832).

[0003] US 4 497 293 discloses a motorcycle in accordance with the preamble of claim 1. There, a lubricating oil pump is mounted below the crank shaft within the oil pan of the engine.

Problem to be Solved by the Invention

[0004] The prior art V-type internal combustion engine for a motorcycle, however, has a problem. Since a lubricating oil pump and a cooling water pump are disposed vertically in a rear portion of a crank case, the rear portion of the crank case must be extended longer rearwardly and also a mission case portion must be largely protruded rearwardly from the crank case in order to avoid the interference between the pumps and a transmission. This results in enlargement of the internal combustion engine, thereby making it difficult to ensure a desirable ground clearance of the internal combustion engine and to reduce the height of a driver's seat and pillion seat.

[0005] In view of the foregoing, the present invention has been made, and an object of the present invention is to provide a motorcycle with a V-type internal combustion engine, which is capable of compactly forming a rear portion of a crank case and a mission case portion without any interference with a lubricating oil pump and a cooling water pump, thereby ensuring a desirable ground clearance of the internal combustion engine and reducing the heights of a driver's seat and a pillion seat.

Means for solving the Problem

[0006] To achieve the above object, according to a first feature of the present invention, there is provided a motorcycle with a V-type internal combustion engine in accordance with claim 1.

[0007] In this motorcycle, a front bank and a rear bank of the engine are disposed fore and aft at an upper part of the crank case in such a manner as to cross each other in a V-shape centered at a crank shaft disposed laterally in a state that the crank shaft is mounted on a body frame, and a mission case portion for containing a transmission is integrally provided on a rear portion of a crank case for containing the crank shaft.

[0008] According to the first feature of the present invention, since the oil pump and the water pump are disposed in front of and over the crank shaft, it is possible to compactly form the rear portion of the crank case and the mission case portion continuous thereto without any interference with the oil pump and the water pump, and hence to ensure a desirable ground clearance of the internal combustion engine and easily reduce the heights of the driver's seat and the pillion seat. In this case, although the front portion of the crank case is slightly swelled by the effect of the above arrangement of the oil pump and the water pump, the swelled portion of the crank case is contained in a lower dead space of the front bank, and therefore, it does not obstruct the compactness of the internal combustion engine.

[0009] According to a second feature of the present invention, in addition to the first feature, the lubricating oil pump and the cooling water pump are coaxially disposed, and both ends of a single pump shaft usually driven by the crank shaft are connected to the pumps.

[0010] According to the second feature, the oil pump and the water pump can be usually driven by the crank shaft via the common transmission system, to thereby simplify the transmission system. Further, since the drive system of both the pumps disposed over the crank shaft is not required to be dipped in oil accumulated in the oil sump of the crank case, it is possible to eliminate the agitation of oil by the drive system and hence to reduce the power loss.

[0011] According to a third feature of the present invention, in addition to the first or second feature, a starting motor connected to the crank shaft via a starting transmission unit is mounted to the crank case in such a manner as to be disposed in front of and under the crank shaft.

[0012] According to the third feature, the starting motor disposed in front of and under the crank shaft also does not obstruct the compactness of the rear portion of the crank case and the mission case portion, and since the starting motor is contained in the lower dead space of the front bank, it does not obstruct the compactness of the internal combustion engine. Further, the starting transmission unit is dipped in oil accumulated in the oil sump on the bottom of the crank case by the effect of the above arrangement of the starting motor; however, since the starting transmission unit is activated not during operation of the engine but upon start-up of
the engine, it does not agitate the oil during operation of the engine and thereby does not cause the power loss.

According to a fourth feature of the present invention, in addition to the first or second feature, an oil filter is mounted in a filter chamber formed in the crank case in such a manner as to be positioned substantially directly over the crank shaft, and the filter chamber is partitioned by the oil filter into an inlet chamber connected to a discharge port of the lubricating oil pump and an outlet chamber connected to the portions to be lubricated of the front and rear banks.

According to the fourth feature, with the above-described arrangement and configuration of the oil pump, the filter chamber and the oil filter, it is possible to make the length of the oil passage as short as possible, and also to arrange the lubricating systems for the front and rear banks substantially symmetrically each other and hence to uniformly lubricate both the banks.

Mode for Carrying out the Invention

Hereinafter, an embodiment of the present invention will be described with reference to the accompanying drawings.

Brief Description of the Drawings

It is illustrated in:

Fig. 1  A side view of a motorcycle on which a V-type internal combustion engine of the present invention is mounted.

Fig. 2  A side view of the internal combustion engine shown in Fig. 1.

Fig. 3  An enlarged vertical sectional view taken on line 3-3 of Fig. 2.

Fig. 4  A sectional view taken on line 4-4 of Fig. 3.

Fig. 5  A sectional view taken on line 5-5 of Fig. 2.

Fig. 6  A system diagram showing the flow of cooling water in the internal combustion engine.

Fig. 7  A sectional view taken on line 7-7 of Fig. 2.

Fig. 8  An enlarged view showing front and rear timing transmission units shown in Fig. 3 and their neighborhoods.

Fig. 9  An enlarged view of a transmission shown in Fig. 3 and its neighborhood.

Fig. 10  A plan view showing an exhaust system of the internal combustion engine and its neighborhood.

Fig. 11  A plan view of a cylinder head of a rear bank of the internal combustion engine.

Fig. 12  A view seen along an arrow 12 of Fig. 9.

In the following description, the front, rear, right, and left sides are based on a body of the motorcycle.

Entire Configuration of Motorcycle (see Figs. 1 and 2)

A front fork (not shown in Figs. 1 and 2) for supporting a front wheel is steerably connected to the front end of a body frame 1 of a motorcycle M. A rear fork 3 for supporting a rear wheel 2 is vertically swingably connected to a rear portion of the body frame 1, and a rear cushion 7 is interposed between the rear ends of the rear fork 3 and the body frame 1.

A V-type internal combustion engine E having a front bank 41 and a rear bank 42 is mounted on an intermediate portion of the body frame 1, and a fuel tank 5 is mounted on the intermediate portion of the body frame 1 at a position over the engine E. A main seat 6a and a pillion seat 6b are mounted on the rear portion of the body frame 1 in such a manner as to be continuous to the rear end of the fuel tank 5.

A chain transmission unit 10 for connecting an output shaft 97 of a transmission 8 connected to the internal combustion engine E and a hub of the rear wheel 2 is disposed on the left side of the rear wheel 2. A starting motor 11 is disposed in front of and under the crank shaft 15.

A front carburetor 121 connected to the front bank 41 and a rear carburetor 122 connected to the rear bank 42 are disposed in a valley portion 28 between the front bank 41 and the rear bank 42 of the internal combustion engine E. A front exhaust pipe 131 connected to a front surface portion of the front bank 41 and a rear exhaust pipe 132 connected to a rear portion of the rear bank 42 are collectively connected to the front end of a common exhaust muffler 14. The exhaust muffler 14 is disposed opposite to the chain transmission unit 10 with respect to the rear wheel 2, that is, on the right side of the rear wheel 2.

Entire Configuration of Internal Combustion Engine (see Figs. 2, 3, 5 and 8)

A front bank 41 and the rear bank 42 of the internal combustion engine E are disposed fore and aft in such a manner as to cross each other at 90° centered at a crank shaft 15 extending from right to left. The crank shaft 15 has a single crank portion 16 having a crank pin 16a, and a pair of right and left journals 18 and 17 adjacent to both the ends of the crank shaft 15. The journals 18 and 17 are supported by a crank case 21 via
ball bearings 20 and 19, respectively.

[0023] The front bank 41 and the rear bank 42 include cylinder blocks 221 and 222 connected to the front and rear sloping surfaces of a cone-shaped upper portion of the crank case 21 supporting the crank shaft 15, and cylinder heads 231 and 232 connected to upper ends of the cylinder blocks 221 and 222, respectively. In this case, the connecting rod 272 of the rear bank 42 is connected to the crank pin 16a in such a manner as to be offset leftwardly from the connecting rod 271 of the front bank 41. The axial line of the rear bank 42 is offset leftwardly from that of the front bank 41 in accordance with a lateral offset S, as shown in Fig. 8, between the connecting rods 271 and 272.

[0024] Pistons 261 and 262 inserted in cylinder bores 251 and 252 of the cylinder blocks 221 and 222 are connected to the crank pin 16a via connecting rods 271 and 272, respectively. In this case, the connecting rod 272 of the rear bank 42 is connected to the crank pin 16a in such a manner as to be offset leftwardly from the connecting rod 271 of the front bank 41. The axial line of the rear bank 42 is offset leftwardly from that of the front bank 41 in accordance with a lateral offset S, as shown in Fig. 8, between the connecting rods 271 and 272.

[0025] As shown in Fig. 5, an over-running clutch 53 of a starting transmission unit 94, and a drive gear 54a of a first transmission unit 54 connected to a clutch 100 are mounted to a right end portion, projecting outwardly from the right journal 18, of the crank shaft 15 in such a manner as to be adjacent to the right journal 18, and the clutch 100 are disposed on the other side of the crank case 21, so that good balance in weight is maintained between both sides of the crank case 21 and accordingly, when the internal combustion engine is mounted on the body frame 1, it is possible to easily offer good balance in weight between the right and left sides of the motorcycle M.

Valve System (see Figs. 2, 3, 4, 8, and 9)

[0032] Intake valves 371 and 372 and exhaust valves 381 and 382 are respectively provided in the cylinder heads 231 and 232 of the front and rear banks 41 and 42 in such a manner that the intake valves 371 and 372 are offset to the valley 28 side between the front and rear banks 41 and 42. Both ends of cam shafts 41 and 412 extending in parallel to the crank shaft 15 are supported by the cylinder heads 231 and 232 via ball bearings 50 and 50', respectively. The cam shaft 411 is adapted to open/close the intake valve 371 and the exhaust valve 381 via rocker arms 391 and 401, respectively, and the cam shaft 412 is adapted to open/close the intake valve 372 and the exhaust valve 382 via rocker arms 392 and 402, respectively. Timing chains 441 and 442 are wound around the drive timing sprockets 421 and 422 fixed to the left end portion of the crank shaft 15 and driven timing sprockets 431 and 432 fixed to the left ends of the cam shafts 411 and 412 of the front and rear banks 41 and 42, respectively. Both the drive timing sprockets 421 and 422 has a common boss 45 press-fitted around a portion, adjacent to the outer end of the left journal 17, of the crank shaft 15.

[0033] The drive timing sprockets 421, the timing chain 441, and the driven timing sprocket 431 of the front
bank 4, constitute the front timing transmission unit 46_1 for reducing the rotational speed of the crank shaft 15 to half and transmitting the reduced rotational speed to the corresponding cam shaft 41. The front timing transmission unit 46_1, which is disposed in a front timing transmission chamber 47_1 formed in a side wall, on the generator 30 side, of the front bank 4, is pressed-fit into the right and left case halves 21b and 21a and the right and left bearings 20 and 19 are previously lightly press-fitted in the right and left case halves 21b and 21a, respectively, and upon assembly of both the case halves 21b and 21a, the right and left case halves 21b and 21a are connected through the ball bearings 98' and 98, and both ends of the output shaft 97 of the transmission 8, which are provided directly behind the crank shaft 15 in such a manner as to be located hind the crank shaft 15 in such a manner as to be located.

[0034] The rear timing transmission unit 46_2 is disposed outside the front timing transmission unit 46_1 in the axial direction, that is, it is located closer to the generator 30 than the front timing transmission unit 46_1 is. The rear shaft 15 is pressed-fit in the rear timing transmission unit 46_2 as shown by an arrow R in Fig. 4, and accordingly, the rear sides of the timing chains 44_1 and 44_2 are loosened. To give specific tensions to the loosened rear sides of the timing chains 44_1 and 44_2, arc-chained tensioners 48_1 and 48_2 are fitted to the rear sides of the motorcycle M. The rear sides of the timing chains 44_1 and 44_2 are loosened from the front bank 4, 1, of the internal combustion engine E, and the front and rear exhaust pipes 13_1 and 13_2 are collected and connected to the exhaust muffler 14 disposed on the right side of the rear wheel 2. Further, with this configuration, since the front and rear timing transmission units 46_1 and 46_2 are collectively disposed on one side, to which the rear bank 4_2 is offset from the front bank 4_1, of the internal combustion engine E, and the front and rear exhaust pipes 13_1 and 13_2 are arranged on the upper and lower sides respectively, the front and rear exhaust pipes 13_1 and 13_2 are connected to the exhaust muffler 14 disposed on the right side of the rear wheel 2.

[0041] A mission case portion 95 protruded from a lower portion of the rear bank 4_2 is formed integrally with the crank case 21. An input shaft 96 and an output shaft 97 of the transmission 8, which are provided directly behind the crank shaft 15 in such a manner as to be located on the front and rear sides in parallel to the crank shaft 15, are contained in the mission case portion 95. Both ends of the input shaft 96 are supported by right and left walls of the mission case portion 95 via a pair of ball bearings 98' and 98, and both ends of the output shaft 97 are supported by the right and left walls of the mission case portion 95 via a pair of ball bearings 99' and 99.
An inner member 101 of the clutch 100 covered with the right cover 34 connected to the right side surface of the crank case 21 is spline-connected to the right end portion of the input portion 96. A first driven gear 54b, which is meshed with the first drive gear 54a to constitute the first transmission unit 54, is mounted to the inner end of the outer member 102. A plurality (five in the example shown in the figures) of speed change gear trains $G_1$ to $G_5$ are selectively arranged between the input shaft 96 and the output shaft 97.

[0042] As shown in Fig. 9, a left wall 95a, which supports the left end portions of the input shaft 96 and the output shaft 97, of the mission case portion 95 is offset rightwardly from the timing transmission unit 462 of the rear bank 42. Accordingly, when the tensioner lifter 492 of the timing transmission unit 462 of the rear bank 42 is disposed outwardly, that is, leftwardly from the timing transmission unit 461 of the front bank 41, it is possible to minimize the rightward offset of the mission case portion 95 from the crank case 21, and hence to realize the compactness of the internal combustion engine E.

Vehicular Speed Sensor (see Figs. 2, 9 and 12)

[0043] In particular, since the timing transmission unit 462 of the rear bank 42 is disposed outwardly, that is, leftwardly from the timing transmission unit 461 of the front bank 41, it is possible to minimize the rightward offset of the mission case portion 95 from the crank case 21, and hence to realize the compactness of the internal combustion engine E.

[0044] The rear wall of the mission case portion 95 has a mounting hole 103, and a vehicular speed sensor 105 having a detecting portion 105a inserted in the mission case portion 95 through the mounting hole 103 is fixed on the rear wall of the mission case portion 95 with a bolt 110. The vehicular speed sensor 105 is disposed with the detecting portion 105a facing to the tips of a top driven gear, that is, a driven gear 104 of the top gear train $G_5$.

[0045] The top driven gear 104, which is spline-connected to the output shaft 97, serves as a shift gear for working the second-speed gear train $G_2$ by leftward shift thereof. In this embodiment, even when the top driven gear 104 is shifted leftwardly, the outer periphery of the top driven gear 104 is not deviated from the detecting region of the vehicular speed sensor 105. The vehicular speed sensor 105 creates a signal corresponding to the number of teeth of the top driven gear 104 just crossing the detecting portion of the vehicular speed sensor 105 and outputs the signal to a computer (not shown). The computer calculates a vehicular speed on the basis of the signal input from the vehicular speed sensor 105 and displays the vehicular speed on a speed meter (not shown) on an instrument panel (not shown) of the motorcycle M.

[0046] In this way, the vehicular speed sensor 105 for detecting the rotational speed of the top driven gear 104 usually rotated together with the output shaft 97 can be mounted on the rear wall of the mission case portion 95 without any interference with not only the rear bank 42 tilted rearwardly toward the mission case portion 95 side but also the rear exhaust pipe 132 mounted on the rear portion of the rear bank 42.

[0047] A rib 106 for covering the lower surface of the vehicular speed sensor 105 is integrally formed on the rear surface of the mission case portion 95. The central portion of the rib 106 has a through-hole 107 allowing a lead wire 108 of the vehicular speed sensor 105 to pass therethrough.

[0048] As shown in Fig. 2, a pair of right and left hangers 1121 and a pair of right and left hangers 1122 are integrally formed on the upper and lower sides of the rear surface of the mission case portion 95 in such a manner as to project therefrom, and a pair of right and left hangers 1123 are integrally formed on the front surface of the crank case 21 in such a manner as to project therefrom. When the internal combustion engine E is mounted on the body frame 1, these hangers 1121, 1122, and 1123 are connected to the body frame 1. Then, the vehicular speed sensor 105 is disposed in a rear dead space of the interior of the mission case portion 95 surrounded by the rear side two pairs of the hangers 1121, and 1122. With this configuration, it is possible to enhance the space efficiency.

[0049] The above rib 106 functions to protect the vehicular speed sensor 105 from being affected by small stones and sands flying from a road during running of the motorcycle M. The through-hole 107 for allowing the lead wire 108 to pass therethrough functions as a port for discharging rainwater and cleaning water permeated in the rib 106.

Lubricating and Cooling System (see Figs. 2, 3, 5 and 6)

[0050] As shown in Figs. 2, 3 and 5, the first drive gear 54a key-connected to the right end portion of the crank shaft 15 is meshed at its two different portions in the peripheral direction with a pump drive gear 56 and the first driven gear 54b.

[0051] The pump drive gear 56 is key-connected to a pump shaft 61 which is supported via a bearing 86 by the right cover 34 connected to the right end surface of the crank case 21. The pump shaft 61, which is in parallel to the crank shaft 15, is disposed in front of and over the crank shaft 15.

[0052] An inner rotor 58 of a trochoid type oil pump 57 for lubrication is fixed on the inner end of the pump shaft 61, and an impeller 63 of a water pump 62 for cooling is fixed on the outer end of the pump shaft 61. A pump housing 60 for containing an outer rotor 59 of the oil pump 57 is screwed in a partition wall 65 for supporting the ball bearing 20 of the crank case 21. A pump casing 64 for containing the impeller 63 is fixed on the outer surface of the right cover with a bolt 87. In this way, the oil pump 57 and the water pump 62 are coaxially disposed in front of and over the crank shaft 15. The oil
pump 57 is provided on the crank case 21 in such a manner as to be adjacent to the outer side of the over-running clutch 53 in the radial direction.

[0053] A suction port of the oil pump 57 is connected via a suction pipe 68 to a strainer 67 (see Fig. 2) disposed in an oil sump 66 on the inner bottom of the crank case 21, and a discharge port of the oil pump 57 is communicated via an oil passage 69 to the crank shaft 15, the cam shafts 41, and 42 of the front and rear banks 41 and 42, and other portions to be lubricated.

[0054] An oil filter 70 positioned substantially directly over the crank shaft 15 is interposed in the course of the oil passage 69. The oil filter 70 is mounted to a filter chamber 71 formed in the right cover 34, and a cap 72 for closing an opening of the chamber 71 is fixed to the cover 34. An inlet chamber 71a on the outer peripheral side of the oil filter 70 in the filter chamber 71 is communicated to the discharge port of the oil pump 57 via an upstream portion 69a of the oil passage 69 formed in the crank case 21, and an outlet chamber 71b on the inner peripheral side of the oil filter 70 in the filter chamber 71 is communicated to two branch oil passages 69b and 69c, formed in the cap 72, of the oil passage 69. One branch oil passage 69b is communicated to a portion 73 to be lubricated of the crank shaft 15 system. The other branch oil passage 69c is further branched at a connection surface between the crank case 21 and the right cover 34 into front and rear branch oil passages 69b and 69c, formed in the crank case 21, and an outlet chamber 71 is communicated to a discharge port of the oil pump 57.

[0055] When the oil pump 57 is driven by the rotation of the crank shaft 15 via the pump drive gear 56 and the pump shaft 61, oil accumulated in the oil sump 66 is communicated via an oil passage 69 to the crank shaft 15, the cam shafts 41, and 42 of the front and rear banks 41 and 42, and other portions to be lubricated.

[0056] The oil filter 70 is provided with a relief valve 70b for short-circuiting the inlet chamber 71a to the outlet chamber 71b when a filter element 70a of the oil filter 70 becomes blocked.

[0057] In the water pump 62, as shown in Fig. 6, a suction pipe 75 is connected to an outlet of the carburetor 122 of the rear bank 4 2 , a heating chamber 80 is connected to an upper joint 79 2 communicated to the combined chamber 80 and a bypass outlet joint 84 is connected to a heating chamber of the combined chamber 80. A thermostat 82 is disposed in the combined chamber 80, and a thermostat cover 81 for holding the combined chamber 80 is screwed in a lower surface portion of the cylinder head 23 2 of the rear bank 4 2. Both ends of a bypass communication water pipe 77 4 disposed in the valley portion 28 are connected to the thermostat cover 81. An outlet joint 83 connected to the outlet of the combined chamber 80 and a thermostat cover 81 is connected to the inlet of the radiator 29 via a water pipe 77 5.

[0061] A thermostat 82 is disposed in the combined chamber 80, and a thermostat cover 81 for holding the thermostat 82 and covering the opening of the combined chamber 80 is connected to the front surface of the cylinder head 23 2.

[0062] An outlet joint 83 connected to the outlet of the thermostat 82 is integrally formed on the thermostat cover 81. The outlet joint 83 is connected to the inlet of the radiator 29 via a water pipe 77 5.

[0063] A bypass outlet joint 84 communicated to the combined chamber 80 via a communication passage 84 is integrally formed on the upper joint 79 2. The bypass outlet joint 84 is communicated to a heating chamber of the carburetor 12 2 of the rear bank 4 2, a heating chamber of the carburetor 12 2 of the front bank 4 1, and the suction pipe 75 in sequence by way of a bypass water pipe 85. The bypass outlet joint 84 has an inside diameter sufficiently smaller than that of the outlet joint 83 of the thermostat cover 81.

[0064] When the temperature of water in the combined chamber 80 becomes equal to or less than a specific temperature, the thermostat 82 blocks the combined chamber 80 from the thermostat cover 81 and opens the communication passage 84 between the combined chamber 80 and the bypass outlet joint 84. On the other hand, when the temperature of water in the combined chamber 80 becomes more than the specific temperature, the thermostat 82 connects the combined chamber 80 to the thermostat cover 81 and closes the communication passage 84.

[0065] As described, when the water pump 62 is driven by the rotation of the crank shaft 15 via the pump drive gear 56 and the pump shaft 61, if the temperature of water in the combined chamber 80 is relatively low,
Further, it is not required to make a layout of piping the banks 41 and 42. The water pipes 773 and 774, there-

erafter pipes 773 and 774 are sufficient to be relatively short since the thermostat 82 communicates the combined chamber 80 is integrally formed on the upper joint 792, it is possible to collectively mount the upper joint 792 and the bypass outlet joint 84 to the rear bank 42, and hence to simplify the piping works.

Since the thermostat 82 blocks the combined chamber 80 from the thermostat cover 81 and opens the communication passage 84'. Consequently, cooling water is fed first from the discharge pipe 76 to the water jacket 242 of the front bank 41 by the water pump 62. Here, about a half of the cooling water is immediately fed to the water jacket 242 of the front bank 41 and is then fed to the combined chamber 80 of the rear bank 42 by way of the upper communication water pipe 774. In the combined chamber 80, the cooling water is combined with the above cooling water having passed through the water jacket 242 of the rear bank 42. The cooling water thus combined is fed from the combined chamber 80 to the bypass outlet joint 84 by way of the communication passage 84', being further fed from the bypass outlet joint 84 to the heating chambers of the carburetors 122 and 121 of the rear and front banks 42 and 41 in sequence; and is returned to the suction pipe 75 of the water pump 62. Thereafter, the same circula-

radiation action of the radiator 29. Thereafter, the same circulation is repeated. Such circulation of cooling water not by way of the radiator 29 makes it possible to promote the warming of the internal combustion engine E, and to heat the carburetors 122 and 121 thereby preventing icing of a fuel nozzle and its neighborhood.

With advance of the warming of the internal combustion engine E, the temperature of the cooling water whose components having passed through the water jackets 241 and 242 of the front and rear banks 41 and 42 and combined in the combined chamber 80 becomes the above specific temperature. At this time, since the thermostat 82 communicates the combined chamber 80 to the thermostat cover 81 and closes the communication passage 84', the above cooling water flows on the outlet joint 83 side, and is returned to the suction pipe 75 of the water pump 62 by way of the radia-

tor 29. Thereafter, the same circulation is repeated. Accordingly, the front and rear banks 41 and 42 can be effectively cooled with the cooling water cooled by the radiation action of the radiator 29.

Since the lower and upper communication wa-
ter pipes 773 and 774 are sufficient to be relatively short in length and are disposed in the valley portion 28 be-

tween both the banks 41 and 42, they are hidden by both the banks 41 and 42. The water pipes 773 and 774, there-

fore, are inconspicuous as seen from the outside, that is, do not degrade the appearance of the internal combus-

tion engine E.

Since the thermostat 82 is disposed in the combined chamber 80 in which components of cooling water having cooled the front and rear banks 41 and 42 are combined, it can suitably control the water temperature in both the banks 41 and 42 by certainly detecting an average water temperature in both the banks 41 and 42. Further, it is not required to make a layout of piping for the thermostat 82, thereby simplifying the entire piping layout.

Since the thermostat cover 81 including the outlet joint 83 projecting forwardly is connected to the front surface of the upper portion of the rear bank 42, it is possible to reduce the degree of bending of the water pipe 775 for communicating the outlet joint 83 to the inlet of the radiator 29, and hence to make small the flow re-

The water pipe 775 and also improve the entire appearance of the internal combustion engine E.

Since the bypass outlet joint 84 having the in-

side diameter smaller than that of the upper joint 792 of the rear bank 42 and being communicated to the com-

bined chamber 80 is integrally formed on the upper joint 792, it is possible to collectively mount the upper joint 792 and the bypass outlet joint 84 to the rear bank 42, and hence to simplify the piping works.

Since the oil pump 57 and the water pump 62 are coaxially disposed and are driven by the common pump shaft 61 driven by the first drive gear 54a, it is possible to simplify the drive system thereof.

Since the oil pump 57 is disposed adjacent to the over-running clutch 53 in the radial direction, it is possible to suppress the increase in lateral width of the internal combustion engine E, although the oil pump 57 and the water pump 62 are coaxially disposed.

Since the oil pump 57 and the water pump 62 are disposed in front of and over the crank shaft 15, it is possible to compactly form the rear portion of the crank case 21 and the mission case portion 95 continu-

tous thereto without any interference with the oil pump 57 and the water pump 62, and hence to ensure a de-

sirable ground clearance of the internal combustion engine E and easily reduce the heights of the driver’s seat 6a and the pillion seat 6b. In this case, although the front portion of the crank case 21 is slightly swelled by the effect of the above arrangement of the oil pump 57 and the water pump 62, the swelled portion of the crank case 21 is contained in the lower dead space of the front bank 41, and therefore, it does not obstruct the compactness of the internal combustion engine E.

Since the drive system of both the pumps 57 and 62 disposed over the crank shaft 15 is not required to be dipped in oil accumulated in the oil sump 66, it is possible to eliminate the agitation of oil by the drive sys-

tem and hence to reduce the power loss.

Since the input shaft 96 and the output shaft 97 of the transmission 8 are horizontally disposed di-

rectly after the crank shaft 15 without any interference with the oil pump 57 and the water pump 62, it is possible to achieve the compactness of the mission case portion 95 and also flatten the upper wall of the mission case portion 95. This makes it possible to sufficiently ensure the distance between the mission case portion 95 and the rear exhaust pipe 132 and hence to easily prevent the mission case portion 95 and the transmission 8 con-

tained therein from being thermally affected by the rear exhaust pipe 132.
Starting System (Figs. 2 and 7)

[0076] A containing recessed portion 88 is formed in the bottom surface of the front portion of the crank case 21, and the starting motor 11 is disposed in the containing recessed portion 88 with its axial line directed in parallel to the crank shaft 15. A casing 89 of the starting motor 11 is mounted on the crank case 21 in such a manner that a cylindrical supporting portion 89a at one end of the casing 89 is liquid-tightly fitted in a through hole 90 formed in the end wall of the containing recessed portion 88 and a mounting arm portion 89b at the other end of the casing 89 is fastened to the crank case 21 with a bolt 111. The leading end of a rotor shaft 91 of the starting motor 11 is inserted in the crank case 21, and a pinion 92 formed on the leading end of the rotor shaft 91 is adapted to drive the starting gear 52 via a reduction gear train 93. The starting gear 52, the over-running clutch 53, and the reduction gear train 93 constitute a starting transmission unit 94 for transmitting the rotational power of the starting motor 11 to the crank shaft 15.

[0077] As described above, since the starting motor 11 is disposed in front of and under the crank shaft 15, the starting motor 11 also does not obstruct the compactness of the rear portion of the crank case 21 and the mission case portion 95, and since the starting motor 11 is contained in the lower dead space of the front bank 41, it does not obstruct the compactness of the internal combustion engine E. Further, the reduction gear train 93 is dipped in oil accumulated in the oil sump 66 on the bottom of the crank case 21 by the effect of the above arrangement of the starting motor 11; however, since the reduction gear train 93 is activated not during operation of the engine but upon start-up of the engine, it does not agitate the oil during operation of the engine and thereby does not cause the power loss.

[0078] The present invention is not limited to the above embodiments, and it is to be understood that various changes in design may be made without departing from the scope of the present invention.

[0079] Object: To provide a V-type internal combustion engine for a motorcycle, having a front bank and a rear bank, which is capable of compactly forming a rear portion of a crank case and a mission case portion continuously thereto without any interference with a lubricating oil pump and a cooling water pump.

[0080] Solving Means: A lubricating oil pump 57 for supplying oil to portions to be lubricated of a front bank 41 and a rear bank 42, and a cooling water pump 62 for supplying cooling water to water jackets 241 and 242 of the front and rear banks 41 and 42 are provided in a crank case 21 in such a manner as to be laterally disposed in front of and over a crank shaft 15. (Fig. 2)

Claims

1. Motorcycle having a V-type internal combustion engine in which a front bank (41) and a rear bank (42) are disposed fore and aft at an upper part of a crank case (21) in such a manner as to cross each other in a V-shape centered at a crank shaft (15) disposed laterally in a state that the crank shaft (15) is mounted on a body frame (1), and a transmission case portion (95) for containing a transmission (8) is integrally provided on a rear portion of said crank case (21) for containing said crank shaft (15), characterized in that

a lubricating oil pump (57) for supplying oil to portions to be lubricated of said front and rear banks (41, 42) and a cooling water pump (62) for supplying cooling water to water jackets (241, 242) of said front and rear banks (41, 42) are provided in said crank case (21) in such a manner as to be laterally disposed in front of and over said crank shaft (15).

2. A motorcycle according to claim 1, wherein said lubricating oil pump (57) and said cooling water pump (62) are coaxially disposed, and both ends of a single pump shaft (61) usually driven by said crank shaft (15) are connected to said pumps (57, 62).

3. A motorcycle according to claim 1 or 2, wherein a starting motor (11) connected to said crank shaft (15) via a starting transmission unit (94) is mounted to said crank case (21) in such a manner as to be laterally disposed in front of and under said crank shaft (15).

4. A motorcycle according to claim 1 or 2, wherein an oil filter (70) is mounted in a filter chamber (71) formed in said crank case (21) in such a manner as to be positioned substantially directly over said crank shaft (15), and said filter chamber (71) is partitioned by said oil filter (70) into an inlet chamber (71a) connected to a discharge port of said lubricating oil pump (57) and an outlet chamber (71b) connected to said portions to be lubricated of said front and rear banks (41, 42).

Patentansprüche

1. Kraftrad mit einem Verbrennungsmotor vom V-Typ, worin eine vordere Bank (41) und eine hintere Bank (42) vorne und hinten an einem oberen Teil eines Kurbelgehäuses (21) derart angeordnet sind, dass sie einander in einer V-Form kreuzen, die an einer Kurbelwelle (15) zentriert ist, die im anbrachten Zustand der Kurbelwelle (15) an einem Hauptrahmen (1) seitlich angeordnet ist, und ein Getriebegehäuseabschnitt (95) zur Aufnahme eines Getriebes (8) integral an einem hinteren Abschnitt des Kurbelgehäuses (21) zur Aufnahme der Kurbelwelle (15) vor-
gesehen ist, **dadurch gekennzeichnet, dass** eine Schmierölpumpe (57) zur Ölversorgung von zu schmierenden Teilen der vorderen und/oder hinteren Bank (4₁, 4₂) sowie eine Kühlwasserpumpe (62) zur Kühlwasserversorgung von Wassermänteln (2₄₁, 2₄₂) der vorderen und der hinteren Bank (4₁, 4₂) in dem Kurbelgehäuse (2₁) derart vorgesehen sind, dass sie seitlich vor und über der Kurbelwelle (1₅) angeordnet sind.

2. **Kraftrad nach Anspruch 1, worin die Schmierölpumpe (57) und die Kühlwasserpumpe (62) koaxial angeordnet sind und beide Enden einer normalerweise durch die Kurbelwelle (1₅) angetriebenen einzigen Pumpenwelle (6₁) mit den Pumpen (5₇, 6₂) verbunden sind.**

3. **Kraftrad nach Anspruch 1 oder 2, worin ein mit der Kurbelwelle (1₅) über eine Startergetriebeeinheit (9₄) verbundener Startermotor (1₁) an dem Kurbelgehäuse (2₁) derart montiert ist, dass er vor und unter der Kurbelwelle (1₅) angeordnet ist.**

4. **Kraftrad nach Anspruch 1 oder 2, worin ein Ölfilter (7₀) in einer in dem Kurbelgehäuse (2₁) ausgebildeten Filterkammer (7₁) positioniert ist, und die Filterkammer (1₇) durch den Ölfilter (7₀) in eine Einlasskammer (7₁ₐ), die mit einer Auswurfläche der Schmierölpumpe (5₇) verbunden ist, und eine Auslasskammer (7₁₇), die mit den zu schmierenden Teilen der vorderen und der hinteren Bank (4₁ und 4₂) verbunden ist, unterteilt ist.**

**Revendications**

1. **Motocycle ayant un moteur à combustion interne du type en V dans lequel une rangée avant (4₁) et une rangée arrière (4₂) sont disposées devant et derrière dans une partie supérieure d'un carter de vilebrequin (2₁) de manière à se couper l'une l'autre selon une forme de V centrée sur un vilebrequin (1₅) disposé latéralement dans un état où le vilebrequin (1₅) est monté sur un châssis (1), et une partie de carter de transmission (9₅) pour contenir une transmission (8) est intégralement agencée sur une partie arrière dudit carter de vilebrequin (2₁) pour contenir ledit vilebrequin (1₅), **caractérisé en ce qu'une pompe à huile de lubrification (5₇) pour alimenter de l'huile vers des parties à lubrifier desdites rangées avant et arrière (4₁, 4₂) et une pompe à eau de refroidissement (6₂) pour alimenter de l'eau de refroidissement vers des chemises d'eau (2₄₁, 2₄₂) desdites rangées avant et arrière (4₁, 4₂) sont agencées dans ledit carter de vilebrequin (2₁) de manière à être disposées latéralement à l'avant et au-dessus dudit vilebrequin (1₅).**

2. **Motocycle selon la revendication 1, dans lequel ladite pompe à huile de lubrification (5₇) et ladite pompe à eau de refroidissement (6₂) sont disposées coaxialement, et les deux extrémités d’un arbre de pompe unique (6₁) entraîné habituellement par ledit vilebrequin (1₅) sont reliées auxdites pompes (5₇, 6₂).**

3. **Motocycle selon la revendication 1 ou 2, dans lequel un moteur de démarrage (1₁) relié vilebrequin (1₅) par une unité de transmission de démarrage (9₄) est monté sur ledit carter de vilebrequin (2₁) de manière à être disposé à l'avant et en dessous dudit vilebrequin (1₅).**

4. **Motocycle selon la revendication 1 ou 2, dans lequel un filtre à huile (7₀) est monté dans une chambre pour filtre (7₁) formée dans ledit carter de vilebrequin (2₁) de manière à être positionné sensiblement directement au-dessus dudit vilebrequin (1₅), et ladite chambre pour filtre (7₁) est cloisonnée par ledit filtre à huile (7₀) en une chambre d’entrée (7₁ₐ) reliée à un orifice d’évacuation de ladite pompe à huile de lubrification (5₇) et une chambre de sortie (7₁₇) reliée auxdites parties à lubrifier desdites rangées avant et arrière (4₁, 4₂).**