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(54) **Motorcycle**

(57) The present invention has an object to provide a motorcycle configured to efficiently separate alcohol from blow-by gas. The motorcycle includes an engine (3), an intake path (35), an air cleaner (42), a catch tank (60), a first hosepipe (71), and a second hosepipe (72). The intake path (35) is connected to the engine (3). The

air cleaner (42) is disposed at the intake path (35) and is aligned with the engine (3) in a longitudinal direction. The catch tank (60) is disposed in the surroundings of the air cleaner (42). The first hosepipe (71) connects the inside of the engine (3) and the inside of the catch tank (60). The second hosepipe (72) connects the inside of the catch tank (60) and the intake path (35).

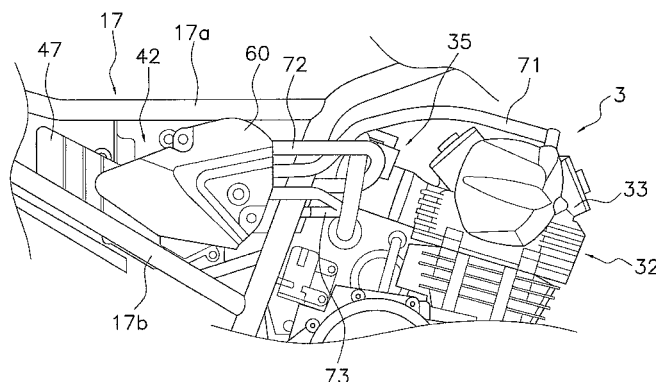


FIG. 4

Description

TECHNICAL FIELD

[0001] The present invention relates to a motorcycle.

BACKGROUND ART

[0002] In the motorcycles, fuel is transferred to a combustion chamber of an engine through an intake path. Then, the transferred fuel may reach a crank case through clearance between a cylinder and a piston without being burned. In this case, the fuel is mixed with lubricant oil stored in the crank case. The lubricant oil, stored in the crank case, increases its temperature in response to engine revolution. The unburned fuel, mixed with the lubricant oil, is accordingly changed into a gaseous state. The gaseous fuel (hereinafter referred to as "blow-by gas") is transferred to the intake path from the crank case. The blow-by gas herein contains fine-particle lubricant oil. Therefore, the lubricant oil is desirably separated from the blow-by gas before the blow-by gas is returned to the intake path from the crank case.

[0003] To cope with this, Japan Laid-open Patent Application Publication No. JP-A-H05-086829 describes a motor cycle provided with an oil catch tank for separating oil from blow-by gas. The oil catch tank is disposed over the engine while being connected to a crank case through a gas supply pipe. Further, the oil catch tank is connected to an air cleaner through a gas discharge pipe. The blow-by gas is transferred from the crank case to the oil catch tank through the gas supply pipe. The blow-by gas then rapidly expands within the oil catch tank. Accordingly, the oil is separated from the blow-by gas. After separation of the oil, the blow-by gas is transferred from the oil catch tank to the air cleaner through the gas discharge pipe, and is again supplied into the cylinder. On the other hand, the oil, separated from the blow-by gas within the oil catch tank, is returned from the oil catch tank to an oil tank disposed beneath the engine through an oil return pipe. Then, the returned oil is again used for lubrication of various components of the engine.

DISCLOSURE OF THE INVENTION

[0004] The present invention has an object to provide a motorcycle configured to efficiently separate alcohol from blow-by gas under a condition that enlargement of the vehicle is inhibited.

This object is achieved by a motorcycle according to claim 1.

[0005] A motorcycle according to an aspect of the present invention includes an engine, an intake path, an air cleaner, a separation device, a first path, and a second path. The intake path is connected to the engine. The air cleaner is disposed at the intake path while being aligned with the engine in either a longitudinal direction or a vertical direction. The separation device is disposed in the

surroundings of the air cleaner. The first path connects the inside of the engine and the inside of the separation device. The second path connects the inside of the separation device and the intake path.

ADVANTAGEOUS EFFECTS OF THE INVENTION

[0006] Alcohol-containing fuel has been recently used as the motorcycle engine fuel. It was found out that when the alcohol-containing fuel is used for the motorcycles, a phenomenon is caused that alcohol enters the crank case through a clearance between the cylinder and the piston without being burned, and is mixed with lubricant oil stored therein. When the lubricant oil herein increases its temperature, blow-by gas, containing the alcohol and the lubricant oil, enters the oil catch tank.

[0007] The alcohol has a feature that it is easily changed into a gaseous state because of its low boiling point. For example, ethanol has a boiling-point range from roughly 78 degrees Celsius to roughly 80 degrees Celsius. When the temperature within the oil catch tank is increased by engine heat it is difficult to change the alcohol into a liquid state within the oil catch tank. In other words, it is difficult to sufficiently separate the alcohol from the blow-by gas. Embodiments of the invention are advantageous as they provide for an approach enhancing the change of the alcohol into the liquid state, thereby avoiding returning the blow-by gas to the intake path while containing massive alcohol. Thus, any large deviation of an air-fuel (A/F) ratio of mixture gas from a target value is avoided.

[0008] Further, alcohol has a boiling-point range narrower than that of gasoline. Gasoline has a boiling-point range from roughly 30 degrees Celsius to roughly 200 degrees Celsius. Compared to this, ethanol, for instance, has a boiling-point range from roughly 78 degrees Celsius to roughly 80 degrees Celsius. In other words, gasoline has a feature of being gradually changed into a gaseous state, whereas alcohol has a feature of being suddenly changed into a gaseous state once reaching its boiling point. Therefore, it is required to separate massive alcohol in a gaseous state from the blow-by gas within the oil catch tank by changing the gaseous alcohol into a liquid state. To achieve this, the oil catch tank is required to ensure sufficient capacity. Embodiments of the invention provide for an approach allowing for a sufficient capacity of the oil catch tank for changing the gaseous alcohol into a liquid state without increasing the entire size of the motorcycles.

[0009] According to the present invention, it is possible to efficiently separate alcohol from blow-by gas under a condition that enlargement of a vehicle is inhibited.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG.1 is a side view of a motorcycle.

FIG.2 is a side view illustrating internal structure of the motorcycle.

FIG.3 is a top view illustrating the internal structure of the motorcycle.

FIG.4 is a side view illustrating structure of a catch tank and its peripheral components.

FIG.5 is a side view of an intake path.

FIG. 6 is a side view of an air cleaner and the catch tank.

FIG.7 is a front view of the air cleaner and the catch tank.

FIG. 8 is a cross-sectional view of the internal structure of the motorcycle, sectioned along line A-A in FIG.2.

FIG.9 is a front view of the catch tank.

FIG.10 is a cross-sectional side view of the catch tank.

FIG.11 is a cross-sectional side view of a catch tank in one of the other embodiments.

FIG.12 is a cross-sectional side view of a catch tank in one of the other embodiments.

FIG.13 is a cross-sectional side view of a catch tank in one of the other embodiments.

FIG.14 is a cross-sectional side view of a catch tank in one of the other embodiments.

FIG.15 is a cross-sectional side view of a catch tank in one of the other embodiments.

FIG.16 is a cross-sectional side view of a catch tank in one of the other embodiments.

FIG.17 is a side view of an air cleaner and a catch tank of one of the other embodiments.

FIG.18 is a side view of an air cleaner and a catch tank of one of the other embodiments.

FIG.19 is a side view of an air cleaner and a catch tank of one of the other embodiments.

FIG.20 is a side view of an air cleaner and a catch tank of one of the other embodiments.

FIG.21 is a side view of a motorcycle according to one of the other embodiments.

FIG.22 is a side view of a motorcycle according to one of the other embodiments.

FIG.23 is a side view illustrating structure and disposition of a power unit of the motorcycle according to one of the other embodiments.

BEST MODE FOR CARRYING OUT THE INVENTION

[Entire Structure]

[0011] FIG.1 illustrates a motorcycle 1 according to an embodiment of the present invention. The motorcycle 1 is a saddle-ride type motorcycle, and includes a vehicle body frame 2 (see FIG.2), an engine 3, a seat 4, a fuel tank 5, a front wheel 6, and a rear wheel 7.

[0012] As illustrated in FIGS.2 and 3, the vehicle body frame 2 includes a head pipe 11, a right side frame 12, and a left side frame 13. As illustrated in FIG.1, the head pipe 11 supports a front fork 14. A handle 15 is fixed to

the upper end of the front fork 14. The front wheel 6 is supported by the lower end of the front fork 14 in a rotatable state.

[0013] The right and left side frames 12, 13 form a frame portion extended from the head pipe 11 to the rearward. As illustrated in FIGS.2 and 3, the right and left side frames 12, 13 are respectively extended from the head pipe 11 to the rearward while being separated from each other in a vehicle-width direction (hereinafter referred to as a transverse direction). The right side frame 12 includes a front frame portion 16 and a rear frame portion 17.

[0014] The front frame portion 16 is bent at plural positions. The front frame portion 16 includes a first portion 16a, a second portion 16b, a third portion 16c, and a fourth portion 16d. The first portion 16a is linked to the head pipe 11. The second portion 16b is extended from the rear end of the first portion 16a to the downward. The third portion 16c is extended from the lower end of the second portion 16b to the forward. The fourth portion 16d is forwardly extended from the third portion 16c in an obliquely upward direction. The fourth portion 16d is linked to the head pipe 11. In the present embodiment, the phrase "(a component) is linked to (another component)" means not only a condition that two individual members are coupled to each other by means of a fixation method such as welding but also a condition that two portions included in single member continue to each other.

[0015] The rear frame portion 17 is extended from the front frame portion 16 to the rearward and is linked to the front frame portion 16. The rear frame portion 17 includes an upper frame portion 17a and a lower frame portion 17b. The front end of the upper frame portion 17a is linked to a bent portion between the first portion 16a and the second portion 16b in the front frame portion 16. The lower frame portion 17b is disposed beneath the upper frame portion 17a. The front end of the lower frame portion 17b is linked to the second portion 16b of the front frame portion 16. The rear end of the lower frame portion 17b is linked to the rear end of the upper frame portion 17a. Further, the upper and lower frame portions 17a, 17b are arranged to get closer to the rearward. The left side frame 13 is formed in approximately the same shape as the right side frame 12. In short, the left side frame 13 includes a front frame portion 28 and a rear frame portion 29 as illustrated in FIG.3. The front frame portion 28 includes a first portion 28a, a second portion 28b, a third portion 28c, and a fourth portion 28d. The rear frame portion 29 includes an upper frame portion 29a and a lower frame portion 29b. Further, the right and left side frames 12, 13 are coupled by a coupling frame 18 extended in the transverse direction. Yet further, support members 21, 22 are bridged over the right and left side frames 12, 13 for supporting the seat 4 and the fuel tank 5. It should be noted that a rear fender 19 is attached to the lower portion of the rear frame portion 17 for covering the rear wheel 7 from the above.

[0016] As illustrated in FIG.1, the seat 4 and the fuel tank 5 are attached to the upper portion of the vehicle body frame 2. The fuel tank 5 is disposed in front of the seat 4. A swing arm 23 is coupled to the rear end of the front frame portion 16 while being allowed to pivot up and down. The rear wheel 7 is supported by the rear end of the swing arm 23 in a rotatable state. Further, a pair of side covers 24 is attached to right and left lateral sides of the vehicle body frame 2. In a side view, the side covers 24 are disposed for laterally covering a space between the upper frame portion 17a and the lower frame portion 17b.

[0017] The engine 3 is a four-stroke engine configured to transmit driving force to the rear wheel 7 through a chain (not illustrated in the figure). The engine 3 is disposed below the fuel tank 5 and is supported by the front frame portion 16. As illustrated in FIG.2, the engine 3 includes a crank case 31 and a cylinder portion 32. A crank shaft (not illustrated in the figure) is disposed in the crank case 31. The cylinder portion 32 is attached to the top of the crank case 31. A piston (not illustrated in the figure) is disposed in the cylinder portion 32. The piston is coupled to the crank shaft.

[0018] The cylinder portion 32 includes a cylinder head 33. An exhaust path 34 (see FIG.1) and an intake path 35 (see FIG.4) are coupled to the cylinder head 33. As illustrated in FIG. 1, the exhaust path 34 is provided with an exhaust pipe 36 and a muffler 37. The exhaust pipe 36 is connected to the front surface of the cylinder head 33. The exhaust pipe 36 is backwardly bent in front of the engine 3. Accordingly, the exhaust pipe 36 is disposed along the outer periphery of the engine 3. The muffler 37 is connected to the rear portion of the exhaust pipe 36 and is disposed lateral to the rear wheel 7.

[0019] FIG.5 illustrates a side view of the intake path 35. The intake path 35 is provided with a first intake pipe 49, a throttle body 41, a second intake pipe 48, and an air cleaner 42. The first intake pipe 49 connects the engine 3 and the throttle body 41. The throttle body 41 is connected to the cylinder head 33 of the engine 3. A throttle valve 43 is disposed in the throttle body 41. An intake amount of the engine 3 is regulated in accordance with change of opening degree of the throttle valve 43. Inhaled air flows towards the engine 3 through the air cleaner 42, the second intake pipe 48, the throttle body 41, and the first intake pipe 49. Further, an injector 44 is disposed in a more downstream position than the throttle valve 43 in an airflow direction. The injector 44 is connected to the fuel tank 5 through a fuel supply hosepipe (not illustrated in the figure). The injector 44 is configured to inject fuel. In the intake path 35, the injector 44 is disposed between the throttle valve 43 and the engine 3. The second intake pipe 48 connects the throttle body 41 and the air cleaner 42.

[0020] In the intake path 35, the air cleaner 42 is disposed in a more upstream position than the throttle body 41 in the airflow direction. As illustrated in FIG.4, the air cleaner 42 is aligned with the engine 3 in a back-and-

forth direction (hereinafter referred to as a longitudinal direction) and is disposed to the rearward of the cylinder head 33. The air cleaner 42 is positioned lateral to the rear frame portion 17. In a plan view, the air cleaner 42 is disposed between the right-side lower frame portion 17b and the left-side lower frame portion 29b. As illustrated in FIG.5, the air cleaner 42 includes an air inlet 47, a filter 46, and a casing 45. The air inlet 47 is provided to the rear portion (i.e., left side in FIG. 5) of the casing 45. External air inhaled into the casing 45 passes through the air inlet 47. The filter 46 is disposed in the inside of the casing 45. The filter 46 is configured to purify the inhaled air passing through it. The casing 45 is a member having a hollow space in its inside. The second intake pipe 48, extended from the throttle body 41, is attached to the front portion (i.e., right side in FIG.5) of the casing 45.

[0021] As illustrated in FIGS.6 and 7, the casing 45 is further provided with a first attachment port 51, a second attachment port 52, and an outlet 54. The first attachment port 51, the second attachment port 52, and the outlet 54 communicate with a portion of the inner space of the casing 45. Here, the portion of the inner space is disposed in a more downstream position than the filter 46 in the airflow direction. The first attachment port 51 and the second attachment port 52 are provided to the front portion of the casing 45. A second hosepipe 72 described below is connected to the first attachment port 51. The second attachment port 52 is positioned lower than the first attachment port 51. A third hosepipe 73 described below is attached to the second attachment port 52. The outlet 54 is provided to the bottom portion of the casing 45. The outlet 54 is protruded from the bottom portion of the casing 45 to the downward. A stopper 55 is detachably attached to the outlet 54. The outlet 54 is sealed by the stopper 55. It should be noted that FIG.7 omits illustration of the stopper 55.

[Catch Tank Structure]

[0022] As illustrated in FIGS.2 to 4, a catch tank 60 is disposed in surrounding of the air cleaner 42 or in the surroundings of the air cleaner 42. The catch tank 60 is a separation device configured to separate alcohol from blow-by gas by changing gaseous alcohol into a liquid state. Specifically, the catch tank 60 is disposed lateral to the air cleaner 42. In other words, the catch tank 60 is aligned with the air cleaner 42 in the transverse direction while being opposed to the lateral surface of the air cleaner 42. As illustrated in FIGS. 3 and 7, the catch tank 60 is attached to the lateral surface of the air cleaner 42. As illustrated in FIG.8, the foregoing right side cover 24 (see FIG. 1) is disposed to the transversely outward of the catch tank 60. The catch tank 60 is disposed between the right side cover 24 and the air cleaner 42 in the transverse direction. The catch tank 60 is disposed to the rearward of the front frame portion 16. Further, the catch tank 60 is disposed between the upper and lower frame por-

tions 17a, 17b of the rear frame portion 17 in an up-and-down direction (hereinafter referred to as a vertical direction). Therefore, the catch tank 60 is disposed to the rearward of the cylinder portion 32 of the engine 3. Further, the catch tank 60 is overlapped with the upper and lower frame portions 17a, 17b in the vertical direction.

[0023] As illustrated in FIGS. 6 to 9, the catch tank 60 includes a tank body 61, a first connection port 62, a second connection port 63, and a third connection port 64. As illustrated in FIG. 9, the tank body 61 is elongated further in the vertical direction than in the transverse direction (i.e., right-and-left direction in FIG. 9), and has a hollow space in its inside. Further, the tank body 61 is elongated further in the longitudinal direction than in the transverse direction. The tank body 61 includes a rear portion convexly protruded to the rearward.

[0024] The first, second, and third connection ports 62, 63, 64 are protruded from the front portion of the tank body 61 to the forward. One end of a first hosepipe 71 is connected to the first connection port 62. The other end of the first hosepipe is connected to the cylinder head 33 of the engine 3. The first hosepipe 71 communicates with the inside of the crank case 31 through a cam-chain chamber (not illustrated in the figure) within the cylinder portion 32. The first hosepipe 71 forms a first path connecting the inside of the crank case 31 of the engine 3 and the inside of the tank body 61. The second connection port 63 is positioned higher than the first connection port 62. One end of the second hosepipe 72 is connected to the second connection port 63. The other end of the second hosepipe 72 is connected to the first attachment port 51 of the air cleaner 42. The second connection port 63 is positioned higher than the first attachment port 51. The second hosepipe 72 forms a second path connecting the inside of the catch tank 60 and the intake path 35. The third connection port 64 is positioned lower than the first connection port 62. One end of the third hosepipe 73 is connected to the third connection port 64. The other end of the third hosepipe 73 is connected to the second attachment port 52 of the air cleaner 42. Further, the third connection port 64 is positioned higher than the second attachment port 52.

[0025] As illustrated in FIG. 10, the tank body 61 is provided with a first divider portion 74 and a second divider portion 75 in its inside. The first divider portion 74 is extended to the rearward (i.e., left side in FIG. 10) from a portion vertically positioned between the first connection port 62 and the third connection port 64 on the inner surface of the tank body 61. The first divider portion 74 is downwardly slanted to the rearward. Further, a first protrusion 76 is provided to the bottom surface of the first divider portion 74. The first protrusion 76 is protruded to the downward from the bottom surface of the first divider portion 74. The second divider portion 75 is extended to the rearward from a portion positioned lower than the third connection port 64 on the inner surface of the tank body 61. Further, the second divider portion 75 is positioned lower than the first divider portion 74. The second

divider portion 75 is shorter than the first divider portion 74 in the longitudinal direction. The rear end of the second divider portion 75 is positioned to the forward of the rear end of the first divider portion 74. The second divider portion 75 is downwardly slanted to the rearward. The slant angle of the second divider portion 75 is smaller than that of the first divider portion 74. Therefore, distance between the first and second divider portions 74, 75 gets smaller to the rearward. Further, a second protrusion 77 is provided to the top surface of the second divider portion 75. The second protrusion 77 is protruded to the upward from the top surface of the second divider portion 75. The second protrusion 77 is positioned to the forward of the first protrusion 76. Therefore, the second protrusion 77 is positioned closer to the third connection port 64 than the first protrusion 76 is.

[Blow-by Gas Processing]

[0026] Next, blow-by gas processing when alcohol-containing fuel is used in the motorcycle 1 will be hereinafter explained with reference to FIGS. 4, 6, and 10. It should be noted that alcohol has a feature that it is easily changed into a gaseous state because of its low boiling point different from a boiling point of lubricant oil. For example, ethanol has a boiling-point range from roughly 78 degrees Celsius to roughly 80 degrees Celsius. Further, alcohol has a feature that it is suddenly changed into a gaseous state once reaching its boiling point because of its narrow boiling-point range different from a boiling-point range of gasoline.

[0027] First, when alcohol-containing fuel reaches the inside of the crank case 31 from the combustion chamber of the engine 3 through clearance between the piston and the cylinder portion 32, alcohol contained in the fuel is mixed with lubricant oil stored within the crank case 31. Next, when the lubricant oil increases its temperature in response to operation of the engine 3 and alcohol accordingly reaches its boiling point, alcohol mixed with the lubricant oil is suddenly evaporated. Blow-by gas, containing the gaseous alcohol, is transferred from the inside of the crank case 31 to the inside of the catch tank 60 through the cam-chain chamber within the cylinder portion 32, the first hosepipe 71, and the first connection port 62. Alcohol, contained in the blow-by gas, is partially changed into a liquid state within the catch tank 60, and is thus separated from the blow-by gas. The rest of the alcohol is transferred to the air cleaner 42 through the second connection port 63, the second hosepipe 72, and the first attachment port 51, while being kept contained in the blow-by gas. In this case, the blow-by gas is transferred to a clean side within the air cleaner 42, i.e., a more downstream position than the filter 46 in the airflow direction. The blow-by gas then joins the mixture gas, and is supplied to the engine 3 through the intake path 35.

[0028] According to the motorcycle 1 of the present embodiment, alcohol, changed into a gaseous state within the crank case 31, is again returned to the combustion

chamber of the engine 3 after passing through the catch tank 60 with large capacity and the air cleaner 42, as described above. The gaseous alcohol is partially changed into a liquid state within the catch tank 60 and is separated from the blow-by gas. Therefore, it is possible to inhibit massive alcohol from being returned to the combustion chamber of the engine 3 all at once. Further, it is possible to inhibit massive blow-by gas to be returned to the combustion chamber of the engine 3 all at once. Therefore, it is possible to inhibit large deviation of an air-fuel ratio of the mixture gas to be supplied to the engine 3 from a target value.

[0029] The liquid alcohol, separated from the blow-by gas within the catch tank 60, is stored within the catch tank 60. The liquid alcohol, stored within the catch tank 60, is gradually changed into a gaseous state by heat of the blow-by gas. The alcohol is then transferred to the air cleaner 42 through the second connection port 63 and the second hosepipe 72 in a gaseous state, and is supplied to the engine 3.

[0030] Further, when quantity of liquid alcohol stored within the catch tank 60 is equal to or greater than predetermined quantity, the liquid alcohol is transferred to the air cleaner 42 through the third connection port 64, the third hosepipe 73, and the second attachment port 52. Therefore, liquid alcohol is prevented from being excessively accumulated in the catch tank 60. Alcohol, accumulated within the air cleaner 42, can be discharged to the outside by removing the stopper 55 from the outlet 54. It should be noted that, when liquid alcohol is accumulated in the lower portion of the catch tank 60, the surface of the liquid alcohol may greatly wave in response to acceleration or deceleration of the motorcycle 1. According to the motorcycle 1, however, liquid alcohol is prevented from easily flowing into the third connection port 64 by the second divider portion 75, the first protrusion 76, and the second protrusion 77 even if the surface of the liquid alcohol greatly waves. It is thereby possible to prevent a large quantity of liquid alcohol from flowing into the air cleaner 42 all at once through the third connection port 64. Further, according to the motorcycle 1, liquid alcohol is prevented from easily flowing into the first connection port 62 by the first divider portion 74 even if the surface of the liquid alcohol greatly waves. Therefore, it is possible to prevent reverse flow of liquid alcohol from the catch tank 60 to the engine 3.

[Feature]

[0031] According to the motorcycle 1 of the present embodiment, the engine 3 and the air cleaner 42 are aligned in the longitudinal direction. Further, the catch tank 60 is disposed in the surroundings of the air cleaner 42. In other words, the catch tank 60 is disposed away from the engine 3. It is therefore possible to inhibit temperature of the catch tank 60 from being increased by heat of the engine 3. Further, the air cleaner 42 is configured to inhale external air and supply it to the engine

3. Among components in the intake path 35, the air cleaner 42 is thereby maintained at relatively low temperature. Therefore, disposition of the catch tank 60 in the surroundings of the air cleaner 42 can inhibit increase in temperature of the catch tank 60. Consequently, it is possible to enhance an effect of separating alcohol from blow-by gas in the catch tank 60.

[0032] Further, alcohol has a feature that it is suddenly changed into a gaseous state at predetermined temperature. According to the motorcycle 1 of the present embodiment, alcohol, changed into a gaseous state within the crank case 31, is again returned to the combustion chamber of the engine 3 through the catch tank 60 with large capacity. If gaseous alcohol is returned to the combustion chamber of the engine 3 without passing through the catch tank 60, a large quantity of alcohol and blow-by gas are transferred to the combustion chamber of the engine 3 all at once when alcohol contained in oil is suddenly changed into a gaseous state. This may result in large deviation of an air-fuel ratio of mixture gas from a target value. According to the motorcycle 1 of the present embodiment, however, alcohol suddenly changed into a gaseous state can be changed into a liquid state within the catch tank 60 by inhibiting increase in temperature of the catch tank 60. It is therefore possible to inhibit a large quantity of alcohol and blow-by gas from being returned to the combustion chamber of the engine 3 all at once. Consequently, it is possible to inhibit large deviation of an air-fuel ratio of mixture gas to be supplied to the combustion chamber from a target value.

[0033] Further, according to the motorcycle 1 of the present embodiment, the catch tank 60 is disposed in the surroundings of the air cleaner 42. It is thereby possible to inhibit increase in temperature of the catch tank 60. In this case, however, it may be difficult for liquid alcohol stored within the catch tank 60 to be again changed into a gaseous state by heat of blow-by gas and to be supplied to the air cleaner 42 as gaseous alcohol. However, the catch tank 60 is herein disposed closer to the air cleaner 42. Distance between the catch tank 60 and the air cleaner 42 is herein shorter than that of the conventional motorcycles. It is thereby possible to shorten the second hosepipe 72 connecting the catch tank 60 and the air cleaner 42. If the second hosepipe 72 is long, alcohol, contained in blow-by gas to be transferred from the catch tank 60 to the air cleaner 42, is changed into a liquid state within the second hosepipe 72. This results in reduction in quantity of alcohol contained in blow-by gas to be supplied to the combustion chamber. Further, this may result in increase in quantity of liquid alcohol to be accumulated in the air cleaner 42. Alternatively, this may result in increase in quantity of liquid alcohol to be accumulated in the catch tank 60. In this case, the catch tank 60 is required to have large capacity. According to the motorcycle 1 of the present embodiment, however, the second hosepipe 72 can be shortened. Therefore, occurrence of the foregoing phenomenon can be inhibited.

[0034] It should be noted that the foregoing features are effective especially in using fuel with large alcohol content, for instance, fuel with alcohol content of 50% or more (E50 or more).

[0035] Further, according to the motorcycle 1 of the present embodiment, the catch tank 60 is aligned with the air cleaner 42 in the transverse direction. The catch tank 60 can be thereby disposed away from the transverse center of the vehicle. Therefore, the catch tank 60 can be cooled down by wind to be received in traveling of the vehicle.

[0036] Further, according to the motorcycle 1 of the present embodiment, the catch tank 60 is overlapped with the rear frame portion 17 in the vertical direction. The vehicle can be thereby inhibited from being enlarged in the transverse direction.

[0037] Further, the catch tank 60 is overlapped with the front frame portion 16 in the longitudinal direction. Specifically, the front frame portion 16 is partially disposed between the engine 3 and the catch tank 60. The structure can inhibit transference of heat from the engine 3 to the catch tank 60.

[0038] Further, the catch tank 60 is elongated further both in the vertical direction and the longitudinal direction than in the transverse direction. Therefore, the catch tank 60 can ensure large capacity, and simultaneously the vehicle can be inhibited from being enlarged in the transverse direction.

[0039] Further, the second hosepipe 72 is disposed between the engine 3 and the catch tank 60, and is disposed at a closer position to the engine 3 than the catch tank 60 is. Therefore, it is possible to further inhibit alcohol from being changed into a liquid state within the second hosepipe 72.

[0040] Further, according to the motorcycle 1 of the present embodiment, the catch tank 60 is a separated member from the air cleaner 42. Therefore, capacity of the catch tank 60 and that of the air cleaner 42 can be sufficiently ensured while the vehicle can be inhibited from being enlarged.

[Other Embodiments]

[0041] (a) The catch tank 60 may be overlapped with a portion of the vehicle body frame 2 in the longitudinal direction.

[0042]

(b) The second hosepipe 72 may not be connected to the air cleaner 42. Instead, the second hosepipe 72 may be connected to another component in the intake path 35, which is disposed in a more downstream position than the filter 46 in the airflow direction.

[0043]

(c) Structure of the catch tank 60 is not necessarily

limited to the foregoing embodiment, and various changes can be made for that. As illustrated in FIG. 11, for instance, the first divider portion 74 may not include the first protrusion 76 (see FIG.10) whereas the second divider portion 75 may not include the second protrusion 77 (see FIG.10).

[0044] As illustrated in FIG.12, a pipe 78, forming the first connection port 62, may be extended to the inside of the catch tank 60. The pipe 78 can prevent reverse flow of liquid alcohol accumulated within the catch tank 60 from the first connection port 62 to the engine 3. Further, gaseous alcohol from the engine 3 passes through the pipe 78 and is blown out to the inner surface of the catch tank 60. Therefore, it is possible to promote a phase change of alcohol from a gaseous state to a liquid state within the catch tank 60. Further, the pipe 78 is a component integrally formed with the first connection port 62. Therefore, the number of components and manufacturing cost can be further reduced than a structure that divider portion(s) is/are separately provided.

[0045] As illustrated in FIG. 13, the pipe 78 may be disposed under a condition that it downwardly slants towards its tip. The structure can further inhibit reverse flow of alcohol from the first connection port 62 to the engine 3.

[0046] As illustrated in FIG. 14, the tank body 61 may be provided with a third divider portion 81 in its inside. The third divider portion 81 is extended from an upper portion of the first connection port 62 to the rearward (i.e., left side in FIG. 14). In addition, the third divider portion 81 is provided with a third protrusion 82 downwardly protruded from its tip. In the structure, gaseous alcohol, which is blown into the tank body 61 through the first connection port 62, is blown to the third protrusion 82. Therefore, it is possible to further promote a phase change of alcohol from a gaseous state to a liquid state.

[0047] As illustrated in FIG. 15, the tank body 61 may be provided with a wall portion 83 downwardly extended from an upper portion of the inner surface of the tank body 61. The wall portion 83 is extended to roughly the same vertical position as the first connection port 62. For example, the wall portion 83 is formed by downwardly extending a portion of the tank body 61. In the structure, gaseous alcohol, which is blown into the tank body 61 through the first connection port 62, is blown to the wall portion 83. Therefore, it is possible to further promote a phase change of alcohol from a gaseous state to a liquid state.

[0048] As illustrated in FIG.16, the first divider portion 74 may be shortened. In this case, the first divider portion 74 is shorter than the second divider portion 75. Further, the tip of the first divider portion 74 is positioned to the rearward of the second protrusion 77. The first divider portion 74 may also achieve the same advantageous effect as that of the foregoing structure.

[0049]

(d) In the foregoing embodiment, blow-by gas of the

engine 3 is taken out of the top of the cylinder portion 32 of the engine 3. However, a method of taking out the blow-by gas is not limited to this. For example, the blow-by gas may be taken out of the crank case 31 of the engine 3. Alternatively, the blow-by gas may be taken out of a portion of the cylinder portion 32 excluding the top thereof.

[0050] Further, the catch tank 60 may be provided with a breather structure in its bottom. The breather structure is herein configured to discharge alcohol accumulated within the catch tank 60 to the outside.

[0051]

(e) The catch tank 60 may not be disposed lateral to the air cleaner 42. The catch tank 60 may be disposed in different positions in the surroundings of the air cleaner 42 as long as it is separated away from the engine 3. For example, the catch tank 60 may be disposed to the upward, downward, forward, or rearward of the air cleaner 42 while being disposed between the right side frame 12 and the left side frame 13 in the transverse direction. Further, the catch tank 60 may be integrally formed with the air cleaner 42.

[0052] For example, as illustrated in FIG.17, the air cleaner 42 may be disposed to the rearward of the engine 3 and to the forward of the catch tank 60 in the longitudinal direction. In other words, the air cleaner 42 is disposed to the rearward of the engine 3 and the catch tank 60 is disposed to the rearward of the air cleaner 42. The catch tank 60 has a flat shape thinner in the longitudinal direction than in the vertical direction. The catch tank 60 is disposed opposed to the rear surface of the air cleaner 42. The first connection port 62, the second connection port 63, and the third connection port 64 are provided to a lateral surface of the tank body 61. Other structures are the same as those of the foregoing embodiment. It should be noted that the catch tank 60 may be disposed to the forward of the air cleaner 42 when the air cleaner 42 is disposed to the forward of the engine 3.

[0053] As illustrated in FIG. 18, the catch tank 60 may be disposed above the air cleaner 42. Specifically, the air cleaner 42 is disposed to the rearward of the engine 3, while the catch tank 60 is disposed opposed to the top surface of the air cleaner 42. The catch tank 60 has a flat shape thinner in the vertical direction than in the longitudinal direction. The first and second connection ports 62, 63 are provided to a lateral surface of the tank body 61. The third connection port 64 is provided to the front portion of the bottom surface of the tank body 61. Other structures are the same as those of the foregoing embodiment.

[0054] As illustrated in FIGS.19 and 20, the air cleaner 42 may include a recess 65 or 66 in a portion thereof opposed to the engine 3. The recess 65 or 66 is recessed to the inward of the air cleaner 42. The catch tank 60 may

be disposed in the recess 65 or 66.

[0055] For example, in FIG.19, the recess 65 is provided to the upper portion of the air cleaner 42. Specifically, the air cleaner 42 is disposed to the rearward of the engine 3, and the recess 65 is provided to an area ranging from the front portion of the top surface of the air cleaner 42 to the upper portion of the front surface of the air cleaner 42. Further, the rear portion of the catch tank 60 is disposed in the recess 65. The catch tank 60 has a flat shape thinner in the vertical direction than in the longitudinal direction. The upper portion of the catch tank 60 is slightly protruded from the top surface of the air cleaner 42. The first and second connection ports 62, 63 are provided to a lateral surface of the tank body 61. The third connection port 64 is provided to the bottom surface of the tank body 61. Other structures are the same as those of the foregoing embodiment. In this case, the catch tank 60 is disposed in the recess 65. Therefore, the catch tank 60 can be separated away from the engine 3 as much as possible. Further, disposition of the catch tank 60 in the recess 65 of the air cleaner 42 can inhibit reduction in a space between the air cleaner 42 and the engine 3. Therefore, it is possible to reliably keep a sufficient space for disposing other member(s) (e.g., a piping to be connected to the engine 3) between the air cleaner 42 and the engine 3.

[0056] On the other hand, in FIG.20, the recess 66 is provided to the lower portion of the air cleaner 42. Specifically, the air cleaner 42 is disposed to the rearward of the engine 3. The recess 66 is provided to an area ranging from the front portion of the bottom surface of the air cleaner 42 to the lower portion of the front surface of the air cleaner 42. Further, the rear portion of the catch tank 60 is disposed in the recess 66. In a side view, the catch tank 60 is bent in an L-shape. A portion of the catch tank 60, disposed below the air cleaner 42, has a flat shape thinner in the vertical direction than in the longitudinal direction. The lower portion of the catch tank 60 is slightly protruded from the bottom surface of the air cleaner 42 to the downward. Further, a portion of the catch tank 60, disposed to the forward of the air cleaner 42, has a flat shape thinner in the longitudinal direction than in the vertical direction. The second connection port 63 is provided to the top surface of the tank body 61. The first and third connection ports 62, 64 are provided to a lateral surface of the tank body 61. Other structures are the same as those of the foregoing embodiment. In this case, the catch tank 60 is disposed in the recess 66. Therefore, the catch tank 60 can be disposed separately away from the engine 3 as much as possible. Consequently, gaseous alcohol is easily changed into a liquid state within the catch tank 60. Further, disposition of the catch tank 60 in the recess 66 of the air cleaner 42 can inhibit reduction in a space between the air cleaner 42 and the engine 3. Therefore, it is possible to reliably keep a sufficient space for disposing other member(s) (e.g., a piping to be connected to the engine 3) between the air cleaner 42 and the engine 3.

[0057]

(f) The air cleaner 42 and the engine 3 may be aligned in the vertical direction. For example, as illustrated in FIG.21, the air cleaner 42 is disposed above the engine 3. Further, the catch tank 60 is aligned with the air cleaner 42 in the transverse direction. In other words, the catch tank 60 is disposed lateral to the air cleaner 42. Alternatively, the air cleaner 42 may be disposed above the engine 3 and simultaneously the catch tank 60 may be disposed to the forward, rearward, or upward of the air cleaner 42. Yet alternatively, the air cleaner 42 may be disposed beneath the engine 3. It should be noted that FIG.21 visibly illustrates the air cleaner 42 and its peripheral components, contained in the inside of the vehicle body cover, for the sake of convenience of explanation.

[0058] Further, a motorcycle 100 illustrated in FIG.21 is a so-called moped motorcycle. In the motorcycle 100, the catch tank 60 is positioned higher than the engine 3. The first connection port 62 (first connection portion) is positioned higher than a fourth connection port 69 (second connection portion). The first connection port 62 is a portion for connecting the tank body 61 and the first hosepipe 71. On the other hand, the fourth connection port 69 is a portion for connecting the engine 3 and the first hosepipe 71. Further, the first connection port 62 is positioned lower than the second connection port 63 (third connection portion). As described above, the second connection port 63 is a portion for connecting the catch tank 60 and the second hosepipe 72. The motorcycle 100 is not provided with the third connection port 64, the third hosepipe 73, and the second attachment port 52. It should be noted that the fourth connection port 69 is provided to the crank case 31 of the engine 3 in FIG.21, but may be provided to the cylinder head 33 just the same as the structure of the foregoing embodiment.

[0059] When blow-by gas stops flowing out of the crank case 31 in the motorcycle 100, liquid alcohol accumulated within the catch tank 60 spontaneously returns into the crank case 31 through the first connection port 62, the first hosepipe 71, and the fourth connection port 69. Therefore, it is possible to process the liquid alcohol accumulated within the catch tank 60 without returning it to the air cleaner 42 as described in the foregoing embodiment. Further, a special device is not required for processing liquid alcohol accumulated within the catch tank 60.

[0060]

(g) In the foregoing embodiment, the present invention is applied to the sport-type motorcycle 1. However, the present invention may be applied to the motorcycles of other types. For example, the present invention may be applied to a scooter-type motorcycle 200 illustrated in FIGS.22 and 23. The motorcycle 200 is provided with a space in front of the seat 4 in

order to dispose legs of a rider. Further, a footboard 8 is disposed below the space in order to put feet of a rider. Further, a swing-type power unit 4 is disposed beneath the seat 4. The power unit 9 includes the engine 3, a power transmission 10, and the air cleaner 42. The power unit 9 is attached to the vehicle body frame 2 in a pivotable state. The power transmission 10 is, for instance, a V-belt continuous variable transmission. The rear wheel 7 is supported by the rear end of the power transmission 10 in a rotatable state. Further, a rear suspension 25 is provided between the power transmission 10 and the vehicle body frame 2. As illustrated in FIG.23, the air cleaner 42 is disposed over the crank case 31, and is disposed to the rearward of the cylinder portion 32. The catch tank 60 is disposed over or above the air cleaner 42. The catch tank 60 is disposed opposed to the top surface of the air cleaner 42. Other structures are the same as those of the foregoing embodiment. Especially, structure of the catch tank 60 is the same as that of the foregoing catch tank 60 illustrated in FIG. 18. The motorcycle 200 provided with the structure can also achieve the same advantageous effects as those of the motorcycle 1 of the foregoing embodiment.

[0061]

(h) A member (s), such as a hosepipe, a cover member, and/or a fixation member, may be interposed between the air cleaner 42 and the catch tank 60.

INDUSTRIAL APPLICABILITY

[0062] The present invention has an advantageous effect of efficiently separating alcohol from blow-by gas. Therefore, the present invention is useful for the motorcycles.

EXPLANATION OF THE REFERENCE NUMERALS**[0063]**

3	Engine
11	Head pipe
12, 13	Side frames (side frame portions)
35	Intake path
42	Air cleaner
60	Catch tank (Separation device)
62	First connection port (First connection portion)
63	Second connection port (Third connection portion)
65, 66	Recesses
69	Fourth connection port (Second connection portion)
71	First hosepipe (First path)
72	Second hosepipe (Second path)

Claims**1.** A motorcycle, comprising:

an engine;
 an intake path connected to the engine;
 an air cleaner disposed at the intake path, the
 air cleaner aligned with the engine in a longitu-
 dinal direction or a vertical direction;
 a separation device disposed in the surround-
 ings of the air cleaner;
 a first path connecting an inside of the engine
 and an inside of the separation device; and
 a second path connecting the inside of the sep-
 aration device and an inside of the intake path.

2. The motorcycle according to claim 1, wherein the separation device is aligned with the air cleaner in a transverse direction of the motorcycle.**3.** The motorcycle according to claim 1, further comprising:

a head pipe; and
 a frame portion extended from the head pipe to
 the rearward, the frame portion including a pair
 of side frame portions separated from each other
 in a transverse direction of the motorcycle,
 wherein the separation device is overlapped
 with the side frame portions in the longitudinal
 direction or the vertical direction.

4. The motorcycle according to claim 1, wherein the separation device is elongated further in the longitudinal direction or the vertical direction than in a transverse direction of the motorcycle.**5.** The motorcycle according to claim 1, wherein the air cleaner is aligned with the engine in the longitudinal direction, and the air cleaner is disposed to the rearward of the engine and to the forward of the separation device in the longitudinal direction.**6.** The motorcycle according to claim 1, wherein the air cleaner is aligned with the engine in the longitudinal direction, and the separation device is disposed above the air cleaner.**7.** The motorcycle according to claim 1, wherein the air cleaner is aligned with the engine in the longitudinal direction, a recess is provided to a portion of the air cleaner, the portion of the air cleaner is opposed to the engine, and the separation device is disposed in the recess.**8.** The motorcycle according to claim 7, wherein the recess is provided to an upper portion of the air cleaner.**9.** The motorcycle according to claim 7, wherein the recess is provided to a lower portion of the air cleaner.**10.** The motorcycle according to claim 1, wherein a first connection portion connecting the separation device and the first path is positioned higher than a second connection portion connecting the engine and the first path, and is positioned lower than a third connection portion connecting the separation device and the second path.**11.** The motorcycle according to claim 1, wherein the air cleaner is aligned with the engine in the vertical direction, and the separation device is aligned with the air cleaner in a transverse direction of the motorcycle.

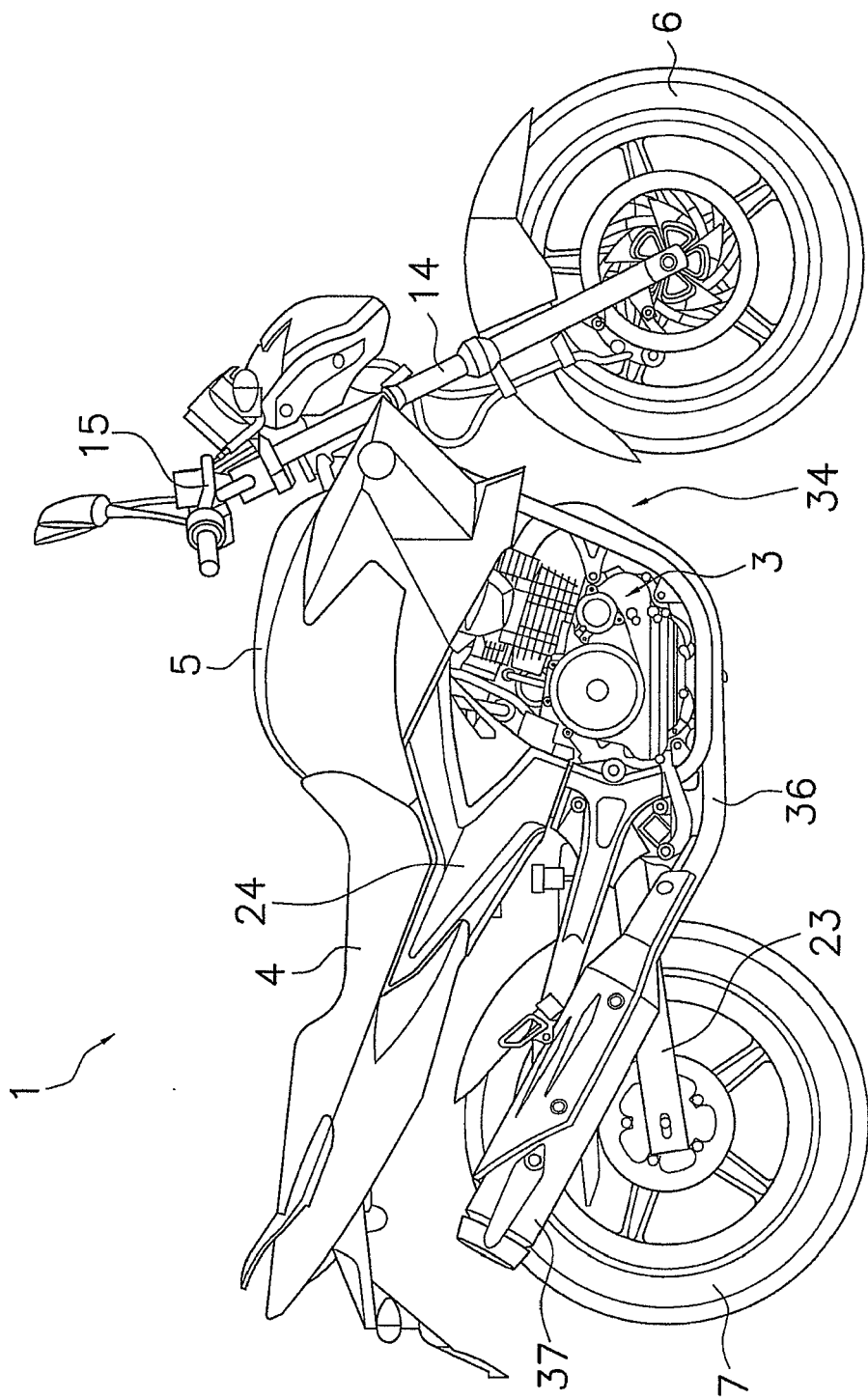


FIG. 1

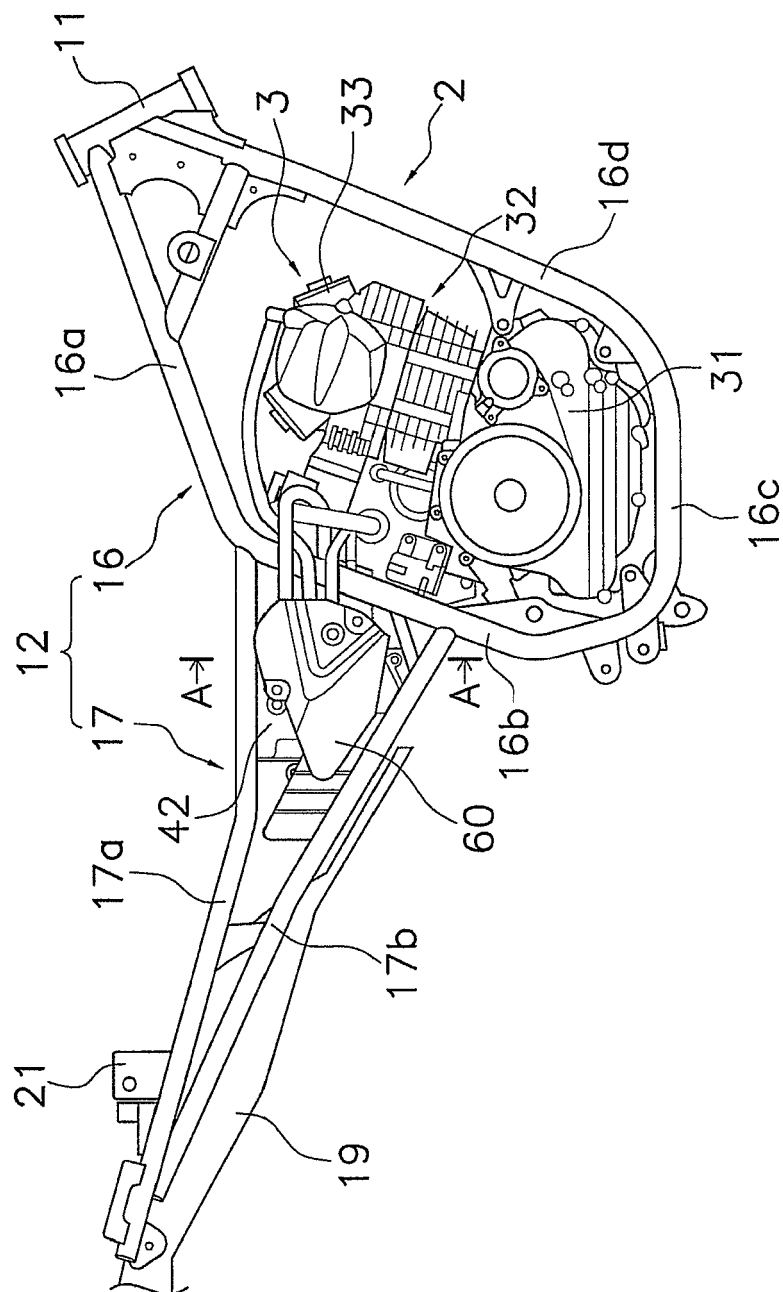


FIG. 2

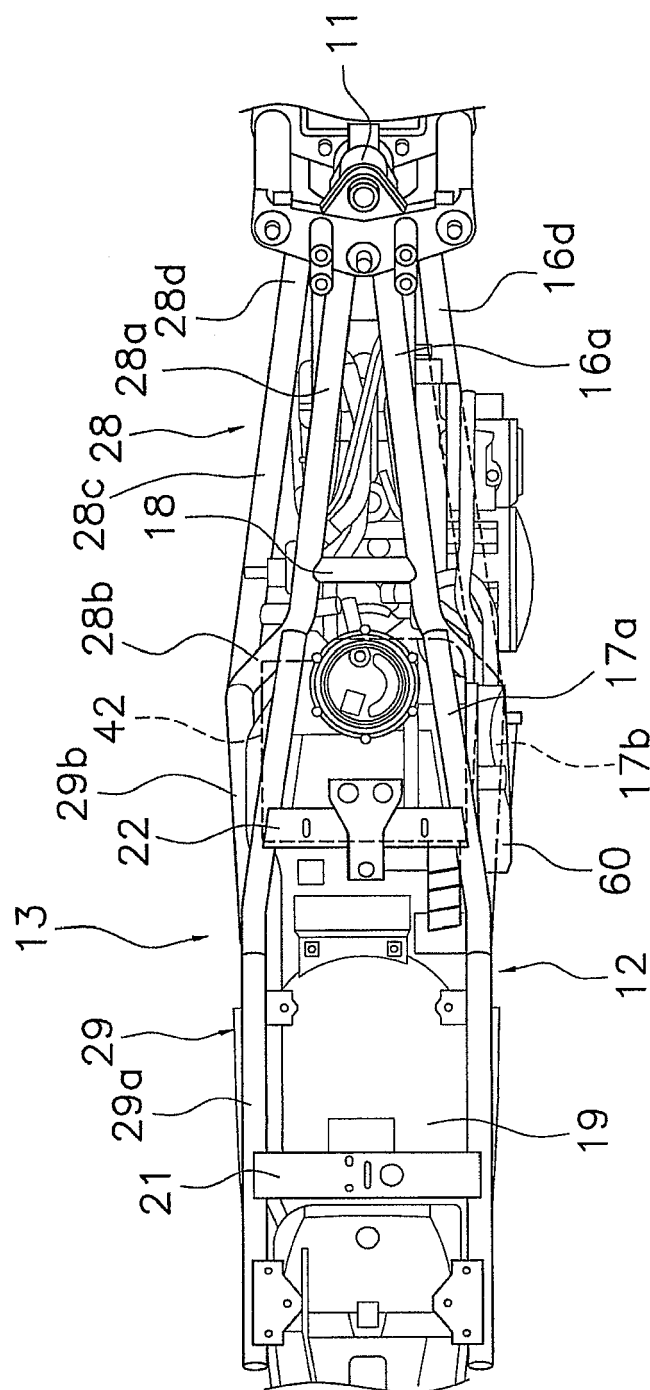


FIG. 3

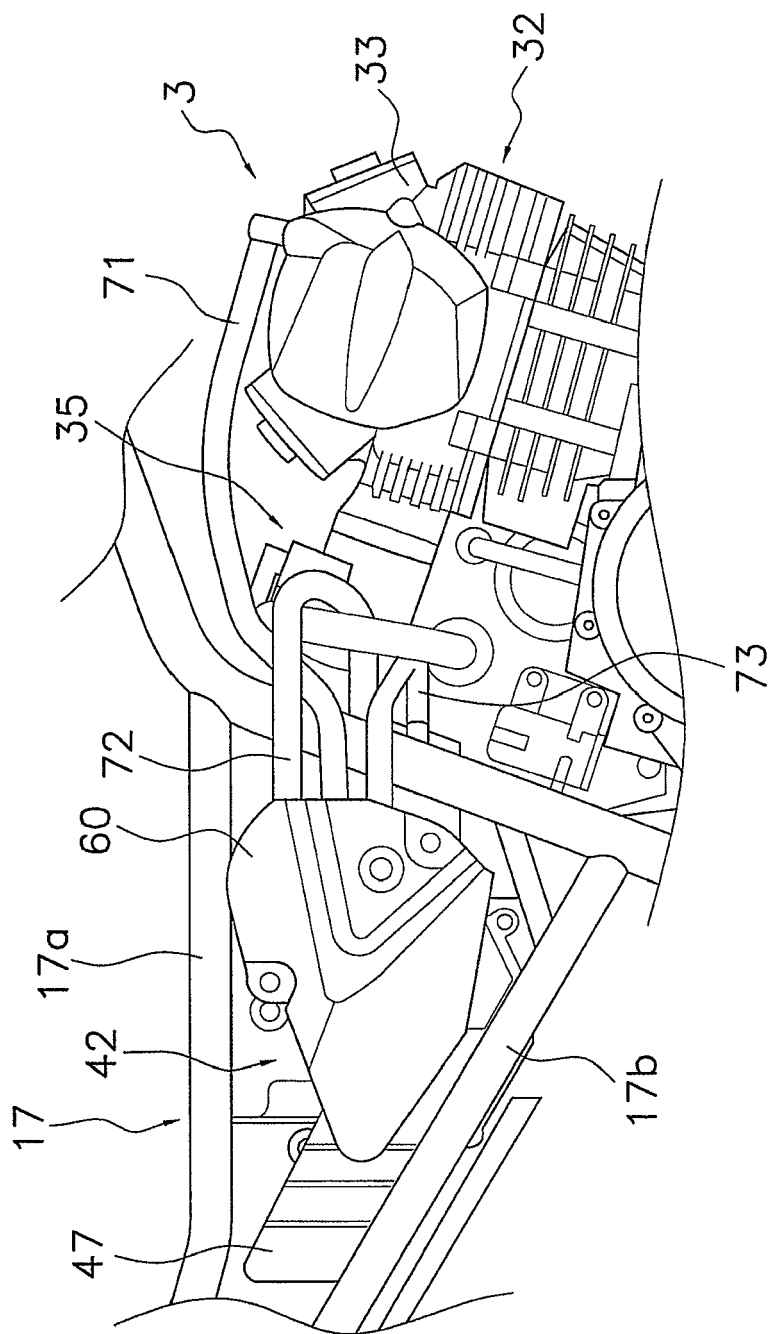
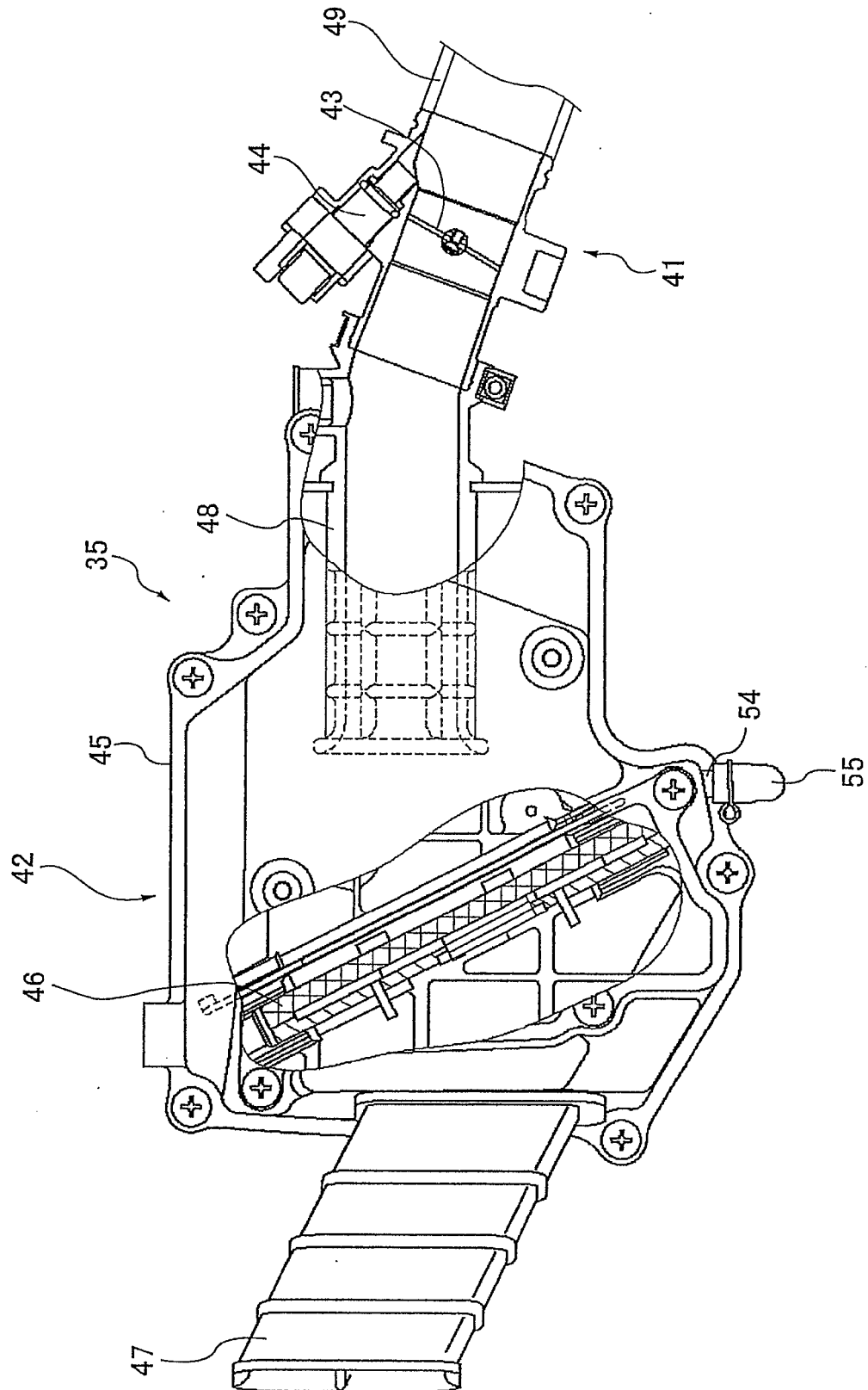


FIG. 4



HELLO

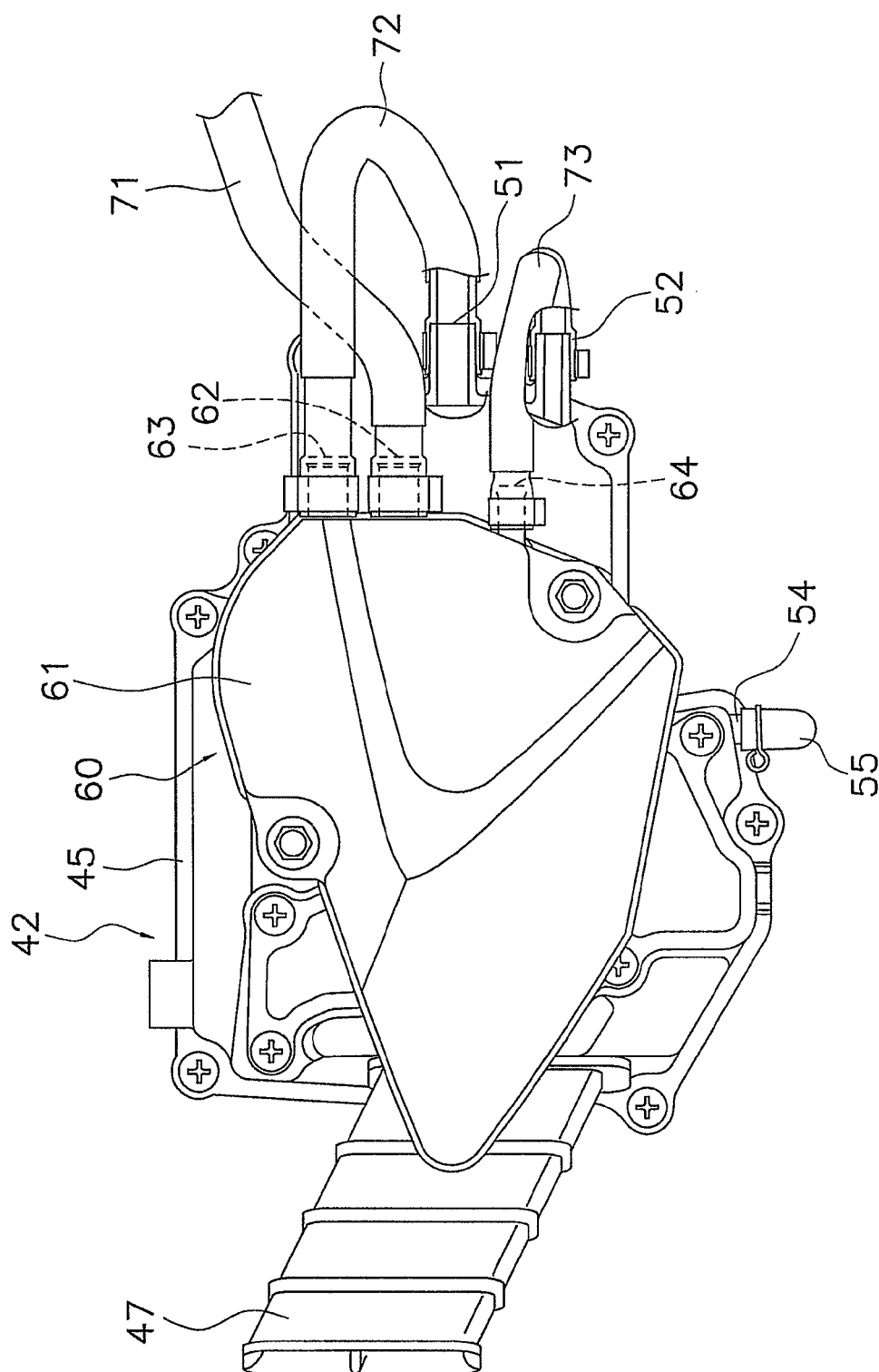


FIG. 6

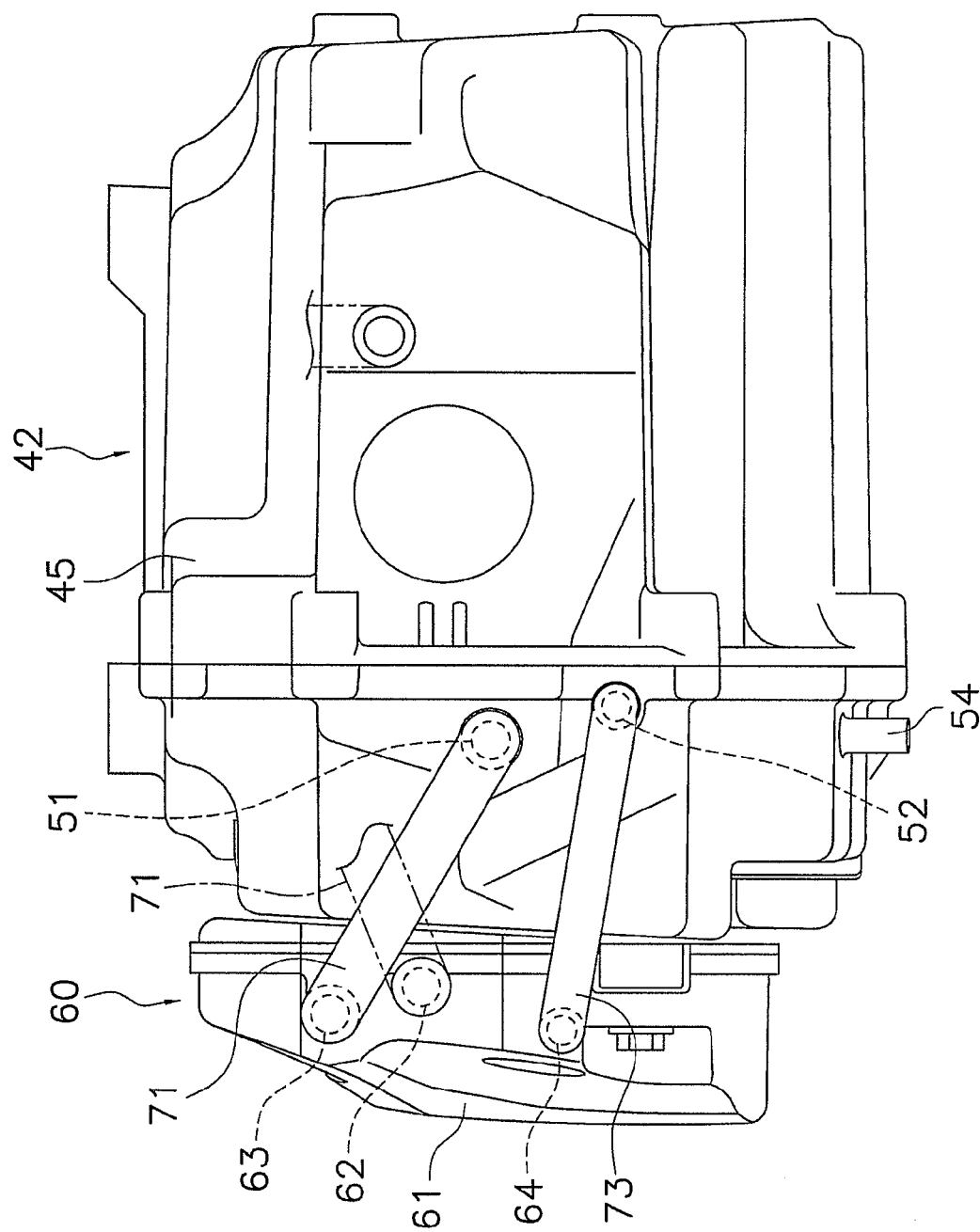


FIG. 7

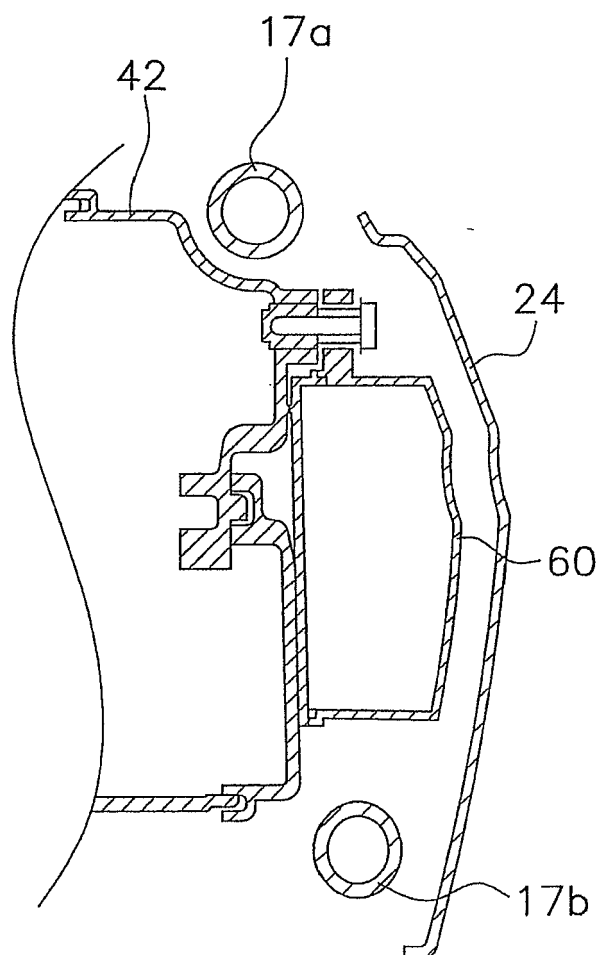


FIG. 8

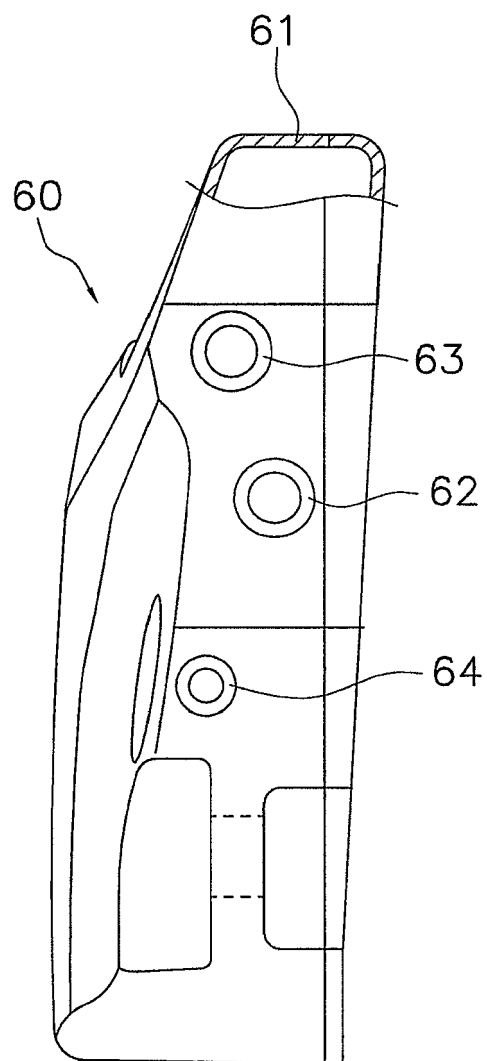


FIG. 9

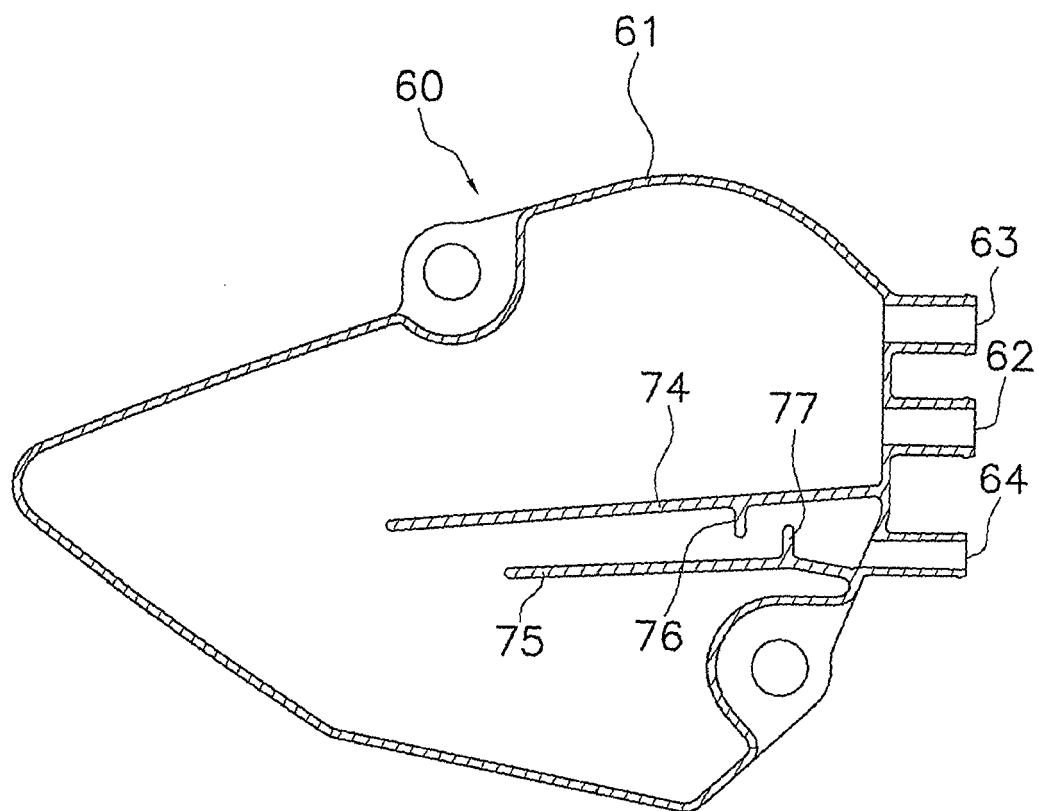


FIG. 10

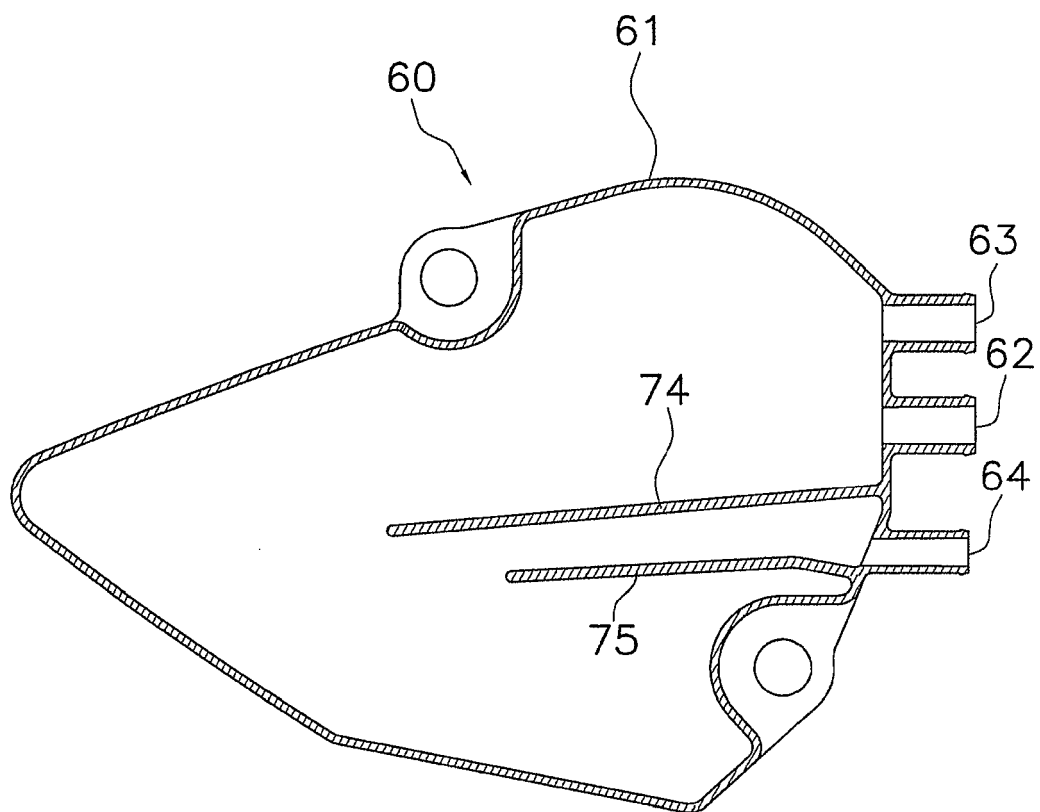


FIG. 11

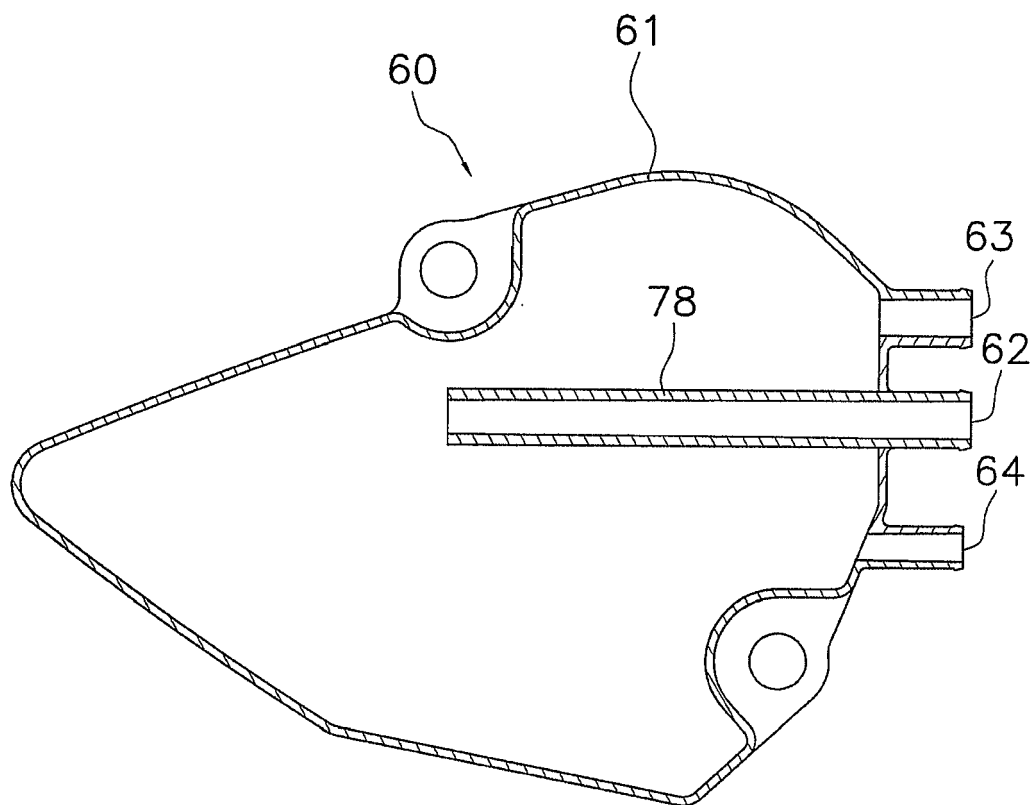


FIG. 12

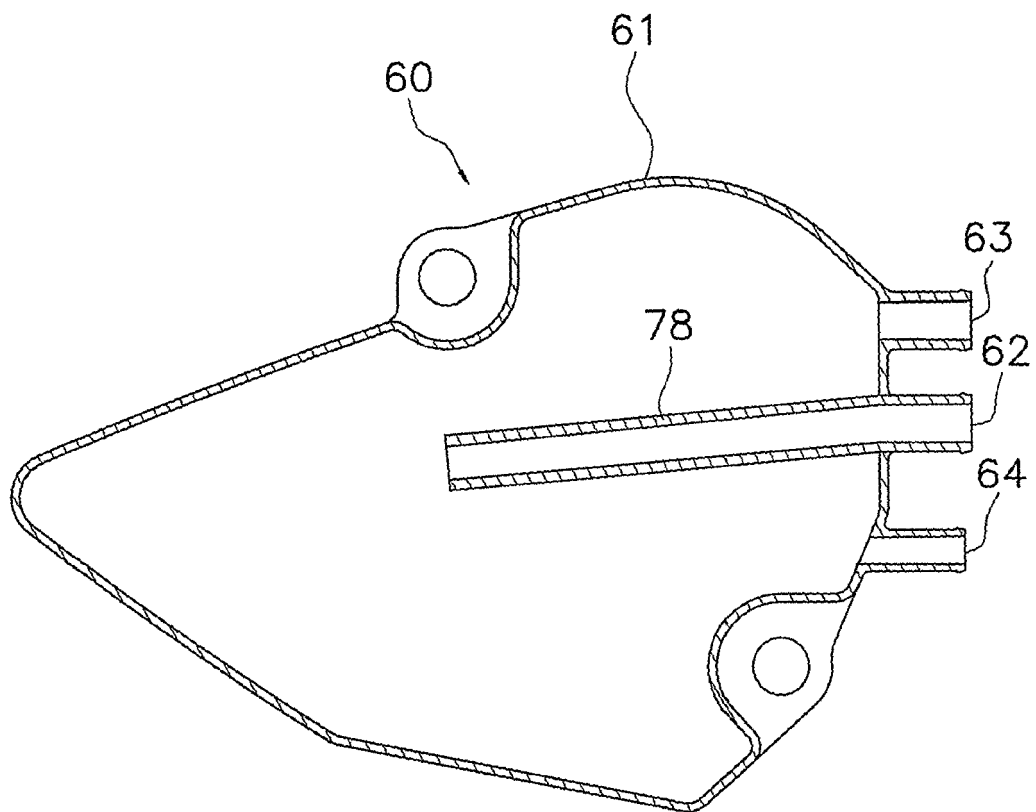


FIG. 13

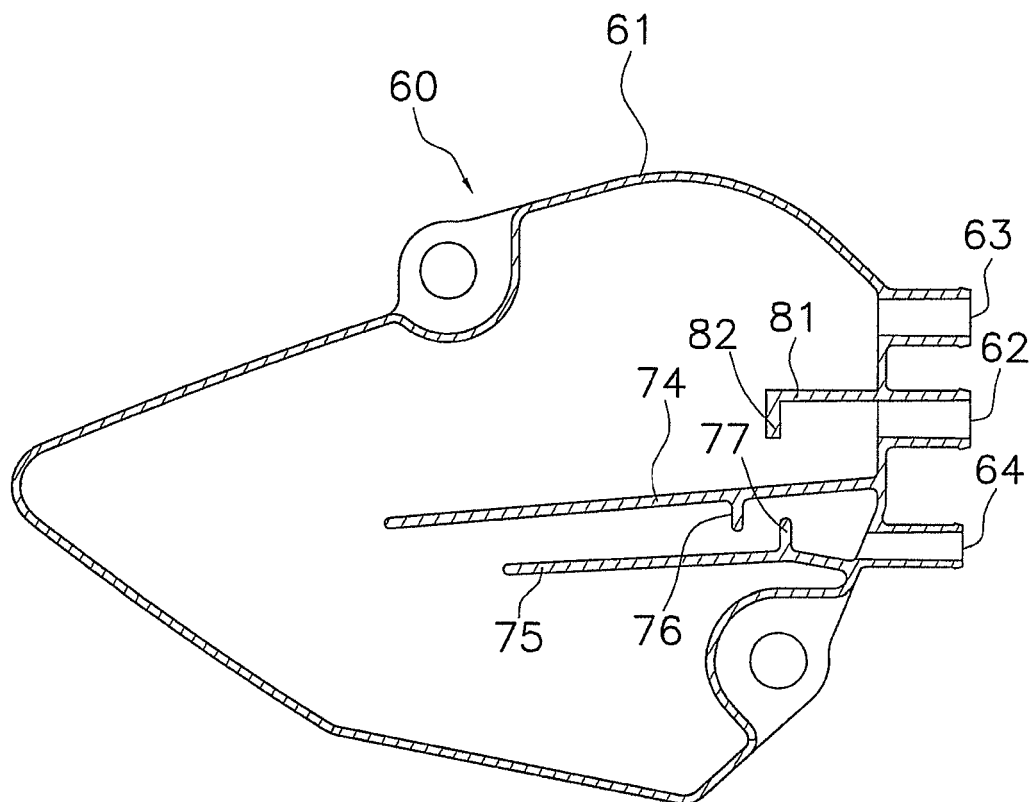


FIG. 14

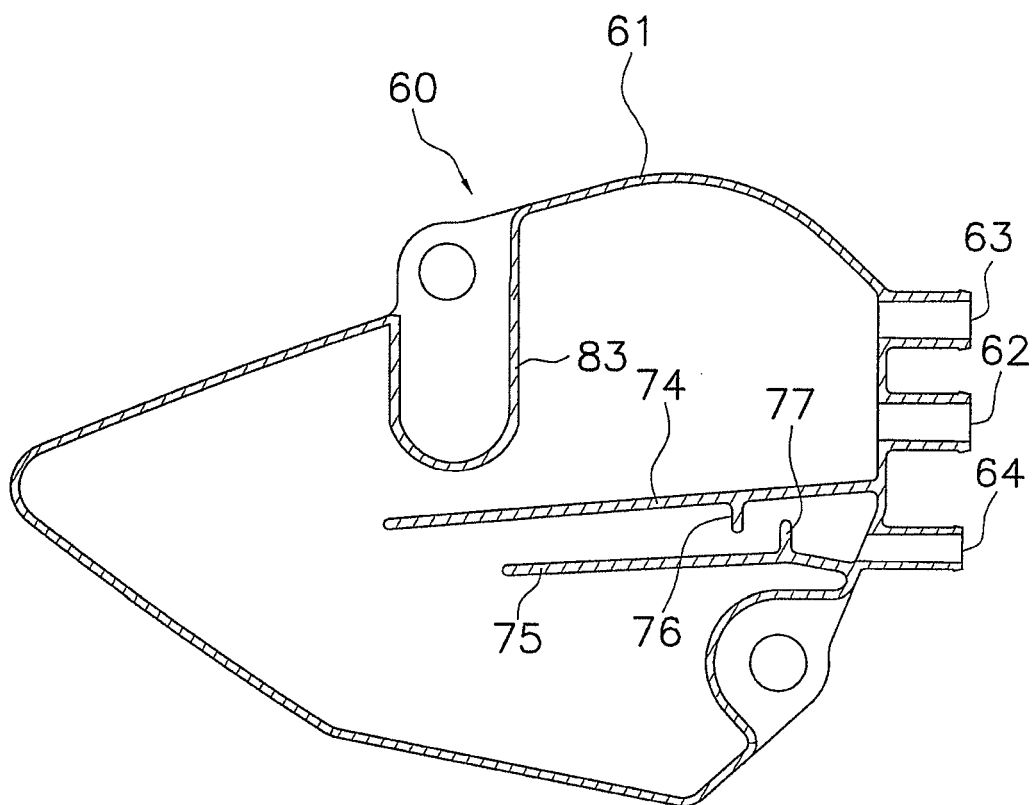


FIG. 15

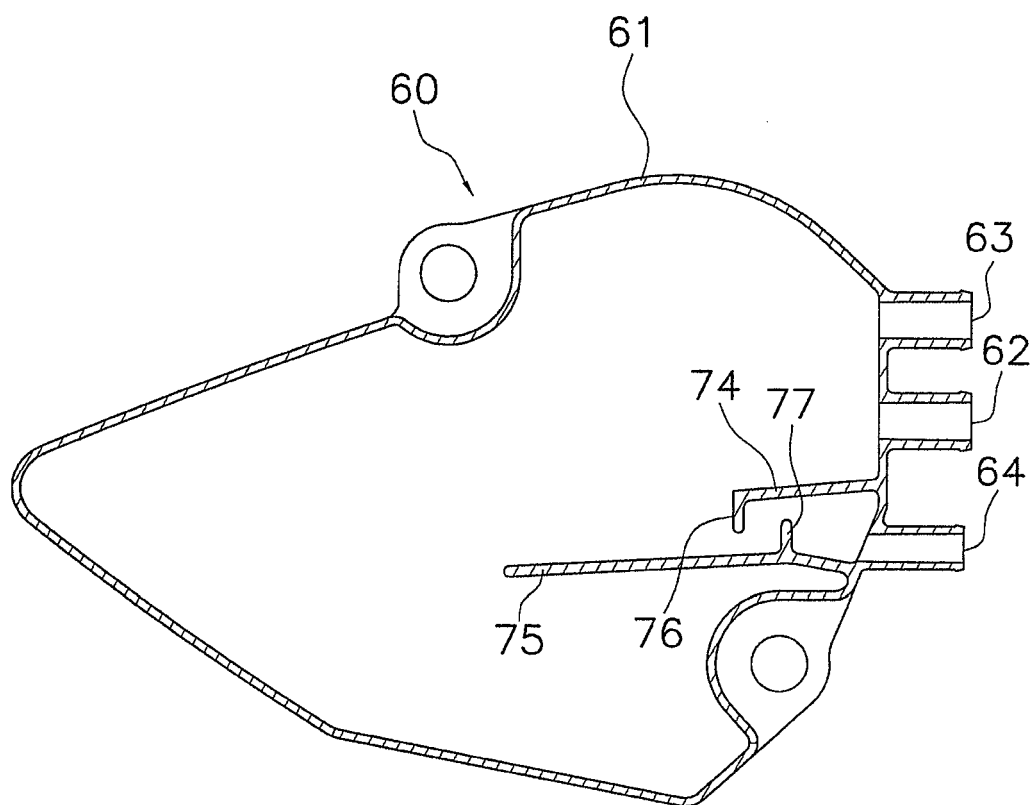


FIG. 16

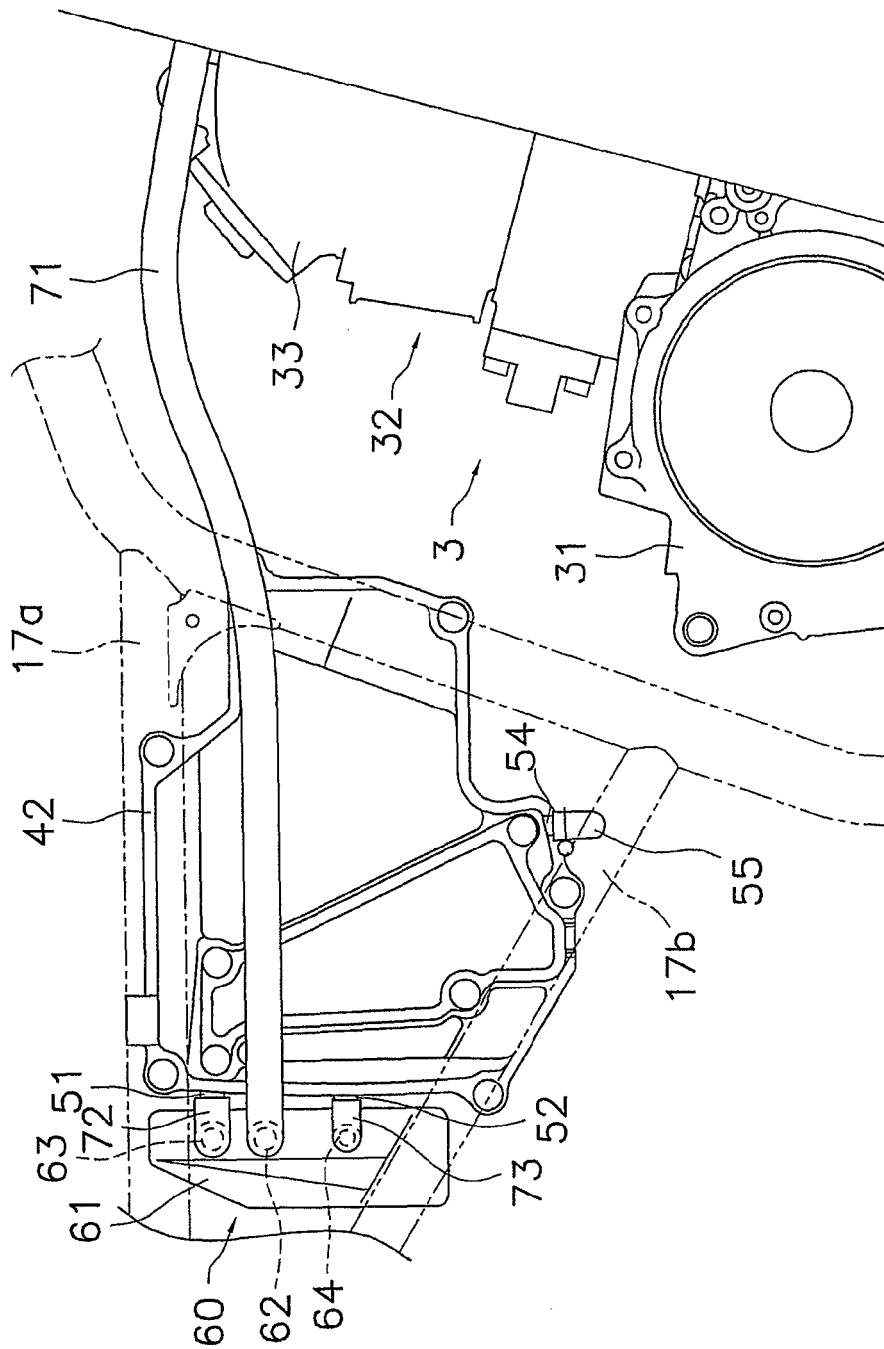


FIG. 17

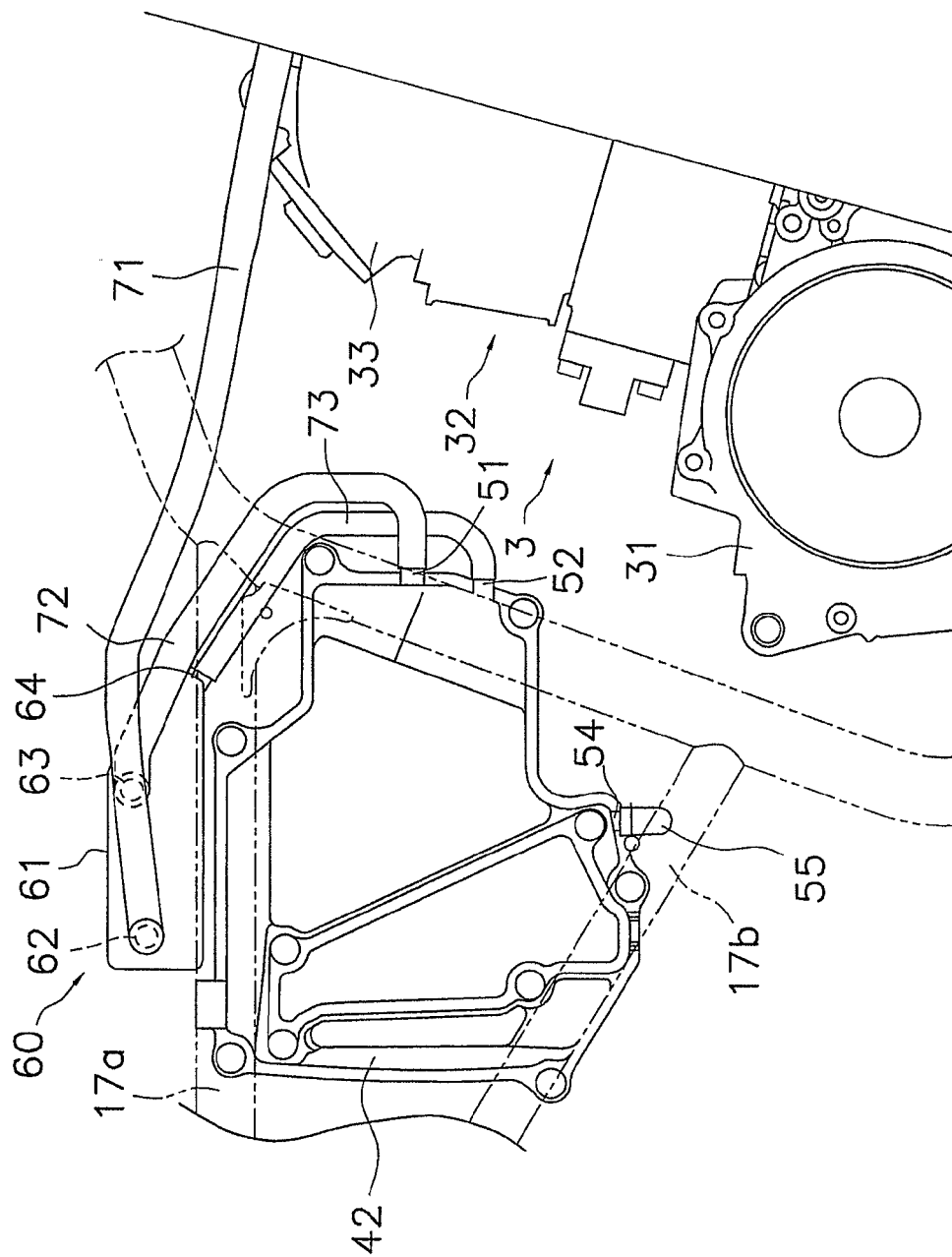


FIG. 18

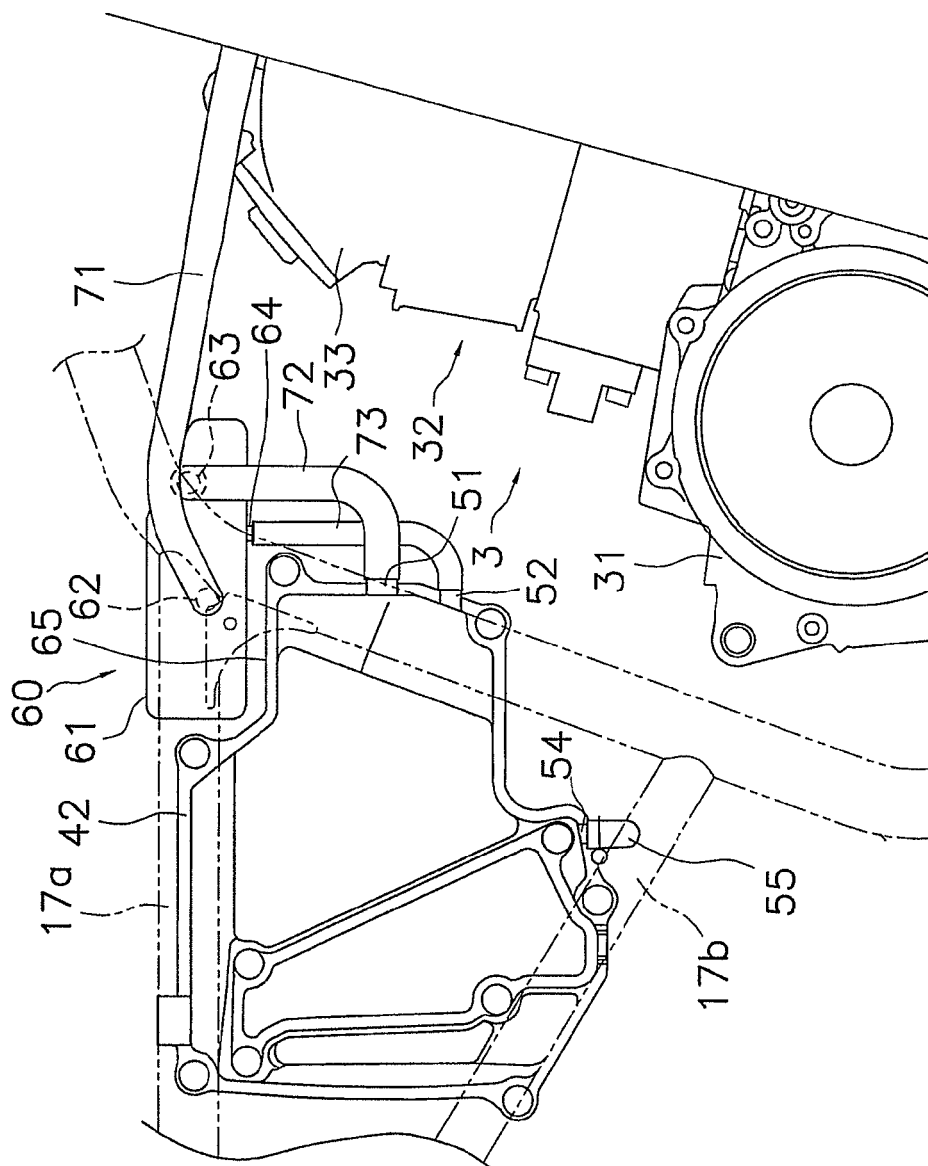


FIG. 19

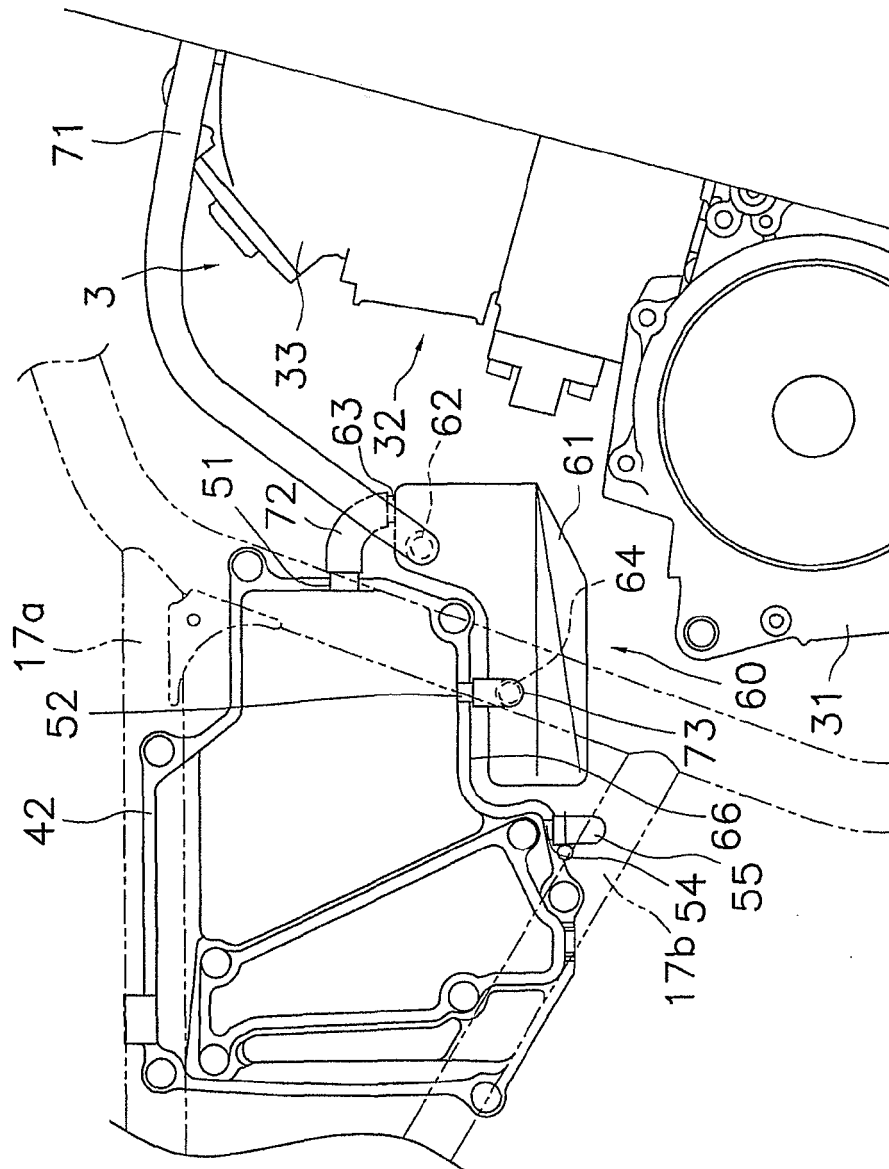


FIG. 20

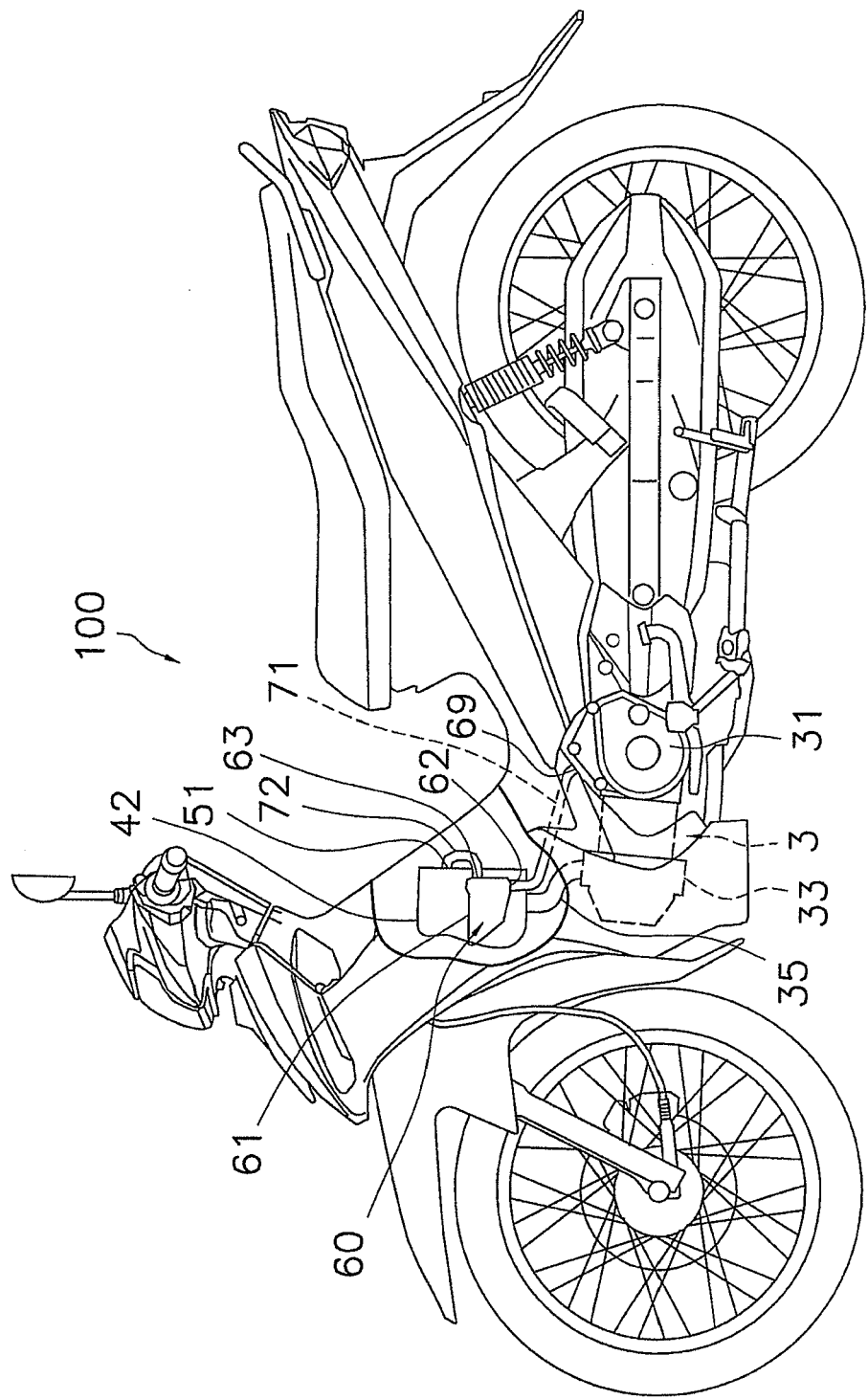


FIG. 21

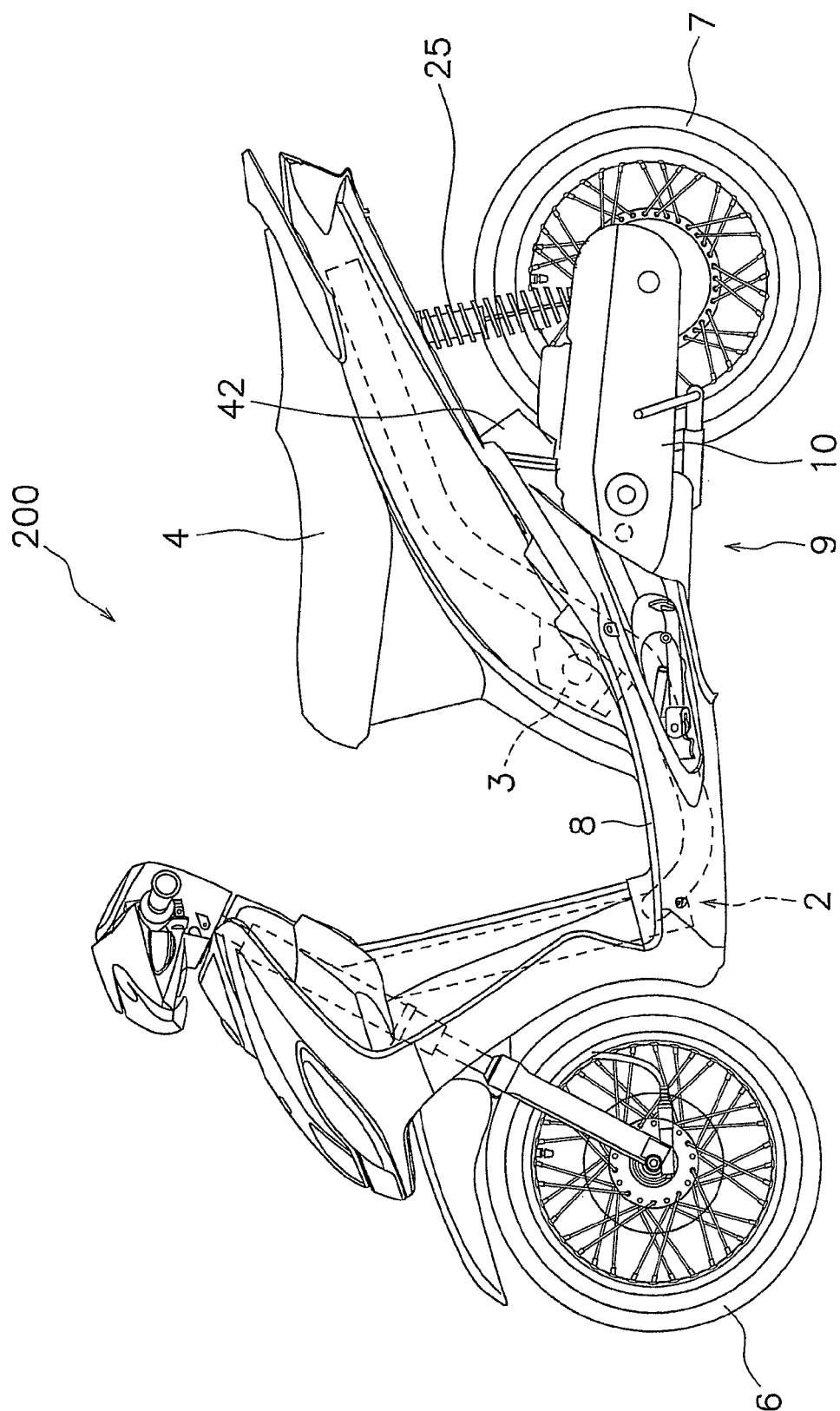


FIG. 22

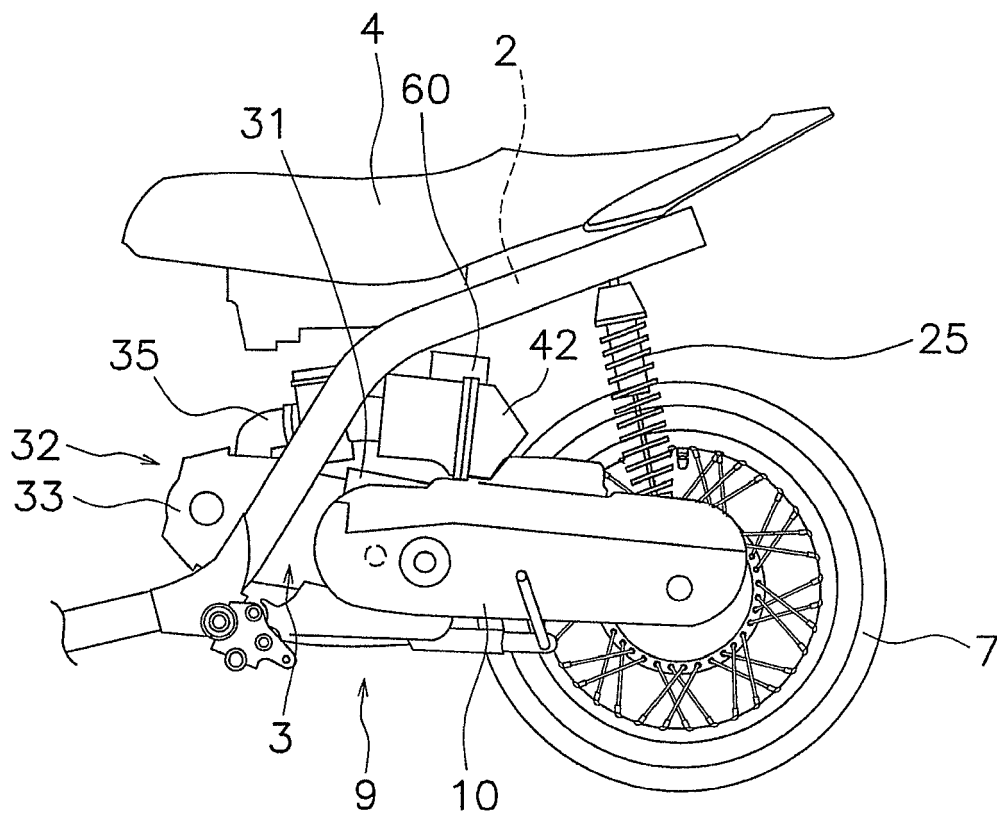


FIG. 23



EUROPEAN SEARCH REPORT

Application Number
EP 10 16 9251

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	* abstract * * figures 1-6 *	5,7,9,11	
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A	* abstract * * figures 1-3 *	5,6,11	
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A	* paragraphs [0023], [0024], [0028], [0036] * * figures 1-6 *	5	
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	* abstract * * figure 1 *		
			TECHNICAL FIELDS SEARCHED (IPC)
			F02B F01M
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 14 October 2010	Examiner Mallo López, Manuel
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	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 10 16 9251

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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