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(54) LIQUID RETURN SYSTEM FOR INTERNAL COMBUSTION ENGINE

VORRICHTUNG ZUR RÜCKFÜHRUNG EINER FLÜSSIGKEIT IN EINER BRENNKRAFTMASCHINE

DISPOSITIF DE RETOUR DE FLUIDE DANS UN MOTEUR

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(56) References cited:
WO-A1-2006/091146
WO-A2-2004/090292
FR-A1- 2 332 424
FR-A1- 2 913 054
US-A- 4 018 580
US-A1- 2009 151 570

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Description

Field of the Disclosure

[0001] The present disclosure relates to fluid return systems of an internal combustion engine and more particularly to a return system associated with a separation system for preventing oil ejection to an air intake of an engine.

Background of the Disclosure

[0002] Environmental concerns regarding vehicle emissions, including hydrocarbons, have become increasingly important in recent years. As recognition of the potential effects on the atmosphere and water ways has increased, so has the desire to minimize these effects by limiting the amount of undesirable material ejected outside the internal combustion system.

[0003] Internal combustion engines by their nature have a crankcase generally pressurized by a small amount of blow-by gases generated during combustion in a cylinder. These blow-by gases have a tendency to mix with other fluids present in the engine (e.g., motor oil) and to be passed through the engine ventilation system, and the blow-by gas reintroduced to the intake mechanism of the engine for re-combustion.

[0004] It is important to control oil and other fluids present in the gas that exits the engine ventilation system to be reintroduced to the intake mechanism. Particularly, where oil mist is present in such gas, this can lead to undesirable emissions (particulate, hydrocarbon, etc.), oil consumption, and reduced reliability (e.g., from carbon deposit buildup).

[0005] Various separation systems have been proposed and implemented in the art, some of which are more desirable than others. One of the tasks following such separation is returning the separated liquid to the crankcase of the engine. This has been performed in various manners, and each of the available previous systems has resulted in a risk of ejection of at least some of the liquid to be fed back to the air intake system.

[0006] For example, because of a pressure drop induced by an oil gas separation system a one-way valve leading to a drainage tube has been implemented to avoid reverse oil flow being sucked through the drain pipe. However, where the one-way valve is stuck in the open position (e.g., due to oil sludge, process tolerance, and/or improper assembly), oil mist and liquid oil may bypass a separator arriving directly at the clean side of the separation system. It will then be ejected with the blow-by gas into the intake system, which can have adverse consequences.

[0007] In another example a siphon has been used in place of the one-way valve, the siphon having an oil column configured to compensate for pressure drop across the separator. However should the pressure drop across the separator increase (e.g. in cold temperatures, and/or as a result of sludge buildup in the separator, and/or blow by gas flow increasing over the life of the vehicle due to wear) the risk of oil being sucked through the siphon injected into the intake system increases dramatically.

[0008] DE 102012211805 discloses an oil separator capable of suppressing re-mixing of oil separated from blow-by gas into the gas. A drain part for returning the oil into an engine is disposed in the bottom part of the housing between an upstream side separation part and a downstream side separation part. A recessed part is formed in the bottom part of the housing between an oil catching body and the drain part. An opening where the oil can circulate is formed in the lower end of a wall part. WO 2006/091146 shows a further example of oil separator provided with a drain.

[0009] However, once again should ΔP increase over the lifetime of vehicle oil may be sucked through the drain hole injected into the intake mechanism. In addition space restraints often limit the availability of such a system.

[0010] In yet another example, the drain has been configured directly to the oil pan, enabling compensation for pressure drop across the separator even where the pressure drop has increased over the lifetime of a vehicle.

[0011] However the system requires design modifications to the engine block and the cylinder head and thus is disruptive to current mass production engines.

[0012] Additional systems have been implemented whereby the liquid is stored until the engine has been shut off, thereby limiting the impact changes in ΔP across the separator. A liquid transfer channel is provided to allow liquid to move from a clean side (i.e., dripped from the separator) and a dirty side to reach a drain provided at a lowest portion of the separator system. This drain then enables the liquid to return to the engine crankcase once the engine has been stopped.

[0013] However, such a system continues to risk contamination of clean side of the separator with the liquid based on the possibility of liquid flowing between the dirty side and the clean side by way of the liquid transfer channel. Such a problem may become particularly aggravated where an engine is installed on an angle.

[0014] It is accordingly an object of the disclosure to provide systems and methods for overcoming one or more problems existing in the prior art.

SUMMARY OF THE DISCLOSURE

[0015] The present disclosure is directed to providing a liquid return system for an internal combustion engine, the liquid return system having no moving parts, draining liquid safely and cleanly to a liquid storage container (e.g., an engine crankcase), limiting risk of transfer of liquid to an engine intake, and which can be integrated within an engine with limited or no design modifications. The technical problem is solved by means of a liquid return system according to claim 1.

[0016] According to embodiments of the present inven-

tion, a liquid return system for an internal combustion engine is provided. The liquid return system includes a housing, a fluid separating means in fluid communication with a first side and a second side of the housing, and a fluid passage bounded at least in part by a bottom piece of the housing, the fluid passage being in fluid communication with both the first and second sides of the housing. The bottom piece of the first side of the housing comprises a drainage means, and a sloped portion of the bottom piece at the second side of the housing is inclined along a length of the bottom piece at the second side relative to a first portion of the second-side bottom piece such that a vertex of the incline coincides with at least a portion of the fluid passage.

[0017] By providing such a liquid return system, a physical height difference is created between the drainage means (e.g., offset to a lower portion of the first side) and the fluid passage. Therefore, liquid transfer from the first side to the second side (e.g., through the fluid passage) is unlikely to occur. Further, because of the incline and vertex alignment with the fluid passage, any liquid that may settle on the second side may be directed back toward the first side via the fluid passage and ultimately to the drainage means. Therefore, the potential for liquid to be exhausted with the gas into the engine intake is significantly reduced or eliminated.

[0018] The first portion of the second-side bottom piece may be substantially planar, i.e., flat relative to the sloped portion.

[0019] The entire bottom piece at the second side can be angled such that the bottom piece at the second side slopes downward towards the fluid passage when viewed from inside the housing. The angle forming such a slope may be greater than 160 degrees and less than 180 degrees, relative to the bottom piece of the first side.

[0020] A wall portion joining the sloped portion of the bottom piece at the second side with the bottom piece at the first side may also be provided. By introducing such a feature, the liquid on the first side is further prevented from reaching the second side.

[0021] The angle formed between the sloped portion of the second side and the first portion of the second side may correspond with an engine installation angle, and may range between 10 and 60 degrees, for example, 15 degrees. According to some embodiments, the angle is at least equal to the engine incline angle. The housing can also be oriented vertically to obtain a similar effect.

[0022] A wall portion separating the first side and the second side may be provided, and the fluid separating means can be mounted on this wall portion.

[0023] The first side may be configured to receive a mixture of liquid and combustion blow-by gas, and the liquid may include a motor oil.

[0024] The second side may include a second drainage means formed through the bottom piece, the second drainage means can be configured to drain liquid from the second side. This may be particularly useful where liquid from the separating means drips or is otherwise disposed on the second side.

[0025] According to some embodiments, the drainage means is in fluid communication with a crankcase of an engine.

[0026] An inlet in fluid communication with the first side may be provided, the inlet comprising a horizontal labyrinth.

[0027] A groove may also be provided, the groove extending transversely to the fluid passage and being bounded on at least one side by the bottom piece. Such a groove may be configured to receive the fluid separating means.

[0028] The fluid separating means may include a fiber mesh, which may be further configured to act as a filter. The fluid separating means may alternatively or in combination comprise, for example, a cycle type separator, an impactor, a swirl type separator, a metallic flap type separator, etc.

[0029] According to further embodiments of the disclosure, a liquid return system for an internal combustion engine may be provided. The liquid return system may include a housing having an inlet side and an outlet side, a wall separating the inlet side from the outlet side of the housing, the wall comprising a fluid separator in fluid communication with both the inlet and outlet sides, and a hole formed through the wall outside an area associated with the fluid separator and bounded at least in part by a bottom of the housing. The bottom of the housing on the inlet side comprises a drain in fluid communication with at least one reservoir, and a first portion of the bottom of the housing on the outlet side forms an angle relative to a second portion of the bottom of the housing on the outlet side so as to form vertex configured to channel liquid present on the bottom of the housing on the outlet side toward the hole.

[0030] By providing such a liquid return system, a physical height difference is created between the drain (e.g., offset to a lower portion of the inlet side) and the hole. Therefore, liquid transfer from the first side to the second side (e.g., through the hole) is unlikely to occur. Further, because of the channeling effect of the angle vertex, any liquid that may settle on the second side may be directed back toward the first side and ultimately to the drain. Therefore, the potential for liquid to be exhausted with the gas into the engine intake is significantly reduced or eliminated.

[0031] The first portion of the second-side bottom piece may be substantially planar, i.e., flat relative to the sloped portion.

[0032] The angle formed between the first portion and the second portion may correspond with an engine installation angle.

[0033] The bottom of the housing on the outlet side may form an acute angle with the wall, e.g., an angle greater than 70 and less than 90 degrees.

[0034] The inlet side may be configured to receive a mixture of liquid and combustion blow-by gas, the liquid possibly including motor oil.

[0035] The outlet side may comprise a second drain formed through the second portion of the bottom of the outlet side, the second drain being configured to drain liquid from the outlet side.

[0036] The at least one reservoir can comprise an engine crankcase.

[0037] The inlet side can comprise a horizontal labyrinth. This may be beneficial for performing an initial separation of liquid from a gas.

[0038] The liquid return system may further include a receiving portion extending transversely to the hole and configured to receive the fluid separator. The fluid separator may include a fiber mesh, and may further be configured to act as a filter. Alternatively, or in combination, fluid separator may comprise a cycle type separator, an impactor, a swirl type separator, a metallic flap type separator, etc.

[0039] According to some embodiments an internal combustion engine comprising a liquid return system according to any preceding information is provided.

[0040] It is intended that combinations of the above-described elements and those within the specification may be made, except where otherwise contradictory.

[0041] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the disclosure, as claimed.

[0042] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the disclosure and together with the description, serve to explain the principles thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043]

Figure 1 is a perspective view of a liquid return system with a fluid separator removed, according to embodiments of the present invention;

Figures 2A and 2B are schematic representations of a liquid return system according to embodiments of the present invention;

Figure 3 is another perspective view of the liquid return system according to embodiments of the present invention;

Figure 4 is a simplified schematic representation of the liquid return system of Fig. 1;

Figures 5A and 5B are illustrations of one previously implemented system presented to aid in understanding of the present disclosure.

DESCRIPTION OF THE EMBODIMENTS

[0044] Embodiments of the current disclosure are generally intended to enable return of a liquid to an appropriate location (e.g., a reservoir) in an internal combustion engine, while providing a substantially liquid-free gas (e.g., blow-by gas) back to the intake of the internal combustion engine. Embodiments of the disclosure are intended to minimize and even eliminate the risk that liquid would be included or mixed in the gas provided back to the engine intake.

[0045] Figure 1 is a perspective view of a liquid return system with a fluid separator removed, according to embodiments of the present disclosure. Liquid return system 1 may include a housing 2 (removed in Figure 1, shown as a dashed line at Figure 4), a bottom piece 6, a fluid separator 35, a fluid passage 20, and a drain 10, among others.

[0046] Liquid return system 1 may be configured to be installed on an angle corresponding to, for example, an engine installation angle. For example, when installed, liquid return system 1 may actually be installed at an angle of tilt relative to level ground in the range of, for example, 1 to 30 degrees. One of skill in the art will recognize that liquid return system 1 may have varying degrees of tilt depending on an engine installation angle associated with the internal combustion engine on which it is intended to be installed.

[0047] Housing 2 may be fabricated from any suitable material (e.g., plastic, metal, composite, etc.) and may form an enclosure surrounding liquid return system 1. For example, housing 2 and bottom piece 6 may be injection molded from a thermoplastic material. According to additional examples, housing 2 may comprise or consist of metal with bottom piece 6 formed of plastic. Housing 2 may then be affixed (e.g., riveted) and the assembly sealed using, for example, gasket or liquid gasket sealing (silicone based for instance)

[0048] Housing 2 may further be configured to receive and emit gas via one or more inlets 3 and one or more outlets 4, respectively. For example, housing 2 may comprise an inlet 3 in fluid communication with at least an inlet side 25 (also referred herein as first side 25) of housing 2, and an outlet 4 in fluid communication with at least an outlet side 29 (also referred herein as second side 29) of housing 2.

[0049] Housing 2 may be generally sealed so as to prohibit the escape of gas from housing 2, except at one or more inlets 3 and or more outlets 4 of housing 2. For example, where portions of housing 2 meet other portions of liquid return system 1 (e.g., joint between a bottom piece 6 and housing 2 of liquid return system 1), one or more seals (e.g., rubber, neoprene, etc.) or other suitable structures for sealing may be provided.

[0050] Importantly, one of skill in the art will understand that portions of housing 2 are not shown in the accompanying drawings so that internal features of liquid return system 1 may be appropriately shown and described. One of skill will further understand that housing 2 is generally intended to surround and enclose the features of liquid return system 1 shown in the accompanying drawings, but that any suitable shape and configuration for a design application are intended to fall within the scope of the present claims.

[0051] Bottom piece 6 may form a bottom portion of

liquid return system 1, and may be configured to receive liquid that has been separated from a gas (e.g., blow-by gas) entering liquid return system 1. Bottom piece 6 may include a first side 25 corresponding to an inlet side 25 of housing 2, and a second side 29 corresponding to an outlet side 29 of housing 2. First side 25 may include at least one drain 10 in fluid communication with a liquid reservoir (not shown), for example, a crankcase of the internal combustion engine. Drain 10 may comprise an orifice located at a position on first side 25 where gravity and/or other forces may cause liquid to be entrained along first side 25 of bottom piece 6 toward drain 10. For example, following installation of liquid return system 1 on an internal combustion engine, drain 10 may be positioned at a lowest point relative to the ground of any other portion of bottom piece 6. This may enable any liquid present on first side 25 of bottom piece 6 to flow into drain 10 for return to the liquid reservoir (not shown). One of skill in the art will understand that more than one drain 10 may be implemented on first side 25 as desired.

[0052] Bottom piece 6 at first side 25 may also include other features configured to entrain liquid toward drain 10. For example, wall 27 which will be described in greater detail below, may be formed as a result of a physical height difference between first side 25 of bottom piece 6 and a sloped portion 15 of second side 22 of bottom piece 6.

[0053] Figures 2A and 2B are schematic representations of a liquid return system 1 according to embodiments of the present invention. As shown in figures 2A and 2B, sloped portion 15 is provided at second side 29 of bottom piece 6 and includes a sloped surface that is inclined along a length L of bottom piece 6 relative to a first portion 16 at a vertex V of bottom piece 6. The first portion of the second-side bottom piece may be substantially planar, i.e., flat relative to the sloped portion. Sloped portion 15 may form an angle Θ with a first portion 16 of bottom piece 6 ranging between 10 and 60 degrees, for example, 15 degrees. According to some embodiments, angle Θ may correspond to an engine installation angle associated with the internal combustion engine on which liquid return system is intended to be installed. For example, where liquid return system is intended to be installed on an internal combustion engine which is installed in a vehicle at an angle of 15 degrees, angle Θ may be equal to or greater than 15 degrees.

[0054] For example, angle Θ can be 30 or even 90 degree for a flat twin engine. Where angle Θ nears 90 degrees, housing 2 may be positioned, for example, with a 15 degree angle to the vertical direction, even when an engine installation angle is 90 degrees.

[0055] One of skill in the art will recognize that such a configuration may also be implemented where both liquid return system 1 and an internal combustion engine are installed to produce an angle of installation, or where liquid return system 1 alone is installed at an angle.

[0056] A portion or the entirety of bottom piece 6 on second side 29 may further be sloped toward first side 25, so as to cause any liquid present on bottom piece 6 at second side 29 to flow towards first side 25. Such a slope may form an angle α with the longitudinal axis L of bottom piece 6 of, for example, between 0.5 and 5 degrees. One of skill in the art will recognize that variations on such an angle implementation may be used without departing from the scope of the present disclosure.

[0057] Fluid separator 35 may be any suitable device configured to separate a liquid from a gas upon passing a liquid/gas mixture through fluid separator 35. For example, fluid separator 35 may be a mesh of fibers (e.g., microfibers), or other suitable material configured to allow gas to pass through while trapping liquid droplets present in the gas on the fibers of the mesh. Such droplets may then be entrained, for example, by gravity, to fall from fluid separator 35 onto bottom piece 6. One of skill in the art will recognize that any suitable type of fluid separator 35, or combination thereof, may be used without departing from the scope of the present disclosure. For example, fluid separator 35 may comprise a cycle type separator, an impactor, a swirl type separator, a metallic flap type separator, etc.

[0058] Fluid separator 35 may be positioned so as to separate first side 25 from second side 29, thus enabling fluid communication between the two sides of liquid return system 1. According to some embodiments, fluid separator 35 may extend from side to side and top to bottom of housing 2. In other words, fluid separator 35 may form the entirety of a barrier between first side 25 and second side 29, while maintaining fluid communication between these two sides.

[0059] Alternatively, a dividing wall 34 may be present between first side 25 and second side 29, the dividing wall 34 being configured to receive fluid separator 35. In such a case, dividing wall 34 may be substantially impermeable with the exception of a location intended for installation of fluid separator 35 thereon. Fluid separator 35 may then permit fluid communication between first side 25 and second side 29 via the location on dividing wall 34.

[0060] Bottom piece 6 may further include a receiver 33 configured to receive fluid separator 35 and/or dividing wall 34. According to some embodiments, receiver 33 may be configured, for example, as a channel formed of one or more raised portions of material traversing a width of bottom piece 6. In such an embodiment fluid separator 35 may be configured to be inserted into the channel and to be retained therein (e.g., an interference fit). Alternatively, dividing wall 34 may be inserted into such a channel to be retained therein, while fluid separator 35 may then be mounted to a portion of dividing wall 34 so as to allow fluid communication between first side 25 and second side 29.

[0061] According to another example, receiver 33 may be configured as a groove formed within bottom piece 6 and configured to receive fluid separator 35 and/or dividing wall 34 similarly to the above-described embodiment.

[0062] In yet another configuration, dividing wall 34

may be molded integrally with bottom piece 6 and provided with a portion configured to receive fluid separator 35. One of skill in the art will recognize that various configurations may be implemented for providing a separation between first side 25 and second side 29 without departing from the scope of the present disclosure.

[0063] In contrast to Figures 2A and 2B, Figures 5A and 5B are illustrations of one previously implemented system presented to aid in understanding of the present disclosure. As shown, such a device lacks any sloped portion 15 and therefore, no wall 27 is formed as a result. In addition, fluid passage 20' is positioned at a lowest point on wall 34' in order to permit the liquid present on second side 29' to return to drain hole 10'. Thus, as a result of ΔP across separator 35' and/or simply based on gravity, there is a risk that liquid can pass through fluid passage 20' to second side 29' (i.e., the clean side), and from there to the intake of the engine.

[0064] Figure 3 is another perspective view of the liquid return system according to embodiments of the present disclosure. As shown at figure 3 a fluid passage 20 may be provided further fluidly linking first side 25 and second side 29. Fluid passage 20 may be configured to enable liquid present on second side 29 of bottom piece 6 to flow back to first side 25 and then to 10.

[0065] Fluid passage 20 may therefore, comprise a channel or groove bounded by bottom piece 6 and traversing a portion of bottom piece 6 delineating first side 25 from second side 29. For example, where receiver 33 is provided as raised portions of material, fluid passage 20 may be formed by an absence of material passing through receiver 33.

[0066] One of skill in the art will understand that it may also be possible to provide a fluid passage 20 of a desirable depth by cutting a channel within bottom piece 6 and/or through raised portions associated with receiver 33. According to some embodiments a channel may be provided leading directly from fluid passage 20 to drain 10.

[0067] Fluid passage 20 may be positioned to be coincident with vertex V formed at the junction of sloped portion 15 and first portion 16 on bottom piece 6 on second side 29. Such a configuration permits any liquid present on bottom piece 7 on second side 29 to flow back via fluid passage 20 to first side 25 without being entrained into the gas passing to outlet 4.

[0068] As noted above, wall 27 may join sloped portion 15 and bottom piece 6 at first side 25 based on a height difference between these portions. As a result of this physical height difference and wall 27, any liquid that may be sucked back up from drain 10 into first side 25 is unlikely to surmount wall 27 and is prevented from contaminating second side 29 and the clean blow-by gas therein.

[0069] Figure 4 is a schematic representation of the liquid return system of Fig. 1. As shown at Figure 4, the one or more inlets 3 may be configured to receive a fluid, for example, blow-by gas and to permit the fluid to enter inlet side 25 of housing 2. According to some embodiments, inlet 3 may include a horizontal inlet 60 and/or a labyrinth inlet 65. As shown at Figure 2, a horizontal inlet 60 and a labyrinth inlet 65 may be used in combination. Various detrimental effects (e.g., oil splash) can be mitigated by using such a combination.

[0070] Horizontal inlet 60 may be configured such that, in an installed position, any fluid entering inlet 3 may be redirected, for example, by a plate 67, so as to cause entry of the fluid substantially horizontally into horizontal inlet 60.

[0071] Labyrinth inlet 65 may comprise one or more baffles and be configured to modify a flow direction of the entering fluid, e.g., blow-by gas, one or more times, for example, to induce turbulence and/or to cause at least a portion of liquid present in the fluid to be extracted therefrom. Labyrinth inlet 65 may therefore comprise a series of baffles 68 configured to cause the entering fluid to take the desired path through labyrinth entry 65. One of skill in the art will recognize that more or fewer walls 68 may be provided within labyrinth entry 65 in order to cause the desired effect.

[0072] Following passage of a fluid through inlet 3, such fluid may entrained to inlet side 25 of housing 2. Inlet side 25 may comprise numerous features configured to facilitate the separation of a liquid from the entering fluid (e.g., motor oil from blow-by gas and flow to drain 10. One of skill in the art will recognize that such features may be implemented as desired without departing from the scope of the present claims.

[0073] The above description is not limiting and one of skill will understand that various modifications may be made to the disclosed embodiments without departing from the scope of the appended claims. For example, it may be desirable to add a drain 10' to second side 29. Drain 10' may then be connected to a secondary liquid reservoir (not shown) and its contents drained to the engine crankcase once the engine has stopped operating to avoid contamination of second side 29 with liquid motor oil.

[0074] Further, additional features (e.g., separators 40) may be provided at second side 29 to cause various effects, such as, for example, turbulent flow, greater liquid extraction from blow-by gas, etc., prior to such blow-by gas being reintroduced to the intake of the internal combustion engine.

Claims

1. A liquid return system (1) for an internal combustion engine, comprising:

   a housing (2); and **characterized by** comprising a fluid separating means (35) in fluid communication with a first side (25) and a second side (29) of the housing (2) and configured to cause separation of a liquid from a gas upon passing a liquid/gas mixture therethrough; and

a fluid passage (20) comprising a channel or groove bounded by a bottom piece (6) of the housing (2) and traversing a portion of the bottom piece (6) delineating the first side (25) from the second side (29), the fluid passage (20) providing fluid communication between the first (25) and second sides (29) of the housing (2),
wherein the bottom piece (6) of the first side (25) of the housing (2) comprises a drainage means (10), and
wherein a sloped portion (15) of the bottom piece (6) at the second side (29) of the housing (2) is inclined along a length of the bottom piece (6) at the second side (29) relative to a first portion (16) of the second-side bottom piece such that a vertex of the incline coincides with at least a portion of the fluid passage (20).

2. The liquid return system (1) according to the previous claim, wherein the bottom piece (6) at the second side (29) is angled such that the bottom piece (6) at the second side (29) slopes downward towards the fluid passage (20) when viewed from inside the housing (2).

3. The liquid return system (1) according to the previous claim, further comprising a wall portion (27) joining the sloped portion (15) of the bottom piece (6) at the second side (29) with the bottom piece (6) at the first side (25).

4. The liquid return system (1) according to any of the previous claims, wherein the angle (Θ) formed between the sloped portion (15) of the second side (29) and the first portion (16) of the second side (29) corresponds with an engine installation angle.

5. The liquid return system (1) according to any of the previous claims, wherein the angle (Θ) formed between the sloped portion (15) of the second side (29) and the first portion (16) of the second side (29) ranges between 10 and 60 degrees, for example, 15 degrees.

6. The liquid return system (1) according to any of the preceding claims further comprising a wall portion (34) separating the first side (25) and the second side (29), wherein the fluid separating means (35) is mounted on the wall portion (34).

7. The liquid return system (1) according to any of the preceding claims, wherein the first side (25) is configured to receive a mixture of liquid and combustion blow-by gas.

8. The liquid return system (1) according to any of the previous claims wherein the liquid comprises motor oil.

9. The liquid return system (1) according to any of the preceding claims, wherein the second side (29) further comprises a second drainage means (10') formed through the bottom piece (6), and being configured to drain liquid from the second side (29).

10. The liquid return system (1) of any of the preceding claims, wherein the drainage means (10) is in fluid communication with a crankcase of an engine.

11. The liquid return system (1) of any of the preceding claims, further comprising an inlet (60) in fluid communication with the first side (25), the inlet (60) comprising a horizontal labyrinth (65).

12. The liquid return system (1) of any of the preceding claims, further comprising a groove extending transversely to the fluid passage (20) and being bounded on at least one side by the bottom piece (6), wherein the groove is configured to receive the fluid separating means (35).

13. The liquid return system (1) of any of the preceding claims, wherein the fluid separating means (35) comprises a fiber mesh.

14. An internal combustion engine comprising a liquid return system (1) according to any of claims 1-13.

Patentansprüche

1. Flüssigkeitsrückführsystem (1) für einen Verbrennungsmotor, umfassend:

ein Gehäuse (2), und **dadurch gekennzeichnet, dass** dieses umfasst:

ein Fluidtrennmittel (35) in Fluidkommunikation mit einer ersten Seite (25) und einer zweiten Seite (29) des Gehäuses (2), und ausgelegt, das Trennen einer Flüssigkeit von einem Gas beim Hindurchführen eines Flüssigkeits-/Gasgemisches zu bewirken, und
einen Fluiddurchgang (20), umfassend einen Kanal oder eine Rille, die von einem Bodenstück (6) des Gehäuses (2) begrenzt wird und einen Abschnitt des Bodenstücks (6) durchquert, der die erste Seite (25) von der zweiten Seite (29) abgrenzt, wobei der Fluiddurchgang (20) eine Fluidkommunikation zwischen der ersten (25) und zweiten (29) Seite des Gehäuses (2) vorsieht,

wobei das Bodenstück (6) der ersten Seite (25) des Gehäuses (2) ein Ablassmittel (10) umfasst, und

wobei ein abgeschrägter Abschnitt (15) des Bodenstücks (6) auf der zweiten Seite (29) des Gehäuses (2) entlang einer Länge des Bodenstücks (6) auf der zweiten Seite (29) relativ zu einem ersten Abschnitt (16) des Bodenstücks auf der zweiten Seite derart geneigt ist, dass ein Scheitel der Neigung mit mindestens einem Abschnitt des Fluiddurchgangs (20) zusammenfällt.

2. Flüssigkeitsrückführsystem (1) nach dem vorhergehenden Anspruch, wobei das Bodenstück (6) auf der zweiten Seite (29) derart abgewinkelt ist, dass das Bodenstück (6) auf der zweiten Seite (29) zum Fluiddurchgang (20), gesehen von der Innenseite des Gehäuses (2), abgeschrägt ist.

3. Flüssigkeitsrückführsystem (1) nach dem vorhergehenden Anspruch, ferner umfassend einen Wandabschnitt (27), der den abgeschrägten Abschnitt (15) des Bodenstücks (6) auf der zweiten Seite (29) mit dem Bodenstück (6) auf der ersten Seite (25) verbindet.

4. Flüssigkeitsrückführsystem (1) nach einem der vorhergehenden Ansprüche, wobei der Winkel (Θ), der zwischen dem abgeschrägten Abschnitt (15) der zweiten Seite (29) und dem ersten Abschnitt (16) der zweiten Seite (29) gebildet wird, einem Motorinstallationswinkel entspricht.

5. Flüssigkeitsrückführsystem (1) nach einem der vorhergehenden Ansprüche, wobei der Winkel (Θ), der zwischen dem abgeschrägten Abschnitt (15) der zweiten Seite (29) und dem ersten Abschnitt (16) der zweiten Seite (29) gebildet wird, zwischen 10 und 60 Grad, beispielsweise 15 Grad, beträgt.

6. Flüssigkeitsrückführsystem (1) nach einem der vorhergehenden Ansprüche, ferner umfassend einen Wandabschnitt (34), der die erste Seite (25) und die zweite Seite (29) trennt, wobei das Fluidtrennmittel (35) auf dem Wandabschnitt (34) montiert ist.

7. Flüssigkeitsrückführsystem (1) nach einem der vorhergehenden Ansprüche, wobei die erste Seite (25) ausgelegt ist, ein Gemisch von Flüssigkeit und Verbrennungsdurchblasgas aufzunehmen.

8. Flüssigkeitsrückführsystem (1) nach einem der vorhergehenden Ansprüche, wobei die Flüssigkeit Motoröl umfasst.

9. Flüssigkeitsrückführsystem (1) nach einem der vorhergehenden Ansprüche, wobei die zweite Seite (29) ferner ein zweites Ablassmittel (10') umfasst, das durch das Bodenstück (6) gebildet ist, und ausgelegt ist, Flüssigkeit von der zweiten Seite (29) abzulassen.

10. Flüssigkeitsrückführsystem (1) nach einem der vorhergehenden Ansprüche, wobei das Ablassmittel (10) mit einem Kurbelgehäuse eines Motors in Fluidkommunikation steht.

11. Flüssigkeitsrückführsystem (1) nach einem der vorhergehenden Ansprüche, ferner umfassend einen Einlass (60) in Fluidkommunikation mit der ersten Seite (25), wobei der Einlass (60) ein horizontales Labyrinth (65) umfasst.

12. Flüssigkeitsrückführsystem (1) nach einem der vorhergehenden Ansprüche, ferner umfassend eine Rille, die sich quer zum Fluiddurchgang (20) erstreckt und auf mindestens einer Seite von dem Bodenstück (6) begrenzt wird, wobei die Rille ausgelegt ist, das Fluidtrennmittel (35) aufzunehmen.

13. Flüssigkeitsrückführsystem (1) nach einem der vorhergehenden Ansprüche, wobei das Fluidtrennmittel (35) ein Fasernetz umfasst.

14. Verbrennungsmotor, umfassend ein Flüssigkeitsrückführsystem (1) nach einem der Ansprüche 1 bis 13.

Revendications

1. Système de retour de liquide (1) pour un moteur à combustion interne, comportant :

un logement (2) ; et **caractérisé en ce qu'**il comporte
des moyens de séparation de fluide (35) en communication de fluide avec un premier côté (25) et un deuxième côté (29) du logement (2) et configurés pour provoquer une séparation d'un liquide d'un gaz lors du passage d'un mélange liquide/gaz à travers ; et
un passage de fluide (20) comportant un canal ou une rainure délimité par une pièce de fond (6) du logement (2) et traversant une partie de la pièce de fond (6) séparant le premier côté (25) du deuxième côté (29), le passage de fluide (20) procurant une communication de fluide entre les premier (25) et deuxième (29) côtés du logement (2),
dans lequel la pièce de fond (6) du premier côté (25) du logement (2) comporte des moyens d'évacuation (10), et
dans lequel une partie inclinée (15) de la pièce de fond (6) sur le deuxième côté (29) du logement (2) est inclinée sur une longueur de la pièce de fond (6) sur le deuxième côté (29) par rapport à une première partie (16) de la pièce de fond

de deuxième côté de telle sorte qu'un sommet de la pente coïncide avec au moins une partie du passage de fluide (20).

2. Système de retour de liquide (1) selon la revendication précédente, dans lequel la pièce de fond (6) sur le deuxième côté (29) est inclinée de telle sorte que la pièce de fond (6) sur le deuxième côté (29) s'incline vers le bas vers le passage de fluide (20) lorsqu'elle est vue depuis l'intérieur du logement (2).

3. Système de retour de liquide (1) selon la revendication précédente, comportant en outre une partie de paroi (27) reliant la partie inclinée (15) de la pièce de fond (6) sur le deuxième côté (29) avec la pièce de fond (6) sur le premier côté (25).

4. Système de retour de liquide (1) selon l'une quelconque des revendications précédentes, dans lequel l'angle (θ) formé entre la partie inclinée (15) du deuxième côté (29) et la première partie (16) du deuxième côté (29) correspond à un angle d'installation de moteur.

5. Système de retour de liquide (1) selon l'une quelconque des revendications précédentes, dans lequel l'angle (θ) formé entre la partie inclinée (15) du deuxième côté (29) et la première partie (16) du deuxième côté (29) s'échelonne entre 10 et 60 degrés, par exemple, 15 degrés.

6. Système de retour de liquide (1) selon l'une quelconque des revendications précédentes comportant en outre une partie de paroi (34) séparant le premier côté (25) et le deuxième côté (29), dans lequel les moyens de séparation de fluide (35) sont montés sur la partie de paroi (34).

7. Système de retour de liquide (1) selon l'une quelconque des revendications précédentes, dans lequel le premier côté (25) est configuré pour recevoir un mélange de liquide et de gaz de combustion imbrûlés.

8. Système de retour de liquide (1) selon l'une quelconque des revendications précédentes dans lequel le liquide comporte de l'huile de moteur.

9. Système de retour de liquide (1) selon l'une quelconque des revendications précédentes, dans lequel le deuxième côté (29) comporte en outre des deuxièmes moyens d'évacuation (10') formés à travers la pièce de fond (6), et qui sont configurés pour évacuer du liquide du deuxième côté (29).

10. Système de retour de liquide (1) selon l'une quelconque des revendications précédentes, dans lequel les moyens d'évacuation (10) sont en communication de fluide avec un carter d'un moteur.

11. Système de retour de liquide (1) selon l'une quelconque des revendications précédentes, comportant en outre une entrée (60) en communication de fluide avec le premier côté (25), l'entrée (60) comportant un labyrinthe horizontal (65).

12. Système de retour de liquide (1) selon l'une quelconque des revendications précédentes, comportant en outre une rainure s'étendant transversalement au passage de fluide (20) et qui est délimitée sur au moins un côté par la pièce de fond (6), dans lequel la rainure est configurée pour recevoir les moyens de séparation de fluide (35).

13. Système de retour de liquide (1) selon l'une quelconque des revendications précédentes, dans lequel les moyens de séparation de fluide (35) comportent un tamis en fibre.

14. Moteur à combustion interne comportant un système de retour de liquide (1) selon l'une quelconque des revendications 1 à 13.

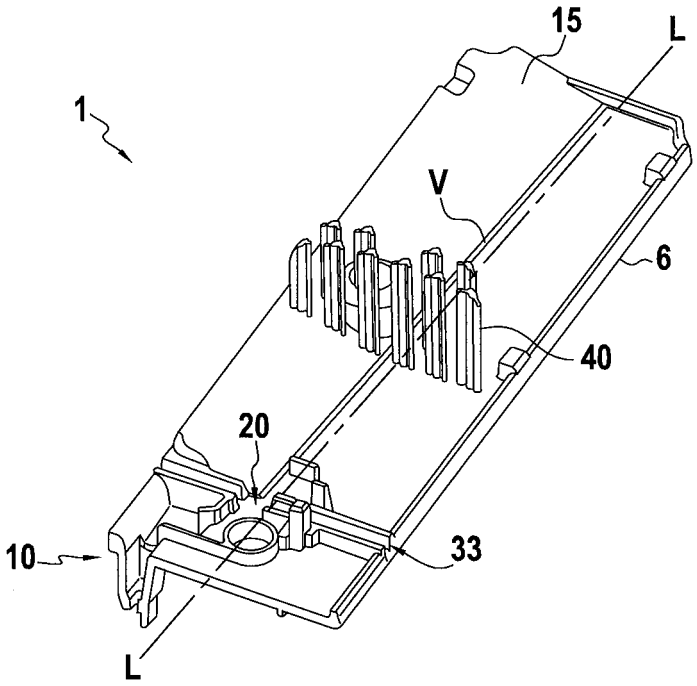

FIG.1A

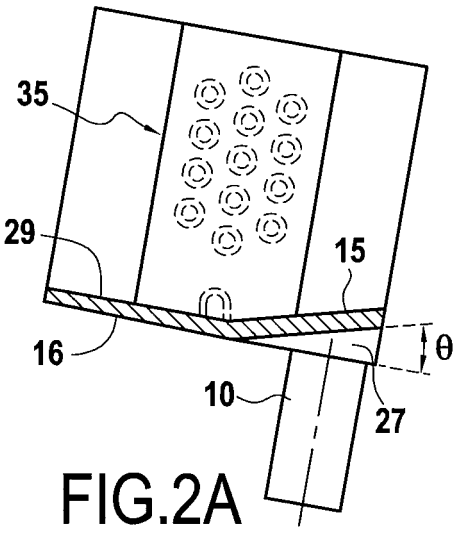

FIG.2A

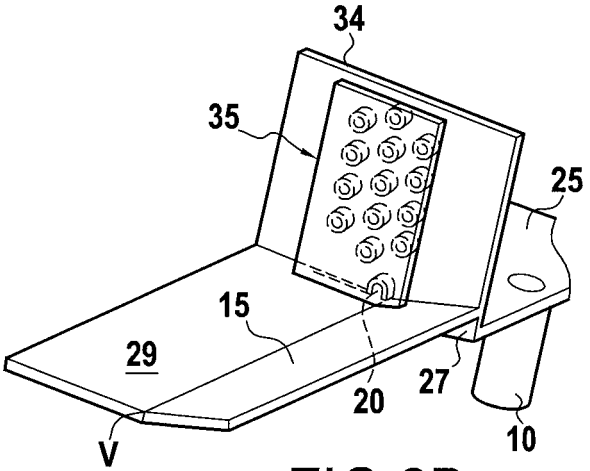

FIG.2B

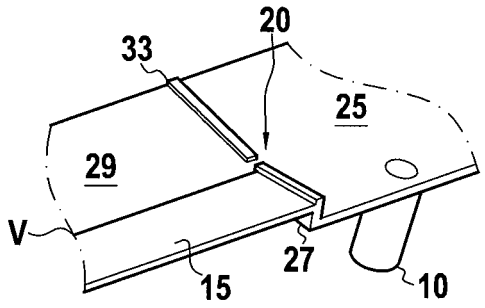

FIG.3

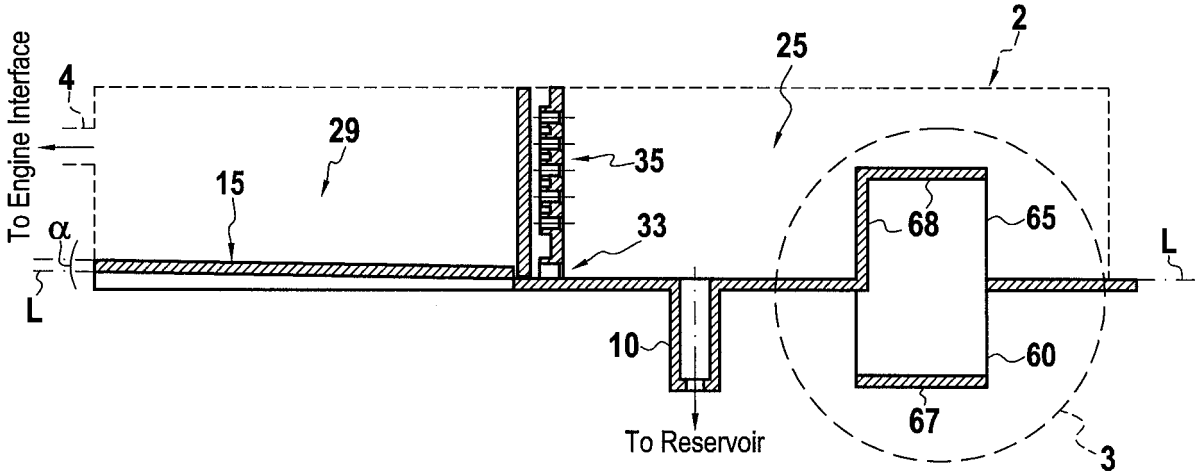

FIG.4

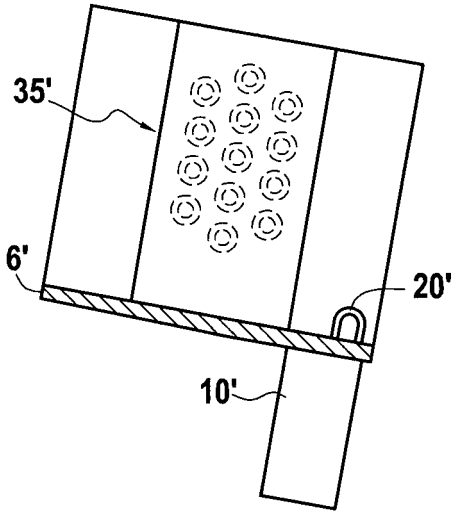

FIG.5A

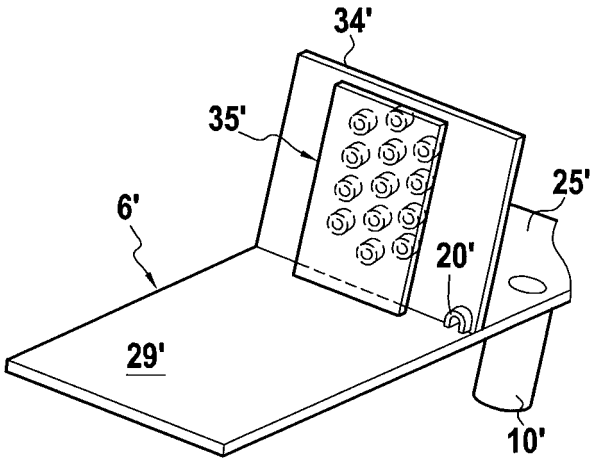

FIG.5B

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 102012211805 **[0008]**
- WO 2006091146 A **[0008]**