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(54) **Shut-off valve for an engine breather system**

(57) If an internal combustion engine is mounted in a vehicle or machine which is operated at an extreme inclination or rolls over, there is a risk that substantial quantities of oil can flow under gravity through the engine breather system and enter the engine induction system. This can cause the engine to run in an un-governed condition and can result in damage to the engine as well as undesirable engine emissions. The invention provides a breather shut-off valve including a valve chamber and a float movably held within the valve

chamber. The valve chamber has a floor, a side wall provided with an inlet aperture, and a roof provided with an exit aperture. The float is adapted to move between a first position in which the exit aperture is open when the valve chamber has no oil or other liquid therein and a second floating position in which the exit aperture is closed by the float when the valve chamber has oil or other liquid therein. The breather shut-off valve is compact in height and can be used with a known pressure regulation valve.

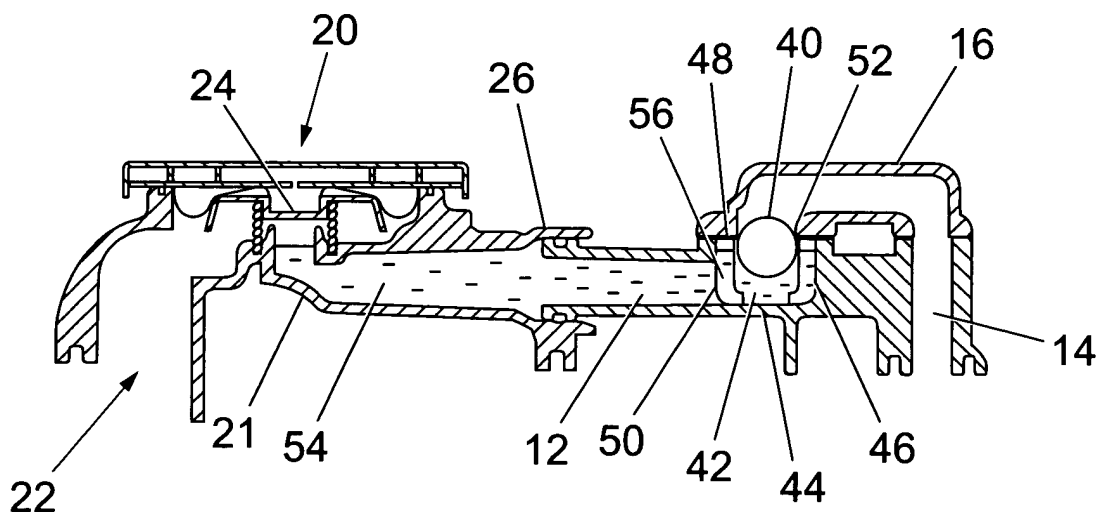


Fig. 4

Description

TECHNICAL FIELD

[0001] This invention relates to breather systems in internal combustion engines which allow the free flow of bypass gases and air movement between chambers of the engine during engine running, and to shut-off valves provided in such breather systems to prevent oil in the breather system from entering the engine induction system, and is particularly but not exclusively applicable to closed circuit breather systems.

BACKGROUND

[0002] An internal combustion engine typically consists of three chambers, the crankcase, the timing case and the top cover. Each of these chambers must be openly connected to allow free flow of bypass gases and air movement during engine running. In a closed breather system blow-by gas escapes past the piston into the crankcase where it mixes with airborne oil droplets and is fed back into the engine induction system. The blow-by gas passes through a woven mesh oil separator which separates the oil from the blow-by gas before allowing the oil to return to the sump under gravity. The blow-by gas then continues through a pressure regulation valve to the induction manifold. The pressure regulation valve typically has a spring-loaded diaphragm which closes when the induction depression overcomes the spring load. Positive crankcase pressure opens the diaphragm and allows blow-by gases to escape into the air intake system. Negative crankcase pressure closes the diaphragm and prevents blow-by gases being drawn back into the engine.

[0003] In the known closed circuit breather systems there is a reliance on gravity to ensure that oil in the blow-by gases returns to the sump. In the event that an engine is not operated in its usual horizontal position, there is a risk that oil may not return to the sump, but may be directed to the pressure regulation valve and hence to the engine induction system by gravity, resulting in undesirable engine emissions. If the engine is mounted in a vehicle or machine which is operated at an extreme inclination or rolls over, there is a risk that substantial quantities of oil can flow under gravity and enter the engine induction system. This can cause the engine to run in an ungoverned condition and can result in damage to the engine as well as undesirable engine emissions.

[0004] The present invention seeks to provide a shut-off valve for a breather system which overcomes one or more of these problems.

SUMMARY OF THE INVENTION

[0005] The present invention provides a shut-off valve comprising a valve chamber and a float movably held

within the valve chamber. The valve chamber has a floor, a side wall provided with an inlet aperture, and a roof provided with an exit aperture. The float is adapted to move between a first position in which the exit aperture is open when the valve chamber has no liquid therein and a second floating position in which the exit aperture is closed by the float when the valve chamber has liquid therein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

Figure 1 is an end view of an internal combustion engine having a closed circuit breather system according to the prior art, including a pressure regulation valve;

Figure 2 is a cross-sectional view of the pressure regulation valve of Figure 1;

Figure 3 is a cross-sectional view of a breather valve according to a first embodiment of the present invention in the open position;

Figure 4 is a cross-sectional view of the breather valve of Figure 3 in a closed position;

Figure 5 is a cross-sectional view of a breather valve according to a second embodiment of the present invention in the open position;

Figure 6 is a cross-sectional view of the breather valve of Figure 5 in a first closed position; and

Figures 7 and 8 are cross-sectional views of the breather valve of Figure 5 in further closed positions.

DETAILED DESCRIPTION

[0007] Referring to the drawings, one embodiment of the present invention is now described, by way of example only.

[0008] A known closed breather system 80 is shown in Figures 1 and 2. An engine 82 has a crankcase 84, an air filter 88 and an induction manifold 86. Blow-by gas which escapes past the pistons (not shown) into the crankcase 84 mixes with airborne oil droplets in the crankcase and is fed back to the engine induction system. The gas first passes through the crankcase breather pipe 94 to a combined filter/separator 90 which separates the oil from the blow-by gas before allowing the oil to return to the crankcase 84 under gravity. The blow-by gas then continues through a pressure regulation valve 20 and along an air intake pipe 96 to the induction manifold 86. The closed breather system shown in Figure 1 does not include a shut-off valve.

[0009] The pressure regulation valve is shown in more detail in Figure 2 and has a housing 21 with a crankcase inlet 22 connected to the crankcase breather pipe 94 via the combined filter/separator 90 and an induction manifold outlet connected to the air intake pipe 96. Mounted in the housing 21 is a spring-loaded diaphragm 24 which closes when the induction depression overcomes the load in the spring 28. Positive crankcase pressure opens the diaphragm 24 to the position shown in Figure 2, thereby allowing blow-by gases to escape into the air intake system along the path indicated by the arrows 30. Negative crankcase pressure closes the diaphragm 24 and prevents blow-by gases being drawn back into the engine.

[0010] A first embodiment of a breather valve or shut-off valve 10 according to the invention is described with reference to Figures 3 and 4. Although the shut-off valve 10 is referred to as a breather valve, it is to be understood that the valve is not limited to use in an engine breather system, and may be used as a shut-off valve in any suitable application in which the flow of fluid is to be prevented when liquid enters the valve.

[0011] The breather valve 10 is shown connected directly to a pressure regulation valve 20 of the type shown in Figure 2, but it is to be understood that the breather valve 10 may be separate. The breather valve 10 comprises a housing 16 having a blow-by gas inlet passage 12 and a blow-by gas outlet passage 14. The gas inlet passage 12 communicates with a valve chamber 42 by means of an inlet aperture 50 in the side wall 46 of the valve chamber 42. The gas outlet passage 14 communicates with the valve chamber 42 by means of an exit aperture 52 in the roof 48 of the valve chamber 42. The floor 44 of the valve chamber 42 is continuous.

[0012] A ball float 40 is movably held within the valve chamber 42. The ball float has a density less than that of oil, so that it is able to float on any oil 54 entering the valve chamber 42. The ball float 40 may be a hollow ball of plastic or metal, or any other suitable construction. A number of vertically extending ribs 56, in this example four ribs 56, are provided on the internal face of the side wall 46. The ribs 56 serve as guides which hold the float 40 so that it is restrained to move only in a vertical direction. Any suitable number of ribs may be provided, or other guide means may be used. The ribs may be omitted provided that the inlet aperture 50 and exit aperture 52 are small enough to restrain the float 40 within the valve chamber 42.

[0013] In the embodiment illustrated in Figures 3 and 4 the gas inlet passage 12 is connected to the induction manifold outlet 26 of a pressure regulation valve 20. The pressure regulation valve 26 is described in more detail above with reference to Figures 1 and 2, and is not further described here.

[0014] A second embodiment of a breather valve 10' according to the invention is described with reference to Figures 5 to 8. The breather valve 10' is also shown connected directly to a pressure regulation valve 20 of the

type shown in Figure 2, but it is to be understood that the breather valve 10' may be separate. Like features are denoted by the same reference signs used to denote the features of the embodiment shown in Figures 3 and 4.

[0015] The valve chamber 42 of the breather valve 10' of the second embodiment has a concave floor 44. In addition to the float 40, the valve chamber 42 also contains a rolling member 58, typically a ball having a density greater than that of oil, so that the rolling member 58 is urged by gravity to the lowest position within the valve chamber 42, even when oil 54 is present in the valve chamber 42. The rolling member 58 may be a steel ball or other metallic ball. The valve chamber 42, the inlet and exit apertures 50, 52, the float 40, the ribs 56 or other guides, if provided, and the rolling member 58 are dimensioned such that the rolling member is restrained within the valve chamber and is unable to exit via the inlet aperture 50 or exit aperture 52.

INDUSTRIAL APPLICABILITY

[0016] The breather valve 10 of the present invention prevents any oil passing through the breather valve in the event of oil entering the breather gas inlet passage 12. In the embodiment of Figures 3 and 4 oil 54 entering the breather gas inlet passage 12 flows into the valve chamber 42. As the oil level rises the float 40 is lifted by the oil from a first non-floating position shown in Figure 3 to a second floating position shown in Figure 4. In the first position breather gas is able to pass around the float 40 and through the exit aperture 52 to the induction manifold 86, in the flow direction indicated by the arrows 30, while in the second position the float 40 is urged by its own buoyancy against the circular exit aperture 52 to provide a shut-off seal which prevents breather gas from passing through the breather valve.

[0017] Because the inlet aperture 50 is provided in the side wall 46 of the valve chamber 42, the breather valve 10 has a compact height, enabling it to be used in engine locations where space is at a premium. If the breather valve is used in conjunction with a pressure regulation valve 20, as shown in Figures 3 and 4, the overall height of the combined pressure regulation valve and breather valve can be no greater than the height of a pressure regulation valve alone, if required.

[0018] It is to be understood that the geometric arrangement of the inlet and outlet passages 12, 14 may be varied to suit the layout of the engine with which the breather valve 10 is to be used. The ribs 56 may be omitted, and other means of guiding or restraining the float within the valve chamber may be used, as will be apparent to the person skilled in the art.

[0019] The breather valve 10' illustrated in Figures 5 to 8 has an additional rolling member 58 in the valve chamber 42 to ensure the secure operation of the breather valve 10' when the engine is not operated in its usual horizontal position.

[0020] When the breather valve 10' is in its normal at rest position, with the valve chamber 42 vertical, the rolling member 58 is in an at rest position at the centre 60 or lowest point of the concave floor 44, as seen in Figures 5 and 6. The breather valve then operates exactly as described above with reference to Figures 3 and 4. However, when the breather valve is inclined to a predetermined angle α , equal to the angle of inclination of the conical portion 62 of the concave floor 44 of the valve chamber 42, the rolling member rolls under gravity towards the side wall 46 of the valve chamber 42. As it rolls towards the side wall 46 it comes into contact with the float 40 and urges the spherical float 40 into sealing contact with the circular exit aperture 52 in the roof 48 of the valve chamber 42, thereby providing a shut-off seal which prevents breather gas from passing through the breather valve 10'.

[0021] It is to be understood that the relative sizes of the inlet and exit apertures 50, 52, the float 40, the rolling member 58 and the valve chamber 42 may be varied, provided that the rolling member 58 is prevented from rolling out of the valve chamber 42 in the event of the breather valve 10' not being operated in its normal operating position. The ribs 56 or other guides, if provided, may also assist in restraining the rolling member 58 and float 40 in the valve chamber 42.

[0022] The breather valve 10, 10' of the present invention can be used with the pressure regulation valve 20 in the engine 82 shown in Figure 1. However its use is not limited to engines having the layout shown in Figure 1. The compact size of the breather valve 10, 10' of the present invention means that it can be used in engine layouts where space is at a premium.

[0023] The present invention provides an improved breather system which can be used in engines in situations where there is a risk of an engine overturning, for example on a work machine or vehicle. The shut-off valve according to the invention can prevent oil in a closed circuit breather system from entering the engine induction system, which can cause the engine to run in an ungoverned condition and can result in engine damage. The shut-off valve according to the invention can also be used in other applications to allow the free flow of gases and to prevent the flow of liquids.

Claims

1. A shut-off valve comprising a valve chamber and a float movably held within the valve chamber, the valve chamber having a floor, a side wall provided with an inlet aperture, and a roof provided with an exit aperture,
wherein the float is adapted to move between a first position in which the exit aperture is open when the valve chamber has no oil therein and a second floating position in which the exit aperture is closed by the float when the valve chamber has

liquid therein.

2. A shut-off valve according to Claim 1, wherein the float is a ball float and the exit aperture is circular.
3. A shut-off valve according to Claim 1 or 2, further including one or more guides inside the valve chamber adapted to guide the float for movement between the first position and the second position, the one or more guides being adapted to allow the passage of fluid therebetween.
4. A shut-off valve according to Claim 3, wherein the one or more guides include a plurality of ribs projecting from the side wall of the valve chamber.
5. A shut-off valve according to any preceding Claim, further including a pressure regulation valve in communication with the inlet aperture.
6. A shut-off valve according to any preceding Claim, further including a rolling member below the float within the valve chamber, wherein the floor of the valve chamber is concave and the rolling member is free to roll over the floor.
7. A shut-off valve according to Claim 6, wherein the rolling member is a ball having a density greater than that of oil.
8. A shut-off valve according to Claim 6 or 7, wherein the rolling member is adapted to move over the concave floor to urge the float against the exit aperture when the shut-off valve is tilted by a predetermined angle from an at-rest position in which the exit aperture is vertically above the floor.
9. A shut-off valve according to Claim 8, wherein the entry aperture is smaller than the float and wherein the float and rolling member have a size such that the float prevents the rolling member from passing through the entry aperture.
10. A breather valve for an internal combustion engine, wherein the breather valve is a shut-off valve according to any preceding Claim and the liquid is oil.
11. An internal combustion engine including a crankcase, an induction manifold and a breather valve, the breather valve comprising a valve chamber and a float movably held within the valve chamber, wherein the valve chamber has an inlet aperture in communication with the crankcase and an exit aperture in communication with the induction manifold, and wherein the float is adapted to move between a first position in which the exit aperture is open when the valve chamber has no oil therein and a second floating position in which the exit aperture

is closed by the float when the valve chamber has oil therein.

12. A work machine having an internal combustion engine according to Claim 11.

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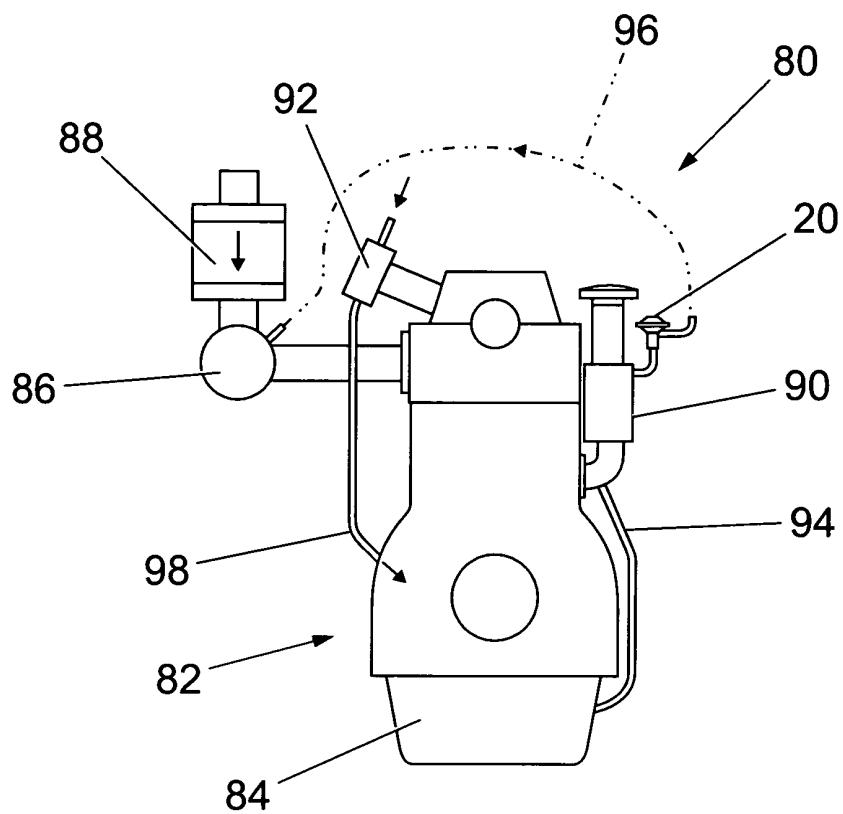


Fig. 1

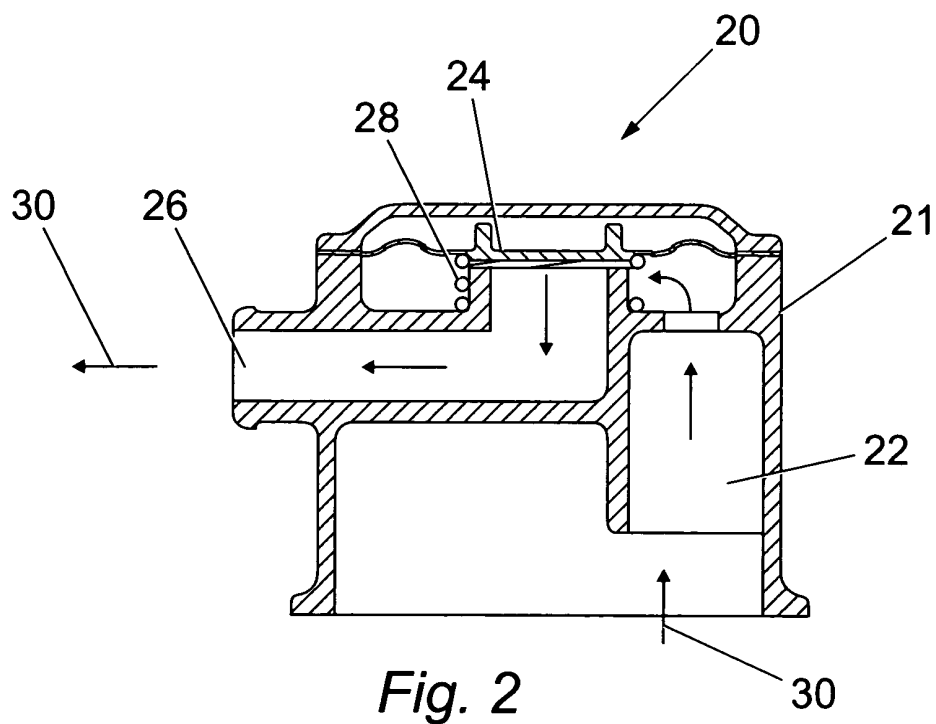


Fig. 2

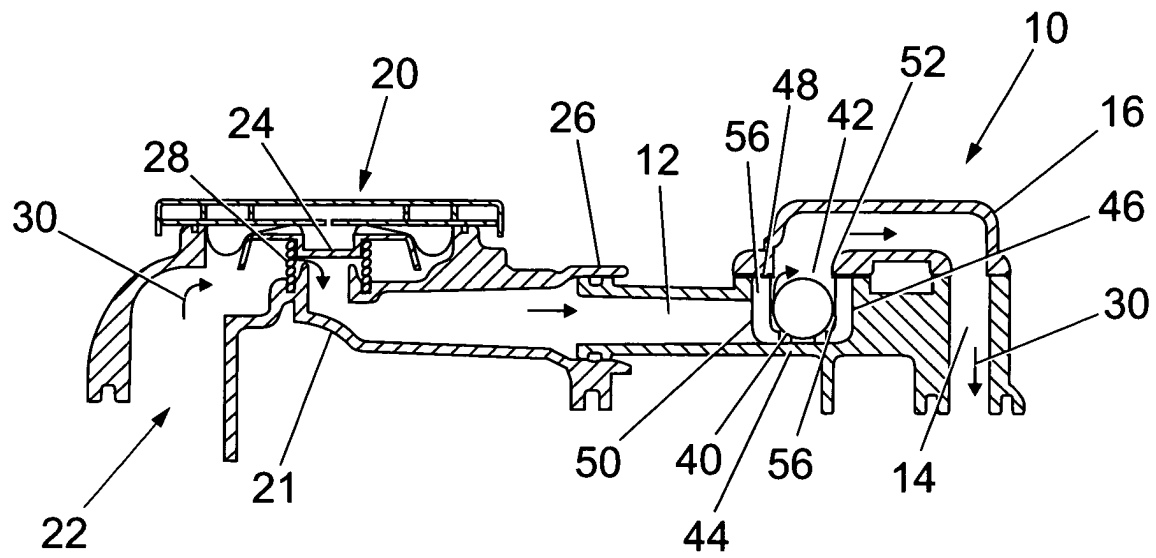


Fig. 3

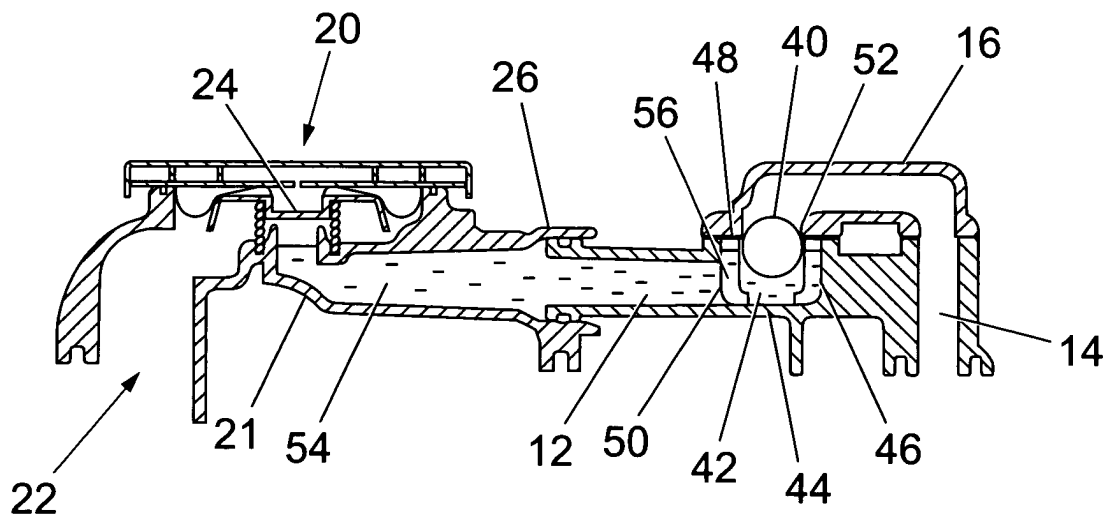


Fig. 4

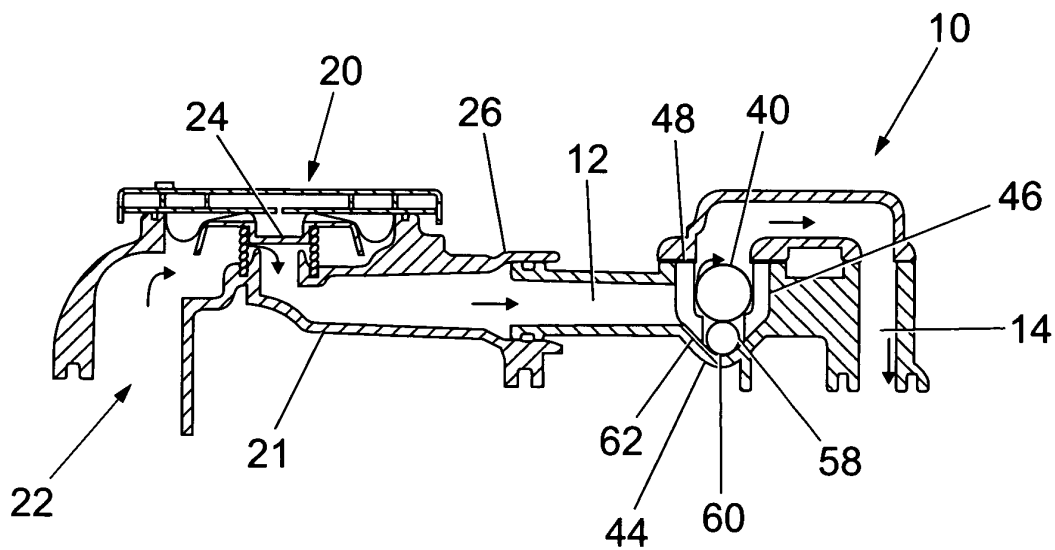


Fig. 5

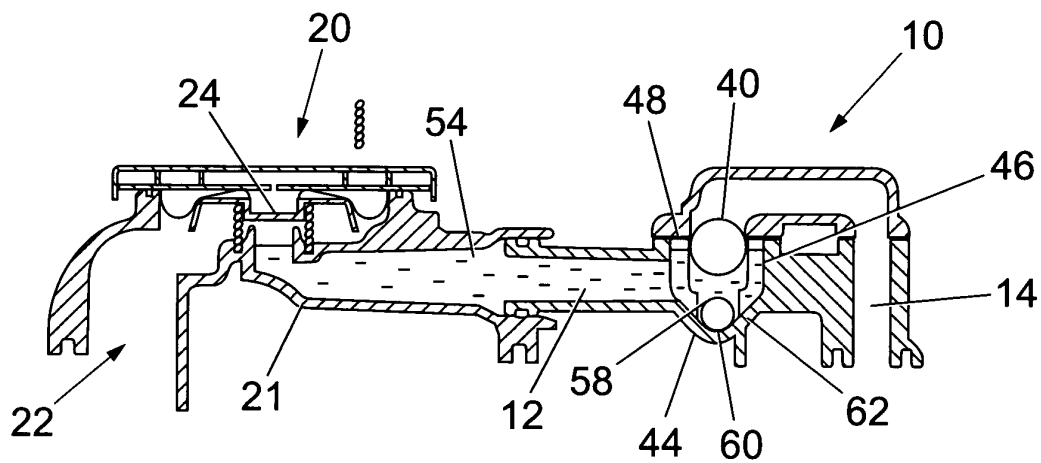


Fig. 6

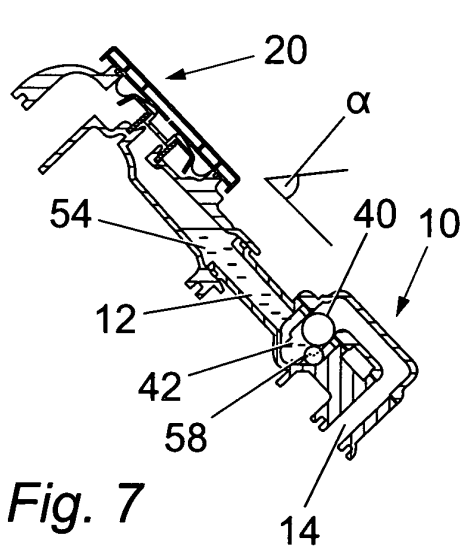


Fig. 7

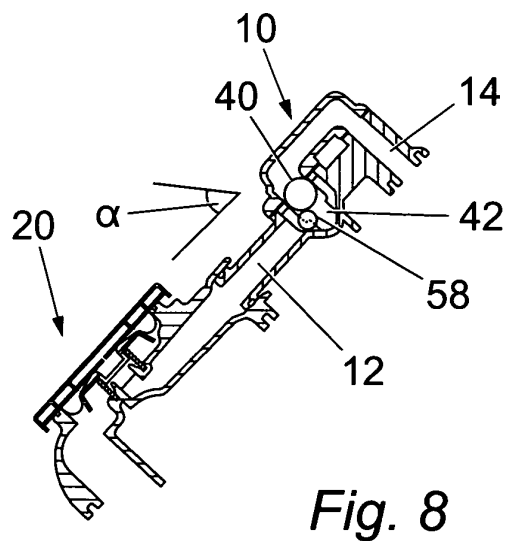


Fig. 8



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 02 25 5865

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Place of search MUNICH		Date of completion of the search 18 December 2002	Examiner Vedoato, L
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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