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(54) Fuel tank ventilation on a pressure washer

(57) A high-pressure washer (1) for delivering a liquid is described, which can be placed in a first position and a second position, and comprises:
- a frame (2),
- a heater (7) for providing heating for the liquid by combustion,
- a fuel tank (4) for storing a fuel (36) for he heater (7), where the fuel tank (4) has a first hose connection (43) and a second hose connection (42).
The high-pressure washer further comprises
- an outer hose connection (46),
- a first ventilation hose (45) coupled to the first hose connection (43) and to the outer hose connection (46),
- a second ventilation hose (44) coupled to the second hose connection (42) and to the outer hose connection (46), and
- an outer ventilation hose (47) coupled to the outer hose connection (46) and having an outer opening (48) to the ambient air.

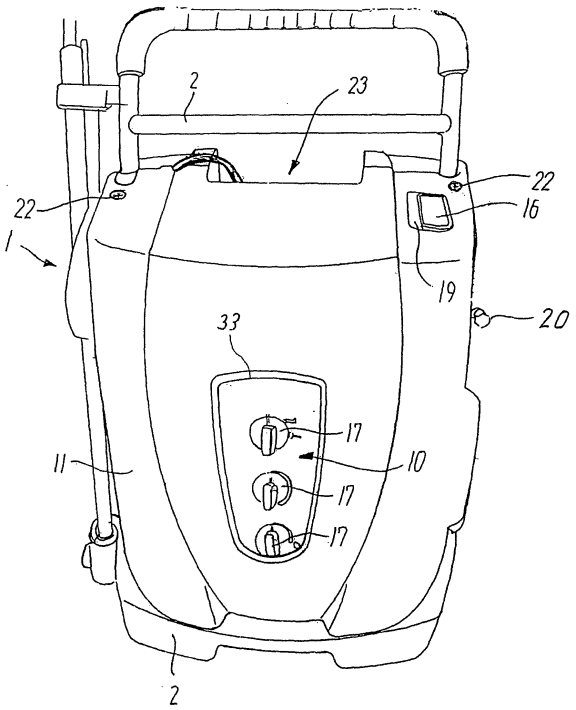

FIG. 1

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Description

Field of the invention

[0001] The present invention generally relates to the ventilation of the fuel tank of a high-pressure washer, and in particular to a technique of preventing the leakage of liquid fuel due to the expansion of vaporized fuel inside the fuel tank. More specifically, the present invention relates to a pressure washer that can be placed in two different positions without any significant risk of leakage of liquid fuel.

Description of the related art

[0002] There are high-pressure washers that deliver a heated liquid under high pressure, where the heating of the liquid is obtained internally in the high-pressure washer by combustion in a burner or heater. This demands a fuel, which is usually provided by a fuel tank mounted on the high-pressure washer. To the present day, pressure washers having a fuel tank are of a construction that is operated, transported, and stored in essentially the same position, which in turn means that the fuel tank also has essentially the same orientation. If the fuel tank is not ventilated, i.e. if it defines an airtight closed space, the removal of fuel from during operation will result in lower pressure inside the fuel tank. However, a continuous and unobstructed flow of fuel is essential for a normal operation. Due to the fact that the orientation of the fuel tank is essentially unchanged, it is possible to provide ventilation at all times by the use of a single ventilation tube or ventilation hose, which is usually coupled to the fuel tank at a point above the maximum fuel level.

[0003] A problem that may occur if the orientation of the described fuel tank is changed is that the surface of the fuel may shift so that the ventilation tube is coupled to the fuel tank at a point below the maximum fuel surface. Air and fumes from the fuel may get trapped in a gas pocket above the fuel surface; and if the temperature increases the volume of the gas pocket expands, which may result in that fuel is pressed out through the ventilation hose.

Object of the invention

[0004] An object according to the present invention is to provide techniques that will allow high-pressure washers with a fuel tank adapted to a more compact and transportable construction. It is an advantage of the present invention that it allows for a high-pressure washer that is easily transportable by hand with a reduced risk for leakage of liquid fuel. A particular feature of the present invention is that it allows for a high-pressure washer with a fixed fuel tank that can be placed in either a vertical or a horizontal position without any leakage of fuel.

Summary/Disclosure of invention

[0005] The above object, the above advantage and the above feature together with numerous other objects, advantages and features will be evident from the detailed descriptions given below of preferred embodiments according to the present invention. The objects, advantages and features are according to a first aspect of the present invention obtained by a high-pressure washer for delivering a liquid, where said high-pressure washer can be placed in a first position and a second position, and said high-pressure washer comprising:

a frame,
a heater, supported by said frame, for providing heating for said liquid by combustion,
a fuel tank, supported by said frame and having an inside and an outside, for storing a fuel for said heater, said fuel tank having a first hose connection and a second hose connection,
an outer hose connection located outside said fuel tank,
a first ventilation hose coupled to said first hose connection and to said outer hose connection,
a second ventilation hose coupled to said second hose connection and to said outer hose connection, and
an outer ventilation hose coupled to said outer hose connection and having an outer opening to the ambient air,

where an amount of fuel, supplied to said fuel tank, defines a first fuel surface located inside said fuel tank when said high-pressure washer is placed in said first position, and a second fuel surface located inside said fuel tank when said high-pressure washer is placed in said second position;
where:

said fuel tank in conjunction with said amount of fuel defining a first residual space within said fuel tank and above said first fuel surface when said high-pressure washer is placed in said first position,
said fuel tank in conjunction with said amount of fuel defining a second residual space within said fuel tank and above said second fuel surface when said high-pressure washer is placed in said second position,
said first residual space contains a first amount of a gas,
said second residual space contains a second amount of gas;
said first, second and outer hose connections, and said first, second and outer ventilation hoses are of such a construction and located so that:
said first amount of gas upon expansion is ventilated through said first ventilation hose and said outer ventilation hose to the ambient air, and
said second amount of gas upon expansion is ven-

tilated through said second ventilation hose and said outer ventilation hose to the ambient air.

[0006] The heater of the high-pressure washer may comprise a burner for providing the conditions for combustion of the fuel, a heater coil through which the liquid to be heated passes, and an electrically driven fan to drive the heat of the combustion over the heater coil. The combustion may be initiated by an electrical spark, e.g. by piezo ignition. Further, the hoses may be of flexible tubing and the outer hose connection may be a T-joint. A ventilation hose may also be one of the arms of a T-junction constituting the outer hose connection.

[0007] Naturally, the gas in the first and second residual spaces may be a mixture of air and fumes of the fuel. The entire amount of fuel supplied to the fuel tank may be contained within the enclosed space defined by the fuel tank. Alternatively or in addition - depending on the orientation of the fuel tank, the placement of the ventilation hoses, and the construction of the ventilation hoses - some of the amount of fuel may be contained within one or both of the first and the second ventilation hoses. This means that the actual volume of fuel contained within the fuel tank may vary depending on what position the high-pressure washer is placed in. Consequently, the volume of the first residual space may not be the same as the volume of the second residual space.

[0008] In order to maximize the storing volume of a fuel tank, and at the same time maintaining a compact design of the high-pressure washer, the shape of the fuel tank may be adjusted to partly fill the gaps between the other parts of the high-pressure washer, or to minimize the distance between the fuel tank and the other parts. In many constructions, this may be achieved by having an irregularly shaped fuel tank. However, an irregularly shaped fuel tank containing fuel may, when place in a certain position, give rise to several enclosed - or residual - spaces containing trapped gas. However, the trapped gas may be ventilated by having a ventilation hose coupled to each enclosed space. If the high-pressure washer, at the same time, is to be easily transportable, this demands that the high-pressure washer, and subsequently the fuel tank, is insensitive to orientation or positioning. If the difference in orientation between two positions is sufficiently large, an individual ventilation hose may be needed for each of the enclosed spaces of air and fuel fumes in each of the two positions.

[0009] When the high-pressure washer is placed in the first position, the first amount of gas may upon expansion be ventilated also through the second ventilation hose and the outer ventilation hose to the ambient air. Similarly, when being placed in the second position, the second amount of gas may upon expansion be ventilated also through the first ventilation hose and the outer ventilation hose to the ambient air. This means that the two ventilation hoses may ventilate the same residual space in either of the first or the second position. These situations may occur when fuel is removed from the fuel tank during operation, or when not enough fuel is supplied to the fuel tank to reach any of the hose connections.

[0010] The outer hose connection may be located above the first hose connection when the high-pressure washer is placed in the first position. In a similar fashion, the outer hose connection may be located above the second hose connection when the high-pressure washer is placed in the second position. This way a trapping caused by the hoses may be avoided with essentially straight ventilation hoses. With a fuel surface below the first hose connection when being in the first position, and below the second hose connection when being in the second position, there is in both positions of the fuel tank an unobstructed passage for an expanding gas through one of the ventilation hoses.

[0011] The second ventilation hose may be constructed so that it, when the high-pressure washer is placed in the first position, reaches a point above the first hose connection before being coupled to the outer hose connection. Similarly, the first ventilation hose may, when the high-pressure washer is placed in the second position, reach a point above the second hose connection before being coupled to the outer hose connection. This way a trapping caused by the hoses may be avoided, even if the outer hose connection is located below the first hose connections when the high-pressure washer is placed in the first position, or if the outer hose connection is located below the second hose connections when the high-pressure washer is placed in the second position. As an example when the high-pressure washer is placed in the first position, with an amount of fuel such that the first fuel surface does not reach the first hose connection, there will be an unobstructed passage through the first ventilation hose, since in the second ventilation hose the fuel cannot reach the outer hose connection due to the fact that the fuel reaches the same level as in the fuel tank, which is below the first hose connection.

[0012] The high-pressure washer may further comprise a fuel tank filler for enabling the filling of the fuel tank with the fuel, whereby a maximum amount of fuel may be defined as the largest amount of fuel that may be provided to the fuel tank by employing the fuel tank filler; where the maximum amount of fuel, when provided to the fuel tank, defines a first maximum fuel surface inside the fuel tank when the high-pressure washer is placed in the first position, and/or a second maximum fuel surface inside the fuel tank when the high-pressure washer is placed in the second position; and the first hose connection may be located above the first maximum fuel surface when the high-pressure washer is placed in the first position, and the second hose connection may be located above the second maximum fuel surface when the high-pressure washer is placed in the second position. Here, the fuel tank filler may be an opening in the tank that is sealed by a cap, a lid, or a sealing element with a similar function. Further, the fuel tank filler may also comprise a hose, or a similar arrangement, that extends from the fuel tank, where the hose has an inner

end coupled to the fuel tank, and an outer end through which the fuel is supplied. Alternatively, the fuel may be supplied through the joint first, second, and outer ventilation hoses, i.e. these joint elements may correspond to the fuel tank filler.

[0013] The fuel tank of the high-pressure washer may define a first upper end and a first lower end when the high-pressure washer is placed in the first position, where the first hose connection may be located at the first upper end and the second hose connection may be located at the first lower end. Alternatively or in addition, the fuel tank of the high-pressure washer may define a second upper end and a second lower end when the high-pressure washer is placed in the second position, where the second hose connection may be located at the second upper end and the first hose connection may be located at the second lower end. Therefore, as the liquid fuel, due to the force of gravity, adjusts to changes in the orientation, the suggested placing of the hose connections may ensure that the residual spaces within the fuel tank can be ventilated. As an example, when the high-pressure washer is placed in the first position, the first hose connection will be located at the upper end of the fuel tank. This may allow for a larger amount of fuel in the fuel tank, as the placing may provide an unobstructed passage for an expanding gas in the first residual space, even at fuel volumes close to the volume of the fuel tank.

[0014] The high-pressure washer may further comprise a pump supported by the frame for delivering the liquid under pressure, the pump further comprising a motor for driving the pump; a control unit, the control unit further comprising a control panel; and a cover that in conjunction with the frame prevents parts of or the whole of the heater, the fuel tank, the first ventilation hose, the second ventilation hose, the outer ventilation hose, the fuel tank filler, the pump, and/or the control unit from being reached by hand. The pump may be a piston pump, which may be driven by an electrical motor. The control unit, which is connected to one or more of the other parts of the fuel pump, determines working parameters such as pressure, flow and temperature of the delivered liquid, where the working parameters may be set manually with the associated control panel.

[0015] The high-pressure washer may be in either a resting state or a moving state, and the high-pressure washer may further comprise a specific contact point or surface; a pair of wheels supported by the frame; and a handle connected to and extending from the frame. On a planar surface, the high-pressure washer in the resting state may be supported by the specific contact point or surface and the pair of wheels, while the high-pressure washer in the moving state may be supported by the handle and the pair of wheels. In the resting state the high-pressure washer is at rest relative to its surroundings, while in the moving state it accelerates or moves at a constant velocity relative to its surroundings. The moving state may be achieved by manual work of a person, e.g. where the person supports the handle by hand and pulls the high-pressure washer after him. The pair of wheels may be of the same construction and/or dimensions; and they may be sharing a common central axis of rotation. The wheels and the handle may be mounted - or supported - so that the moving state will be essentially free from force components being perpendicular to the direction of motion the high-pressure washer.

[0016] The resting state and the first position discussed above may define the same orientation of the high-pressure washer, where the handle may extend in a substantially vertical direction. This means that in a moving state, the handle may extend in a direction between the vertical and the horizontal.

[0017] When the high-pressure washer is placed in either the first position or the second position, the first ventilation hose may define a first ventilation path going within the first ventilation hose and having its first endpoint located at the first hose connection and its second endpoint located at the outer hose connection, such that the gravitational potential energy of a mass following the first ventilation path from its first endpoint to its second endpoint increases in a monotonic fashion. Similarly, the second ventilation hose may define a second ventilation path going within the second ventilation hose and having its first endpoint located at the second hose connection and its second endpoint located at the outer hose connection, such that the gravitational potential energy of a mass following the second ventilation path from its first endpoint to its second endpoint increases in a monotonic fashion. Clearly, as a gas trap demands a local minimum of the gravitational potential on the first ventilation path and/or the second ventilation path, the probability for a gas trap to occur in the corresponding hoses is significantly reduced.

[0018] Similarly, when the high-pressure washer is placed in either the first position or the second position, the outer ventilation hose may define an outer ventilation path going within the outer ventilation hose and having its first endpoint located at the outer hose connection and its second endpoint located at the outer opening to the ambient air, such that the gravitational potential energy of a mass following the outer ventilation path from its first endpoint to its second endpoint increases in a monotonic fashion. Clearly, as a gas trap demands a local minimum on the outer ventilation path, the probability for a gas trap to occur in the outer ventilation hose is significantly reduced.

Brief description of the drawings

[0019] Additional objects and features according to the present invention will be more readily apparent from the following detailed description and appended claims, which are presented in conjunction with the drawing, where:

Fig. 1 illustrates a high-pressure washer with a cover in a close position,

Fig. 2 illustrates a high-pressure washer with the cover removed,

Fig. 3 illustrates a high-pressure washer in a moving state,

Fig. 4 illustrates a cross section of a fuel tank for a high-pressure washer, where the fuel tank has a single ventilation hose according to related art and is placed in a horizontal position,

Fig. 5 illustrates a cross section of a fuel tank for a high-pressure washer, where the fuel tank has a first and a second ventilation hose and is placed in a horizontal position,

Fig. 6 illustrates a cross section of a fuel tank for a high-pressure washer, where the fuel tank has a first and a second ventilation hose and is placed in a vertical position,

Fig. 7 illustrates a fuel tank for a high-pressure washer.

Detailed description of the invention

[0020] The exterior of a preferred embodiment of a high-pressure washer is shown in Fig. 1. The high-pressure washer 1 has a frame 2 providing support for its other components, and it is fitted with a cover 11 for protecting the delivery unit. A handle 14 is connected to the frame 2 for making the transport and handling of the high-pressure washer 1 easier. The cover has an opening 33 for receiving a control unit so that the control panel 10 of the unit is reachable by hand. The control panel comprises knobs 17 for manually setting an active operation mode of the high-pressure washer 1. As an example, a first knob may be for turning on and turning off the a heater of the liquid to be delivered, a second knob may be for setting the temperature of the liquid, and a third knob may be for setting the pressure and/or volumetric flow of the liquid. The high-pressure washer 1 has an air inlet-outlet 23 that allows air to reach the fan and heater behind the cover 11. The air inlet-outlet 23 will also enable cooling of the delivery unit by air convection. The cover 11 defines an opening 19 for the exhaust pipe 16 of the heater, where the opening 19 has such dimensions that the exhaust pipe 16 does not reach the cover 11 when it is in its closed position or changed from its closed position.

[0021] A preferred embodiment of a high-pressure washer 1 with its cover removed is shown in Fig. 2. The frame 2 supports the delivery unit 24 comprising a fan 5 driven by an electric motor 6, a pump 8 driven by another electric motor 18 for delivering the liquid under pressure, and a heater 20 for heating the liquid. The fan 24 establishes an airflow in the heater 20 leading out through the exhaust pipe 16. The heater comprises a burner and a heater coil (not shown in Fig. 2) contained within its exterior, where the fuel tank supplies the burner with fuel for combustion. The liquid passes through the heater coil, while the airflow drives the heat of the combustion over the heater coil, thereby providing heating of the liquid. The control unit 9 is supported by the heater 7 so that the high-pressure washer 1 can be easily operated by the control panel 10 even though the cover has been removed.

[0022] In Fig. 3 a side-view of the presently preferred embodiment of the high-pressure washer in Fig. 1 is illustrated. The cover 11 is attached to the frame by a set of screws 22 at the top of the cover and releasable joints at the front bottom 64 of the high-pressure washer. If the screws 22 are released, this means that the cover 11 can be swung open with the turning point at the front bottom 64. In this motion the opening 19 for the exhaust pipe 16 will not reach the exhaust pipe 16, which otherwise could damage the cover 11 if the exhaust pipe 16 is hot. The fuel tank 4 is located at the back of the of the high-pressure washer 1, where the fuel tank is supplied with fuel through the fuel tank filler 15, which is sealed by a lid screwed in place.

[0023] A specific contact area 13 and the pair of wheels 12 will support the high-pressure washer 1 in its vertical position. Another specific contact area 21, which will support the high-pressure washer 1 at rest in its horizontal position, is provided by an element extruding from the fuel tank 4. This extruding element will also fill the function of a hook for supporting winded external hoses or cables, such as a high-pressure cable and an electric cable for supplying the high-pressure washer 1 with electric power. There is a cut-out 65 in the cover 11 that enables a fixedly mounted outlet 20 for the heated high-pressure liquid to be connected to an external high-pressure hose. There is also an inlet 63 for supplying the high-pressure washer 1 with the liquid to be pressurized and delivered by the high-pressure washer 1. The handle 14 connected to the frame 2 will allow the high-pressure washer 1 to be easily shifted from a vertical to a horizontal position, or to be transported by way of its wheels 12. The high-pressure washer 1 in Fig. 3 is in a moving state, in which it can be maneuvered by a person supporting the high-pressure washer by the handle 14.

[0024] A cross-sectional view of a prior art fuel tank 4 for a high-pressure washer is illustrated in Fig. 4. The fuel tank 4 is oriented in a horizontal position. If the fuel tank were to be oriented in a vertical position the hose connection 41 would be at the upper end of the fuel tank 4. The fuel tank 4 is by the hose connection 41 coupled to a ventilation hose 38 having an outer opening 40 at its distal end, which enables ventilation of the fuel tank 4 when it is oriented in its vertical position. However, when the fuel tank 4 is oriented in its horizontal position a residual space 39 may be defined by the wall of the tank 4 and a surface 37 of the fuel 36. Gas may get trapped in the residual space 39, which upon expansion due to an increase in the temperature would press fuel 36 out

through the ventilation hose 41. This leakage may be an inconvenience as the fumes of the fuel 36 can have an unpleasant smell, or can even be hazardous to inhale. The fuel 36 is also flammable and a leakage may therefore increase the risk of accidents involving fire.

[0025] In Fig. 5 a cross-sectional view a preferred embodiment of a fuel tank for a high - pressure washer is illustrated. The tank 4 is similar to that shown in Fig. 4, but provided with a first hose connection 43 and second hose connection 42. A first ventilation hose 45 is coupled to the first hose connection 43, and a second ventilation hose 44 is coupled to the first hose connection 42. The two hoses are in their other ends coupled to an outer hose connection 46, which is also coupled to an outer ventilation hose 47 having an ventilation opening 48. When being in the horizontal position shown in Fig. 5 a second residual space 39 is defined by the wall of the tank 4 and the surface 37 of the fuel 36. Gas in the second residual space 39 will upon expansion be ventilated through the second ventilation hose 44 and the outer ventilation hose 47 to the ambient atmosphere. This will prevent the temperature induced leakage of fuel discussed in relation to Fig. 4.

[0026] The outer hose connection 46 is, when the fuel tank 4 is in its horizontal position, located above the highest point 60 of the fuel tank 4, which in this case coincides with the second hose connection 42. If a sufficient amount of fuel 36 is supplied to the fuel tank 4, some amount of fuel may be contained within the first ventilation hose when the fuel tank is in its horizontal position. However, if the amount of fuel 36 supplied to the fuel tank 4 is such that the fuel surface 37 reaches the second hose connection 42, the fuel contained within the first ventilation hose 45 will not reach the outer hose connection 46, which would otherwise prevent ventilation of gas contained within the second residual space 52.

[0027] A rocking motion of the fuel tank 4 may cause the fuel 36 to be pressed out through one of the hose connections 42 and 43. With both the first ventilation hose 45 and the second ventilation hose 44 connected to the outer hose connection 46, and with the opening 48 of the outer ventilation hose located above the outer hose connection 46, the fuel pressed through the first ventilation hose will enter the second ventilation hose, and vice versa, instead of being pressed out through the outer ventilation hose 47. Clearly, leakage of fuel 36 due to rocking motions of the fuel tank 4 is prevented by the presently preferred embodiment. In another embodiment it may be sufficient to have the outer hose connection 46 oriented so that the coupling between the outer hose connection 46 and the outer ventilation hose is located on its upper side to prevent such leakage.

[0028] A cross-sectional view a preferred embodiment of the fuel tank in its vertical position is shown in Fig. 6, where the most of the indexing of the elements and features is the same as in Fig. 5. A first residual space 49 is defined by the wall of the tank 4 and the surface 37 of the fuel 36. Gas in the first residual space 49 will upon expansion be ventilated through the first ventilation hose 45 and the outer ventilation hose 47 to the ambient atmosphere. This will prevent the temperature induced leakage of fuel discussed above when the fuel tank is oriented in its vertical position. However, the outer hose connection 46 is locate below the first hose connection 43, while the opening 48 of the outer ventilation hose 47 is located above the highest point 58 of the fuel tank 4, which means that when the fuel tank is filled close to its highest point 58, the placing of the outer hose connection will cause gas to be trapped in the first residual space. Therefore, the gas may upon expansion cause liquid fuel 36 to leak from the tank 4. In alternative embodiment, this may be avoided simply shifting the outer hose connection 46 so that it is located higher than the first hose connection.

[0029] The second ventilation hose 44 may, in a particular embodiment, be of a transparent material. This will allow the second ventilation hose 44 to be used as a fuel level indicator as the fuel surface 37 inside the tank 4 will be on the same level as in the in the second ventilation hose.

[0030] Fig. 7 illustrates a presently preferred embodiment of a fuel tank 4 for a high-pressure washer seen from the backside 62 which faces the rest of the high-pressure washer when mounted and in a vertical position. The fuel tank 4 has a fuel tank filler 15, which is sealable with a screw lid 61. The outer hose connection 46 has the form of a T-junction, where the first ventilation hose 45 and one of the three legs of the T-junction constitutes the same element. This means that the outer hose connection 46 is connected directly to the first hose connection 43 by the same leg. The first hose connection 43 is located at one of the highest points 58 of the fuel tank 4, while the second hose connection 42 is located at the lowest point 57. The second ventilation hose 44 is coupled to the second hose connection 42 at one end, and to one of the legs of the outer hose connection 46 at the other end. The remaining leg of the outer hose connection 46 is coupled to the outer ventilation hose 47, which terminates in an opening 48. A fuel hose 55 is connected to the fuel tank 4 by a fuel hose connection 54 located at the lowest point 57 of the fuel tank 4. This way, fuel can be tapped from the fuel tank 4 through the opening 56 of the fuel hose 55. The backside 62 of the fuel tank 4 has been profiled to closely fit the other components and features of the high-pressure washer, which gives a larger volume as compared to that of non-profiled fuel tank. Further, the backside 62 also has grooves into which the second ventilation hose and the fuel hose fit closely into. A fuel level indicator 53 in the form of a transparent tube is connected to the fuel tank 4 at its lowest point 57.

[0031] The term "supported" is to be understood as if a second item is supported by a first item, and a third item is supported by the same first item, then the third item may be supported by the second item, which in turn is supported by the first item. Additionally or alternatively,

the second item may be supported by the third item, which in turn is supported by the first item. As an example, if it is stated that the delivery unit and the control unit are supported by the frame; then the delivery unit and the control unit are individually supported by the frame, or the control unit is supported by the delivery unit, which in turn is supported by the frame; or the delivery unit is supported by the control unit, which in turn is supported by the frame.

[0032] Here, the prepositions "above" and "below" are to be understood as corresponding to a displacement having vertical component and a horizontal component, where the latter component may be infinitesimal. Further, the term "supported" is to be understood as if a second item is supported by a first item, and a third item is supported by the same first item, then the third item may be supported by the second item, which in turn is supported by the first item. Additionally or alternatively, the second item may be supported by the third item, which in turn is supported by the first item. As an example, if it is stated that the fuel tank and the heater are supported by the frame; then the fuel tank and the heater are individually supported by the frame, or the fuel tank is supported by the heater, which in turn is supported by the frame; or the heater is supported by the fuel tank, which in turn is supported by the frame.

[0033] Further, the term "hose" may be regarded as a device suitable for conveying a liquid or a gas from one location to another location. The hose may be elongated and the shape and/or the size of the cross section of the hose may vary along its length. Further, the hose may be of a flexible as well as an inflexible material. Synonyms for hose may be pipe, pipeline, cylinder, conduit, channel, or tube.

Claims

1. A high-pressure washer (1) for delivering a liquid, where said high-pressure washer (1) can be placed in a first position and a second position, and said high-pressure washer comprising:

(a) a frame (2),
(b) a heater (7), supported by said frame (2), for providing heating for said liquid by combustion,
(c) a fuel tank (4), supported by said frame (2) and having an inside and an outside, for storing a fuel (36) for said heater (7), said fuel tank (4) having a first hose connection (43) and a second hose connection (42),
(d) an outer hose connection (46) located outside said fuel tank,
(e) a first ventilation hose (45) coupled to said first hose connection (43) and to said outer hose connection (46),
(f) a second ventilation hose (44) coupled to said second hose connection (42) and to said outer hose connection (46), and
(g) an outer ventilation hose (47) coupled to said outer hose connection (46) and having an outer opening (48) to the ambient air,

where an amount of fuel (36), supplied to said fuel tank (4), defines a first fuel surface (37) located inside said fuel tank when said high-pressure washer (1) is placed in said first position, and a second fuel surface (37) located inside said fuel tank when said high-pressure washer (1) is placed in said second position;
where:

said fuel tank (4) in conjunction with said amount of fuel (36) defining a first residual space (49) within said fuel tank (4) and above said first fuel surface (37) when said high-pressure washer (1) is placed in said first position,
said fuel tank (4) in conjunction with said amount of fuel (36) defining a second residual space (52) within said fuel tank (4) and above said second fuel surface (37) when said high-pressure washer (1) is placed in said second position,
said first residual space (49) contains a first amount of a gas,
said second residual space (52) contains a second amount of gas;
said first (43), second (42) and outer (46) hose connections, and said first (45), second (44) and outer (47) ventilation hoses are of such a construction and located so that:
said first amount of gas upon expansion is ventilated through said first ventilation hose (45) and said outer ventilation hose (47) to the ambient air, and
said second amount of gas upon expansion is ventilated through said second ventilation hose (44) and said outer ventilation hose (47) to the ambient air.

2. A high-pressure washer (1) according to claim 1, wherein said first amount of gas upon expansion is ventilated also through said second ventilation hose (44) and said outer ventilation hose (47) to the ambient air, and/or said second amount of gas upon expansion is ventilated also through said first ventilation (45) hose and said outer ventilation hose to (47) the ambient air.

3. A high-pressure washer (1) according to any of the claims 1 to 2, wherein said outer hose connection (46) is located above said first hose connection (43) when said high-pressure washer (1) is placed in said first position; and/or said outer hose connection (46) is located above said second hose connection (42) when said high-pressure washer (1) is placed in said second position.

4. A high-pressure washer (1) according to any of the claims 1 to 3, wherein said second ventilation hose (44), when said high-pressure washer (1) is placed in said first position, reaches a point above said first hose connection (43) before being coupled to said outer hose connection (46), and/or said second ventilation hose (44), when said high-pressure washer (1) is placed in said second position, reaches a point above said second hose connection (42) before being coupled to said outer hose connection (46).

5. A high-pressure washer (1) according to any of the claims 1 to 4, further comprising;

(h) a fuel tank filler (15) for enabling the filling of said fuel tank (4) with said fuel (36),

whereby a maximum amount of fuel is defined as the largest amount of fuel (36) that can be provided to said fuel tank (4) by employing said fuel tank filler (15); where said maximum amount of fuel, when provided to said fuel tank (4), defines a first maximum fuel surface inside said fuel tank when said high-pressure washer (1) is placed in said first position, and a second maximum fuel surface inside said fuel tank (4) when said high-pressure washer (1) is placed in said second position; and/or said first hose connection (43) is located above said first maximum fuel surface when said high-pressure washer (1) is placed in said first position, and said second hose connection (42) is located above said second maximum fuel surface when said high-pressure washer (1) is placed in said second position.

6. A high-pressure washer (1) according to any of the claims 1 to 5, wherein said fuel tank (4) defines a first upper end (58) and a first lower end when said high-pressure washer (1) is placed in said first position, where said first hose connection (43) is located at said first upper (58) end and said second hose connection (42) is located at said first lower end, and/or said fuel tank (4) defines a second upper end (60) and a second lower end when said high-pressure washer (1) is placed in said second position, where said second hose connection (42) is located at said second upper end (60) and said first hose connection (43) located at said second lower end

7. A high-pressure washer (1) according to any of the claims 1 to 6, wherein said high-pressure washer (1) further comprising:

(i) a pump (8), supported by said frame (2), for delivering said liquid under pressure, said pump (8) further comprising a motor (18) for driving said pump,
(j) a control unit, said control unit (9) further comprising a control panel (10), and
(k) a cover (11), in conjunction with said frame (2), preventing parts of or the whole of said heater (3), said fuel tank (4), said first ventilation hose (45), said second ventilation hose (44), said outer ventilation hose (47), said fuel tank filler (15), said pump (8), and/or said control unit (9) from being reached by hand.

8. A high-pressure washer (1) according to any of the claims 1 to 7, wherein said high-pressure washer () can be in a resting state and a moving state, and said high-pressure washer further comprising:

(l) a specific contact point or surface (13, 21),
(m)a pair of wheels (12) supported by said frame (2), and
(n) a handle (14) connected to and extending from said frame (2),

where, on a planar surface, said high-pressure washer (1) in said resting state is supported by said specific contact point or surface (13, 21) and said pair of wheels (12), and said high-pressure washer (1) in said moving state is supported by said handle (14) and said pair of wheels (12).

9. A high-pressure washer (1) according to claim 8, wherein said resting state and said first position defines the same orientation of said high-pressure washer (1), and said handle (14) extends in a substantially vertical direction.

10. A high-pressure washer (1) according to any of the claims 1 to 9, wherein, when said high-pressure washer (1) is placed in either of said first position or said second position,
said first ventilation hose (45) defines a first ventilation path going within said first ventilation hose (45) and having its first endpoint located at said first hose connection (43) and its second endpoint located at said outer hose connection (46), such that the gravitational potential energy of a mass following said first ventilation path from its first endpoint to its second endpoint increases in a monotonic fashion, and said second ventilation hose (44) defines a second ventilation path going within said second ventilation hose (44) and having its first endpoint located at said second hose connection (42) and its second endpoint located at said outer hose connection (43), such that the gravitational potential energy of a mass following said second ventilation path from its first endpoint to its second endpoint increases in a monotonic fashion.

11. A high-pressure washer (1) according to any of the claims 1 to 10, wherein, when said high-pressure washer () is placed in either of said first position or said second position,

said outer ventilation hose (47) defines an outer ventilation path going within said outer ventilation hose (47) and having its first endpoint located at said outer hose connection (46) and its second endpoint located at said outer opening (48) to the ambient air, such that the gravitational potential energy of a mass following said outer ventilation path from its first endpoint to its second endpoint increases in a monotonic fashion.

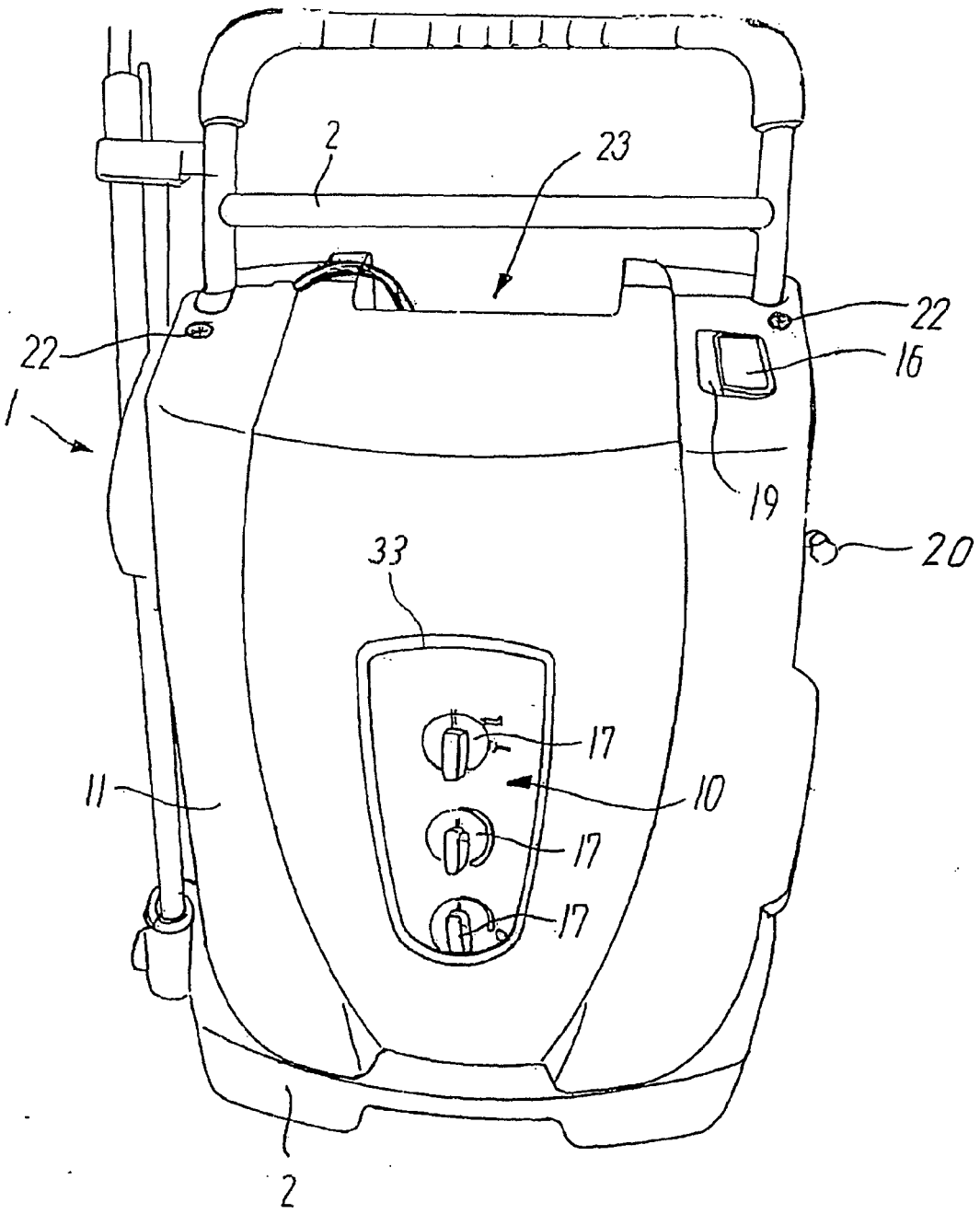

FIG.1

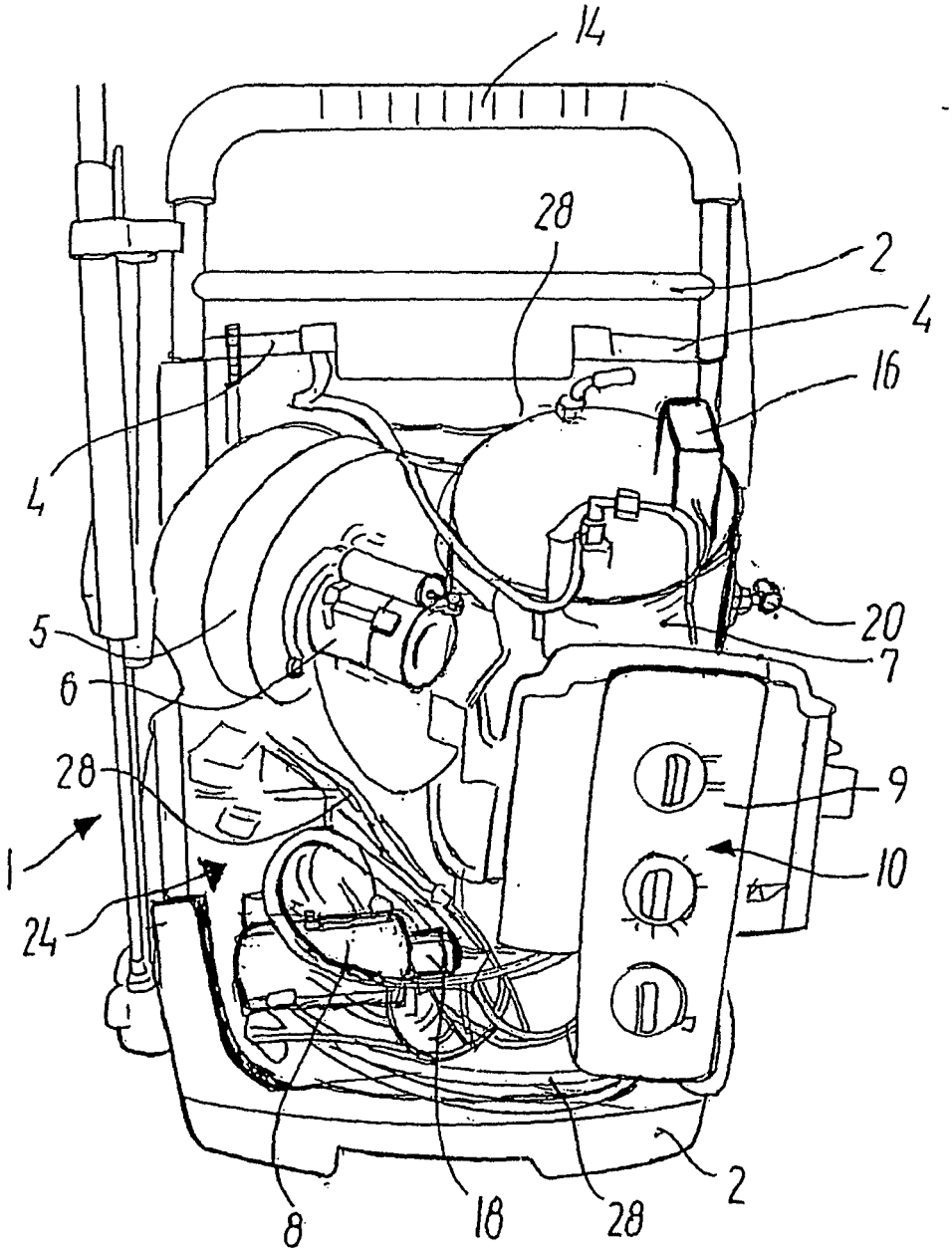

FIG. 2

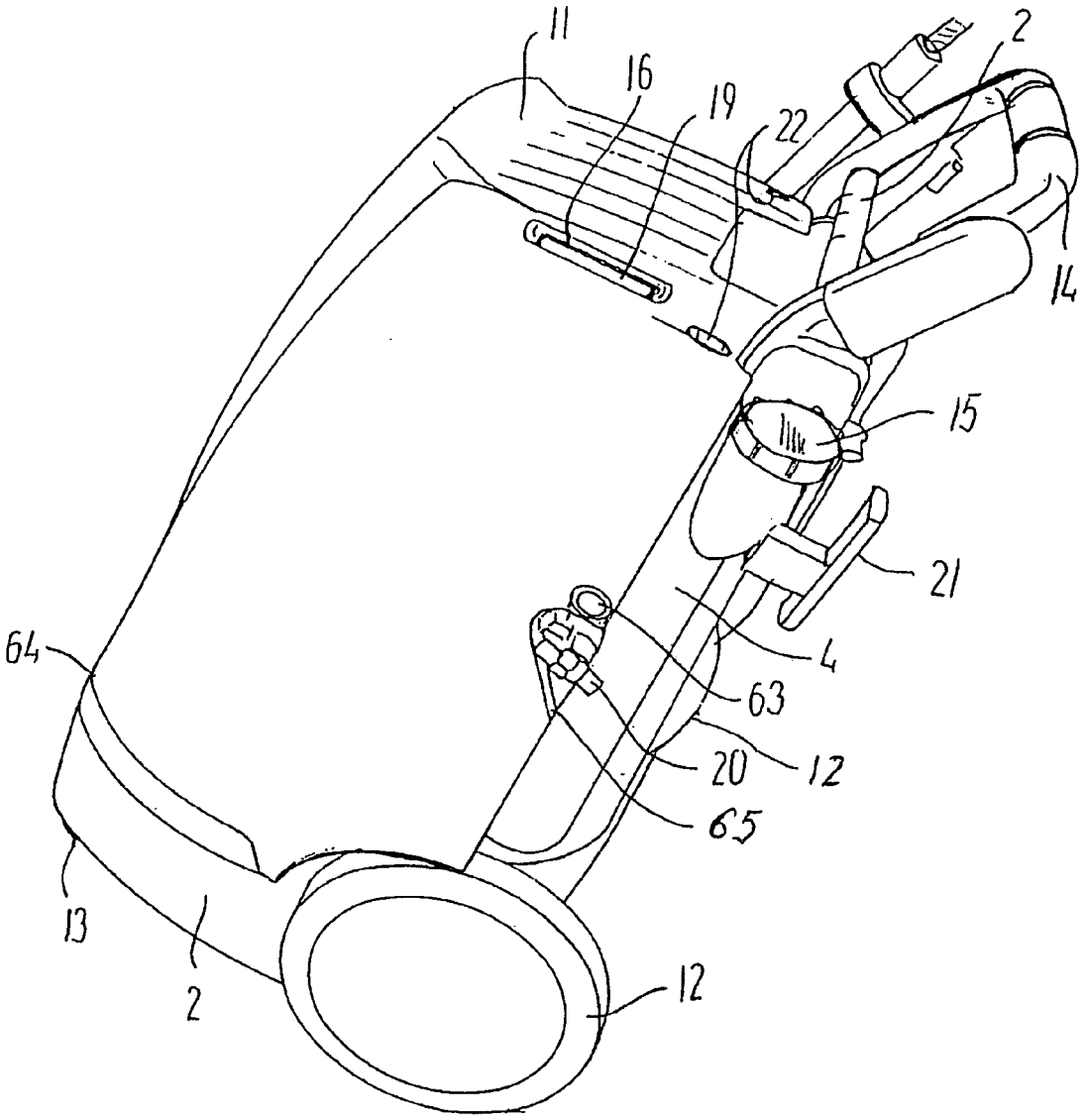

FIG.3

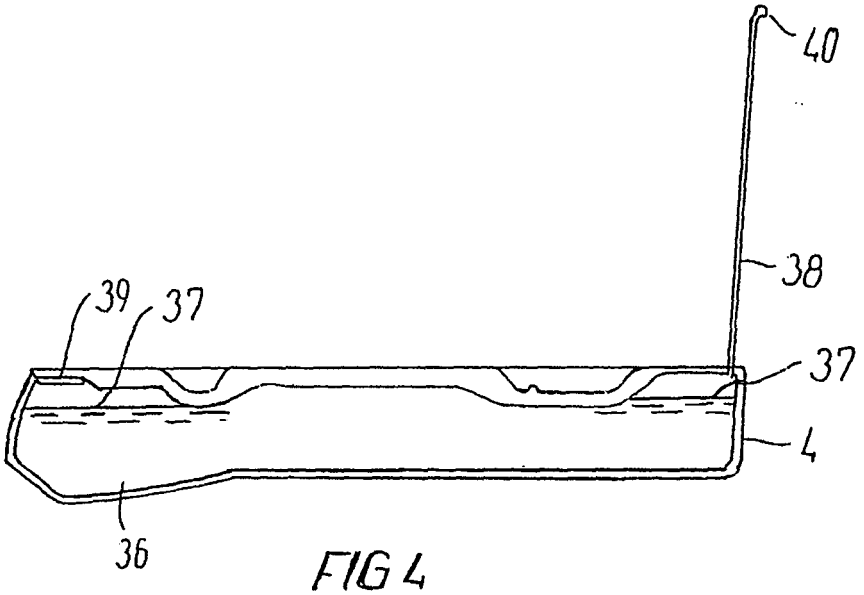

FIG 4

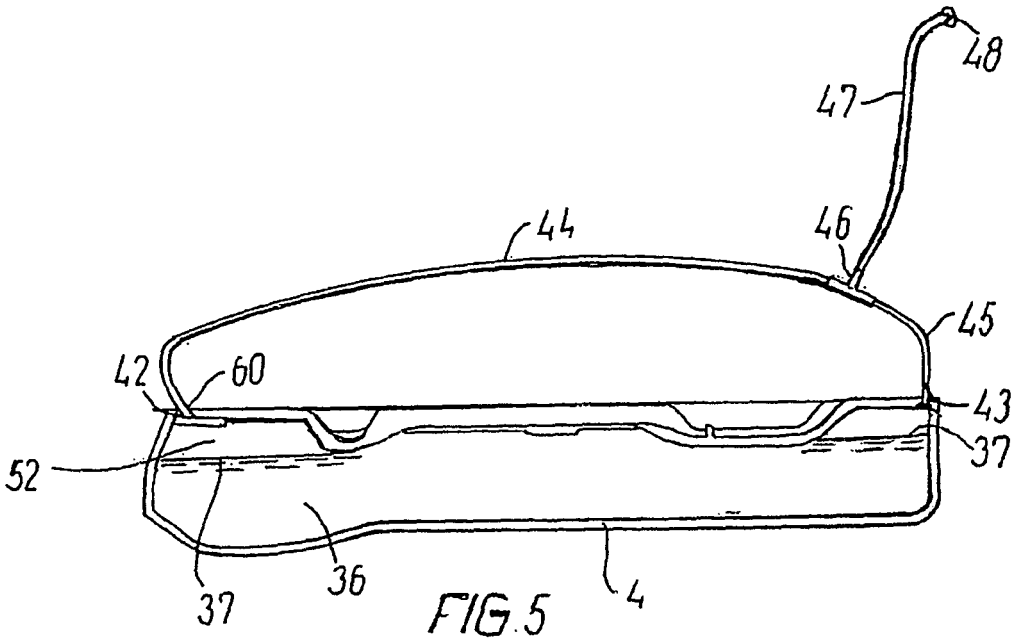

FIG.5

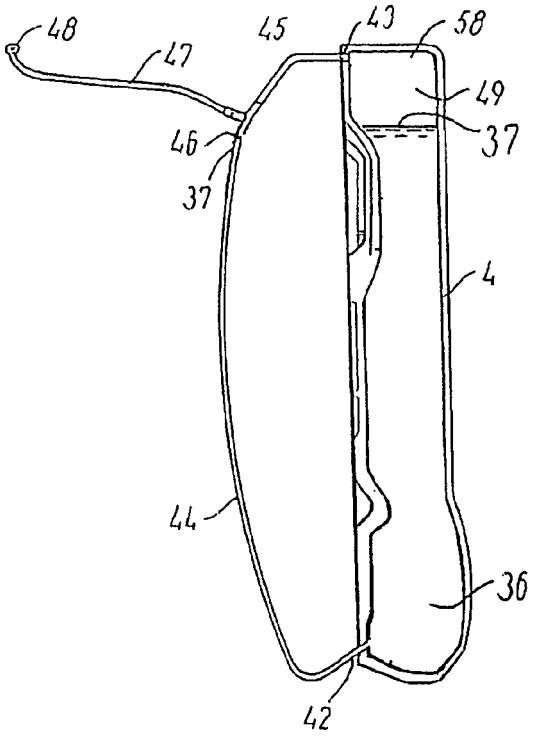
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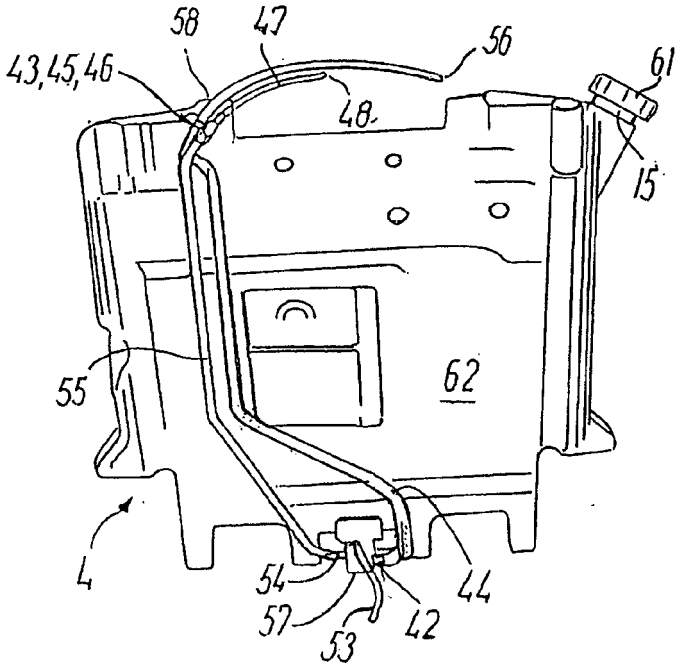
FIG. 6


58
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43,45,46
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FIG 7

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EUROPEAN SEARCH REPORT

Application Number
EP 08 01 3001

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			B08B B60K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 November 2008	Muller, Gérard

CATEGORY OF CITED DOCUMENTS

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21-11-2008

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