Aug. 19, 1941. M. HURST 2,253,467

LIQUID SUPPLY CONTAINER

Filed July 9, 1938

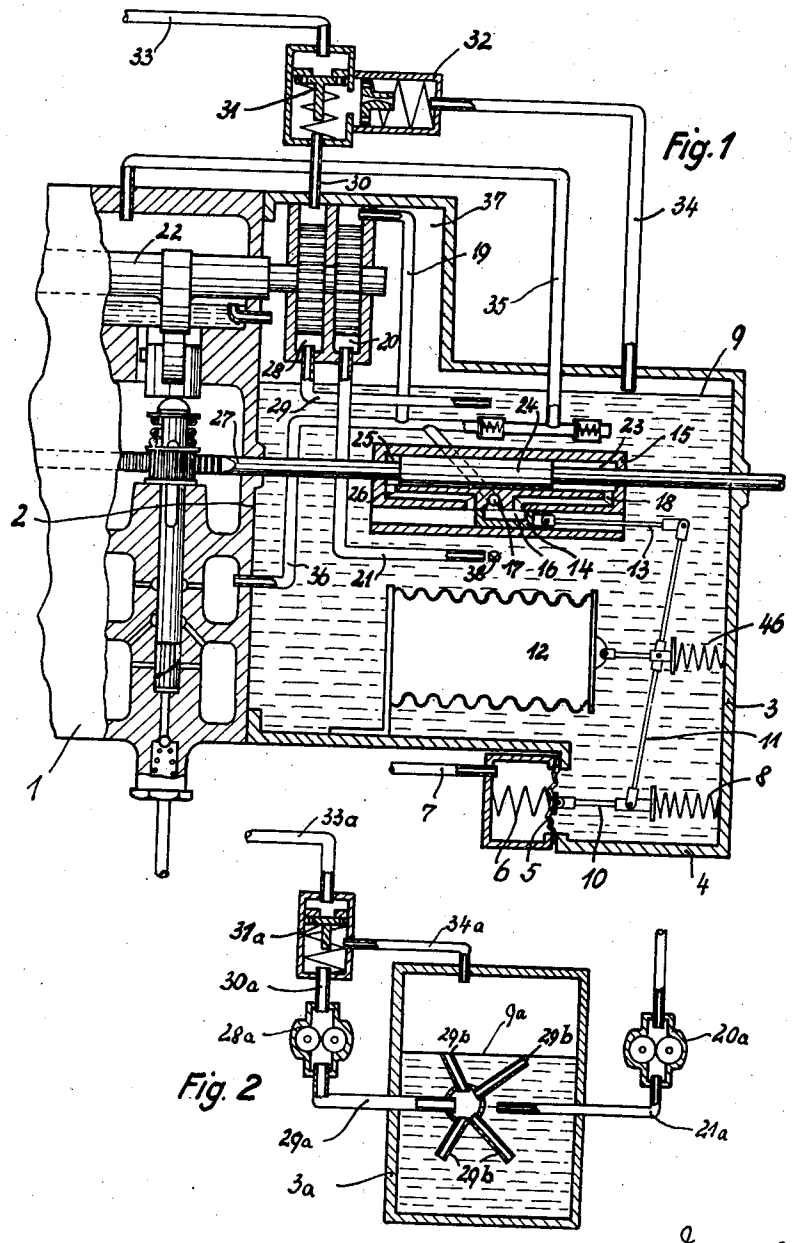


Fig. 1

Fig. 2

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Patented Aug. 19, 1941 2,253,467

UNITED STATES PATENT OFFICE

2,253,467

LIQUID SUPPLY CONTAINER

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Application July 9, 1938, Serial No. 218,430
In Germany July 22, 1937

17 Claims. (Cl. 123—140)

The present invention relates to oil and other liquid supply containers, of the type wherein the quantities of liquid consumed are automatically made up again, from an inflow pipe which opens into the container, as soon as the liquid level has reached a predetermined point or limit, which can vary with the position of the container.

Known containers of the type, such as carburettors with float valves, no longer work reliably when the inclination of the container relative to the liquid level becomes too large. This is the case, for instance, when a vehicle with a carburettor is travelling up a very steep gradient. However, containers of this kind are really not usable in aircraft which have to fly in a climbing position or diving position or even upside down.

The purpose of the invention is to eliminate these drawbacks and to produce a container of the said type in which reliable operation is afforded in any desired position of use. The container is specially intended to be suitable as an oil supply vessel for the governor of injection pumps in aero-engines where it is necessary to supply, for instance, a servomotor for strengthening the governing forces, with adequate quantities of oil in any desired position. According to the present invention, this is obtained by simple means through a constantly driven pump the suction pipe of which commences in or opens into the container and the delivery pipe of which opens into the inflow pipe in such a way that the pump counteracts the pressure prevailing in the inflow pipe and cuts off this pipe as long as the end of the suction pipe dips into the liquid in the container, but which is no longer able to cut off the inflow pipe as soon as the delivery pressure of the pump has decreased correspondingly when the suction pipe emerges from or is no longer covered by the liquid.

The drawing illustrates several examples of construction of the invention.

Figure 1 is a section through a liquid container built on to an injection pump.

Figure 2 is another form of construction of the liquid container.

1 is an injection pump, to the end 2 of which is flanged a liquid container 3. In the lower part 4 of the container is secured a flexible membrane 5. On one side, this membrane is under the influence of a spring 6 and of the induction pressure of an engine (not shown), the induction pipe of which is connected through a pipe 7 with the casing part 4. The spring 6 and the vacuum in the induction pipe of the engine are counteracted on the other side of the flexible membrane 5 by a weaker spring 8 and the air pressure prevailing in the casing. The air pressure corresponds roughly to that of the atmosphere, since the casing is always in communication with the atmosphere through an opening not shown. With this arrangement the small negligible static pressure which the oil present in the container exerts on the flexible membrane can be disregarded. The opening (not shown) in the casing can lead to the exterior, through a U-shaped pipe or a non-return valve, for instance, so that the container does not run empty even when it is placed upside down.

To a rod 10, which provides the connection between the flexible membrane 5 and the spring 8, there is pivotally connected a lever 11 which is rotatably mounted at about its centre on one end of an aneroid capsule 12. The upper end of the lever 11 is connected through a rod 13 with an adjusting member 14 of a servomotor or booster 15. When the external air pressure decreases, the aneroid capsule 12 expands against the action of a spring 46 and moves the adjusting member 14 to the right in Figure 1. The same action also occurs when the vacuum in the induction pipe of the engine increases and the flexible membrane 5 consequently sags to the left (in Figure 1) and in so doing takes with it the other end of the lever 11. In both cases, as will be explained further hereafter, a servomotor 15 which strengthens the control forces of the governor is intended to set the injection pump to a decrease of the injection amount corresponding to the decrease in the weight of air sucked in.

On the opposite movement of the aneroid capsule 12 or of the flexible membrane 5, the converse movement of the adjusting member 14 occurs in a corresponding way. The movement of the aneroid capsule 12 and of the flexible membrane 5 may also naturally, under certain circumstances, be terminated in such a way that the adjusting member 14 remains inoperative. Alternatively, the movements may be so supplemented that they both operate at the same time in the same direction upon the adjusting member 14 and impart a particularly large adjusting movement to it.

In Figure 1 the adjusting member 14 occupies its right hand end position, in which its inner space 16 is in communication both with an opening 17 of the stationary part of the booster 15 and with a duct 18. The opening 17 is connected to a delivery pipe 19 of a toothed wheel

pump 20, the suction pipe of which is a pipe 21. In the example of construction shown, the toothed wheel pump 20 is driven directly by the cam shaft 22 of the injection pump 1, and thus always operates as soon as the engine operates. It delivers oil from the oil supply 9 in the container 3, and, in the position shown of the adjusting member or slide valve 14, it pumps oil through the opening 17 and the duct 18 into a cylindrical space 23, which in Figure 1 is located at the right of a piston 24. As a result, the piston 24 moves to the left and pushes the quantity of oil, which is contained in a space 25 to the left of the piston 24, through a duct 26 back into the container 3. When this happens, the injection pump is set in known manner to a decrease of the injection amount by means of a control rod 27 secured to the piston. If, on the other hand, owing to compression of the aneroid capsule (higher atmospheric pressure) or owing to a pressure increase in the induction pipe of the engine (opening of a throttle valve not shown), the slide valve 14 is moved into its left hand end position, then the oil delivered by the pump passes through the opening 17, 16 at 26 into the booster. It reaches the space 25 and pushes the piston 24 to the right in Figure 1, whereby the oil present in the space 23 can flow back into the oil supply 9 through the duct 18, which is now open. On the right hand movement of the piston 24, the injection pump is set to a large delivery amount through the control rod 27. If the adjusting member 14 reaches its middle position or intermediate positions owing to the movement of the aneroid capsule or of the flexible membrane, then oil can flow from the recess 16 to both sides of the piston. By this means, the middle position of the piston and also other intermediate positions occur.

Near the pump 20 is disposed a second toothed wheel pump 28, which is driven in the same way as the pump 20. The pump 28 has a suction pipe 29, the end of which, in the container position according to Figure 1, is situated directly below the liquid level 9. The pressure pipe 30 of the pump 28 leads to a valve 31, which is installed in an inflow pipe 33. The inflow pipe is a branch of the lubricating plant (not shown) of the engine. The inflow pressure, with this arrangement, can amount to between 1 and 6 atmospheres absolute pressure. In the example of construction, the valve 31 is constructed as a non-return valve and is set to about 0.2 atmospheres absolute pressure. In Figure 1, there is installed in the right of the valve casing a throttle 32, the throttle cross section of which is so small that at all speeds of the pump occurring during operation the oil pressure produced by the pump in the valve casing is somewhat larger than the presure prevailing in the pipe 33. In order that the oil pressure produced by the pump 28 may not become unnecessarily large at the higher speeds of the pump and with enlarged oil delivery, the throttle 32 is constructed at the same time as a valve which opens at a slightly higher pressure, of, for instance, a little more than 6 atmospheres absolute pressure (see Figure 1). The oil flowing through the throttle 32 passes back to the container through a pipe 34.

With the oil level 9 shown in Figure 1, the pump 28 sucks up oil through its suction pipe 29, which is situated just under the liquid level, and forces it towards the valve 31. The valve 31 is kept closed by the liquid pressure so produced, and thus the inflow pipe 33 is cut off, so that the oil delivered flows back into the container 3 through the inflow pipe 34. In this way, the oil level would always be maintained in the container, if oil were not required at the same time for lubricating purposes. In the example of construction according to Figure 1, a pipe 35 and a pipe 36 branch off from the delivery pipe 19 of the oil pump 20, which delivery pipe leads to the booster 15. The pipe 35 conducts lubricating oil to the cam shaft of the injection pump, and lubricating oil is fed through the pipe branch 36 to the chambers which surround the pistons of the injection pump. As soon as so much oil has been consumed that the end of the suction pipe 29 emerges from or is no longer covered by the fluid, the pump 28 sucks up air instead of oil. Since by sucking up the same volume of air, which can be compressed, instead of oil as previously, a smaller pressure is now obtained in the delivery pipe 30, the valve 31 opens under the pressure of the oil in the inflow pipe 33, so that oil now passes from the inflow pipe through the valve 31, the throttle 32, and the pipe 34 into the container 3. This automatic replenishing of the oil is only interrupted again when the liquid level has again become so high that the free end of the suction pipe 29 again dips into or is covered by the oil. The pump 28 can then deliver oil again and hereby produce in the delivery pipe 30 a pressure which is high enough to close the valve 31 and thus to prevent the further filling up of the container with oil. If the inflow of oil to the container were not cut off, then the container could fill up completely with oil and a pressure would be produced therein which would prevent the correct working of the governor and of the aneroid capsule 12.

In Figure 1, the free end of the suction pipe 29 is located in the container 3 above the suction end of the suction pipe 21 of the second pump 20, so that, even with the container inclined, the open end of the suction pipe 29 is not uncovered by or does not emerge from the fluid. Even if the container 3 were turned completely upside down, in the present example of construction the end of the induction pipe 29 would be covered by and would not emerge from the liquid for the following reason.

In the normal position of use, the free end of the suction pipe 29 is located comparatively well up in the container, so that the volume of the container present above the oil level 9 is fairly small. On the other hand, in the same position of use, the space below the inlet end of the suction pipe 21 of the consumption pump 20 is comparatively large, and, in fact, larger than the space above the oil level 9 in Figure 1. By this means it is ensured that even when the container 3 is upside down, the oil level is so high that the suction pipe 21 remains with its open end within the oil supply 9. In this position, the consumption pump 20 can suck up oil until the oil level of the container, which is upside down, has sunk to the open end of the suction pipe 21. This is the case in the example of construction shown in Figure 1 when the container is still only about half full of fluid. Thus, even if the container was kept upside down for several hours without interruption, the oil supply could advance to this level without the supply of oil to vital parts of the plant being interrupted. In practice, however, it will never occur that the container remains so long in an abnormal position, so that there is no danger that the lubri-

cation might be interrupted, even for only a short time, on account of lack of oil in the container.

From the longitudinal section through the container **3** shown in Figure 1, it can be seen that the inner space of the container is roughly symmetrical in the plane of section. For the middle part of the container is almost rectangular, and the free space of the lower part **4** of the container is approximately as large as the upper free space **37** about the two toothed wheel pumps **20** and **28**. Thus, when the container tilts approximately the same quantity of liquid can always flow into the space **37** which flows out of the space **4**, and vice versa. In addition, in the roughly rectangular central part of the container the parts **12**, **11** are disposed roughly symmetrically to the approximate centre or centre of gravity **38** of the inner space of the container. Further, in the plane perpendicular to the plane of the drawing, attention is also appropriately given in the same way to the fact that the parts of the inner space or of the installations located in front of and behind the centre of gravity **38** are approximately the same.

In another form of construction according to Figure 2, the free end of the suction pipe **21***a* of the consumption pump **20***a*, which supplies the oil to the lubricating points and to any other consumption points, begins approximately in the centre of the container **3***a*. The suction pipe **29***a*, on the other hand, opens into the container with a plurality of ends **29***b*, which are disposed so as to be distributed in all directions in the space about the end of the suction pipe **29***a*. If all the ends **29***b* are below the fluid level **9***a*, then a large amount of fluid is sucked up by the pump **28***a*, and there occurs a high pressure in the pressure pipe **30***a*, which is connected with the container **3***a* by a comparatively narrow or restricted pipe **34***a* which acts as a throttle. This pressure is larger than the pressure in the inflow pipe **33***a*, so that the valve **31***a* is closed by it. If, however, all of the, for instance, six, ends **29***b* (two of which are not shown because they are located in planes above and below the plane of the drawing, respectively) are not situated below the fluid level, less fluid is delivered. In this case, there arises in the delivery pipe **30***a* only a fairly small pressure, because the smaller amount of liquid can flow faster through the restricted pipe **34***a* into the container **3***a*. At the smaller pressure, the valve **31***a* now opens, and so much liquid flows through the valve **31***a* and the pipe **34***a* until all the ends **29***b* of the suction pipe **29***a* have again become completely submerged in the liquid and can no longer deliver any air, i. e. until the liquid content of the container has again become sufficiently large. In this way, the end of the induction pipe **21***a* of the consumption pump **20***a* can never emerge from the fluid level.

I declare that what I claim is:

1. A liquid supply container including a pump, a suction pipe connected to said pump and having an inlet end in said container, and means to automatically supply liquid to said container when the inlet end of said suction pipe is uncovered by the liquid in said container, irrespective of the position of the container, a second pump for delivering liquid to a liquid-using device, and a suction pipe for said second pump, the inlet end of which is located in the approximate centre of the container and at a substantially lower level than the inlet end of said first-mentioned suction pipe in the normal position of said container.

2. A container for oil for use with internal combustion engines for vehicles, including a pump, a suction pipe connected to said pump and opening into said container, means connected to said container to automatically supply oil thereto when the inlet end of said suction pipe is uncovered by oil irrespective of the position of the container, an oil operated governing servomotor, a fuel injection pump receiving oil from said container and governed by said servomotor, a third pump adapted to supply oil for lubrication of said injection pump and to deliver oil under pressure for operating said servomotor, and a suction pipe, connected to said third pump, the inlet end of which pipe is located in the approximate centre of the container and at a substantially lower level than the inlet end of said first-mentioned suction pipe in the normal position of said container.

3. A container as set forth in claim 2 which is flanged on to said injection pump at the side of the casing thereof.

4. A container as set forth in claim 2 in which the governing servomotor includes means arranged within said container and responsive to the pressure in the induction pipe of said internal combustion engine for controlling said servomotor.

5. A container as set forth in claim 2 in which the first and third pumps, the governing servomotor and the connecting pipes are disposed within the container.

6. A container as set forth in claim 2 which is roughly symmetrical and in which the governing servomotor includes means for controlling the same, said controlling means, servomotor, the first and third pumps and the connecting pipes being disposed roughly symmetrically to the centre of the container

7. In a fuel supply system for internal combustion engines, a container, means for supplying liquid to said container, means to maintain a predetermined quantity of liquid therein irrespective of the position of said container and without any substantial increase in pressure therein, a fuel injection pump having fuel delivery adjusting means, a governor, a servomotor controlled by said governer and adapted to displace said adjusting means, a pump adapted to supply liquid from said container for operating said servomotor, and a suction pipe, connected to said latter pump, the inlet end of which pipe opens into a central portion of said container, the quantity of liquid maintained in said container normally being sufficient to keep said inlet end covered with liquid.

8. In a fuel supply system for internal combustion engines, a container, a source of liquid under pressure connected to said container, means for maintaining a predetermined quantity of liquid in said container irrespective of the position of said container and without any substantial increase of pressure therein, a fuel injection pump, having fuel delivery adjusting means, for supplying fuel to said engine, a governor subject to the pressure in said container, a governing servomotor mounted in said container and controlled by said governor for displacing said adjusting means, a pump, mounted in said container, for supplying liquid from said container for operating said servomotor, and a suction pipe, connected to said latter pump, the inlet end of which pipe opens into a central por-

tion of said container, the quantity of liquid maintained in said container normally being sufficient to keep said inlet end covered with liquid.

9. In a fuel supply system for internal combustion engines, a container, a source of lubricating oil under pressure connected to said container, means for maintaining a predetermined quantity of lubricating oil in said container irrespective of the position of said container and without any substantial increase of pressure therein, a governor subject to the pressure in said container and to the pressure in the intake pipe of the engine for controlling the speed of said engine, a governing servomotor controlled by said governor, a fuel injection pump, controlled by said servomotor, for supplying fuel to said engine, a second pump for supplying oil from said container for lubrication of said injection pump and for operation of said servomotor, and a suction pipe connected to said second pump, the inlet end of which pipe opens into a central portion of said container, the quantity of liquid maintained in said container normally being sufficient to keep said inlet end covered with liquid.

10. In a fuel supply system for internal combustion engines, a container, a source of liquid under pressure, an inflow pipe connecting said source with said container, a valve in said pipe, a constantly driven pump, a suction pipe connected to said pump and opening into said container, a delivery pipe connected to said pump and to said valve, said pump operable to deliver liquid under pressure from said container to said valve and maintain it in a position cutting off supply of liquid from said source to said container as long as the inlet end of said suction pipe is submerged in liquid in said container, said pump permitting said valve to open and supply liquid to said container when the inlet end of said suction pipe is no longer submerged in liquid in said container, a governor, a governing servomotor controlled by said governor, a fuel injection pump controlled by said servomotor, a third pump adapted to supply liquid from said container for operating said servomotor, and a suction pipe, connected to said third pump, the inlet end of which opens into a central portion of said container and at a substantially lower level than the inlet end of said first-mentioned suction pipe in the normal position of said container.

11. A liquid container, a liquid supply pipe leading into said container, a valve within said pipe opening in the direction of the container, throttle means between said valve and said container, a pump having a suction pipe and a delivery pipe, said suction pipe having an inlet end in the interior of said container and said delivery pipe leading into said supply pipe between the valve and the throttle means, and said throttle means being so dimensioned that the pressure in the delivery pipe automatically closes said valve against the opening pressure in the supply pipe in front of the valve as soon and as long as the liquid level within said container is high enough to cover the inlet end of said suction pipe with liquid.

12. A liquid container according to claim 11, in which the suction pipe of the pump has a plurality of inlet openings within the casing.

13. A liquid container according to claim 11, in which the inlet opening of the suction pipe is so situated that the space above it, viewed from the normal position of the container, is smaller than the space below it.

14. A liquid container according to claim 11, in combination with a second pump, a third pump, and common means for driving said pumps.

15. A liquid container as set out in claim 11, in which said pump is enclosed within said container.

16. A liquid container according to claim 11, in which said throttle means is movable to widen the throttle opening when the pressure on said throttle means exceeds a predetermined amount.

17. A container for oil for use with internal combustion engines for vehicles, including a pump, a suction pipe connected to said pump and having an inlet end opening into said container, means to automatically supply oil to said container when the inlet end of said suction pipe is uncovered by oil in said container irrespective of the position of said container, an oil operated governing servomotor, a fuel injection pump controlled by said servomotor, a third pump adapted to deliver oil under pressure for operating said servomotor, and a suction pipe, connected to said third pump, the inlet end of which pipe is located in the approximate center of said container, and at a substantially lower level than the inlet end of said first-mentioned suction pipe in the normal position of said container.

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