

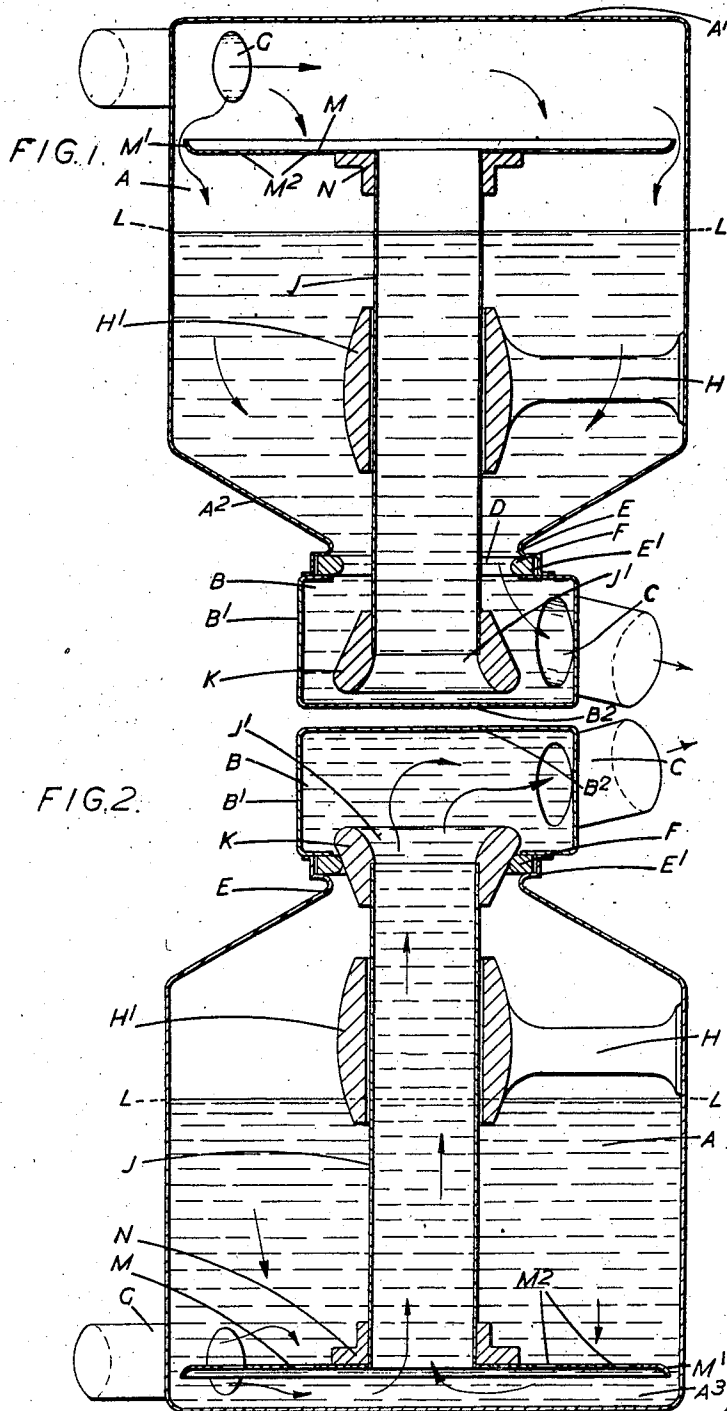
July 9, 1946.

C. L. COWDREY ET AL

2,403,850

TANK

Filed Feb. 14, 1945



Inventors
C. L. COWDREY
By J. A. CHURCHILL
Attorneys

UNITED STATES PATENT OFFICE

2,403,850

TANK

Cecil Louis Cowdrey, Hitchin, and John Adrian Churchill, Luton, England, assignors to D. Napier & Son Limited, London, England, a company of Great Britain

Application February 14, 1945, Serial No. 577,913
In Great Britain March 22, 1944

7 Claims. (Cl. 137—21)

1

This invention relates to tanks for liquids and in particular to tanks mounted in positions where they are liable to be subject to temporary inversion as when fitted in aircraft. The liquid content of such tanks, for example fuel or lubricating oil, is usually withdrawn by a pump and it is necessary that withdrawal may continue uninterruptedly whatever the attitude of the tank. The object of this invention is to make this possible.

According to this invention the tank comprises in combination a main part, which when the tank is in its normal attitude forms the upper part of the whole tank, a part below this which serves as a sump, an outlet from this sump through which the contents of the tank can be withdrawn as by means of a pump, an inlet into the main part through which liquid flows into the tank, a passage forming a communication between these two parts of the tank and through which liquid can flow directly and freely while the attitude of the tank is normal and the main part is uppermost, and means whereby when the tank is inverted so as to bring the sump above the main part, this direct communication is automatically stopped and the liquid compelled to pass into the sump through a separate tubular passage which is then opened and extends from the sump to a portion of the main part of the tank which is then lowermost and beneath the sump so that withdrawal through the outlet from the sump can be continued without interruption. The separate tubular passage is conveniently constituted by a tubular member which extends through the communicating passage between the two parts of the tank and is mounted so that it can move in the direction of its length. One end of this tubular member which lies in the sump is then formed externally as a valve which when the whole tank is inverted and the tubular member caused to move will engage a seating in the communicating passage between the two parts of the tank thus automatically closing this passage and leaving the sump in communication only through the tubular member with a portion of the main part of the tank which is then lowermost.

In a construction embodying these features the communicating passage between the two parts of the tank is constituted by a "neck" having a diameter less than that of the main part of the tank and having therein a circular opening. In this "neck" is mounted an annular member preferably of resilient material such as rubber which constitutes a valve seat. The tubular member which extends through this "neck" has one end

2

in the sump while the other end lies in what is normally the upper part of the main part of the tank and near the inlet thereto. This tubular member has an external diameter substantially less than the diameter of the passage through the "neck" so as to leave an annular passageway around it through which under normal conditions the liquid can flow freely from the upper and main part of the tank into the sump. In the main part of the tank is a guide of suitable construction through which the tubular member passes and in which it can slide freely in the direction of its length. Around the exterior of that end of the tubular member which lies in the sump is a formation constituting a valve which is adapted to engage the annular seat in the passageway through the "neck". This valve formation has a substantial mass so that while the tank is in a normal attitude its weight will keep the tubular member in its lowest position with the valve carried thereby off the seating in the "neck" and the annular communicating passage around the tubular member open for the free flow of liquid until the tank is inverted. When this happens the mass of the valve will then cause the tubular member to slide and bring the valve on to its seat and thus close this passage leaving the liquid free to flow into the sump only through the tubular member. That end portion of the sliding tubular member which when the tank is in its normal attitude lies uppermost and in the main part of the tank is conveniently provided with an annular plate or flange which may have holes therein and which is fixed to the tubular member at or near its end. This plate extends so far radially towards the wall of the main part of the tank as to leave around its edge an annular passage of relatively small radial width through which the liquid flows from the inlet as it goes through the main part of the tank to the sump when the tank is in its normal attitude.

In some cases it is convenient to increase the weight of the whole tubular member and thus assist in ensuring its sliding movement by mounting on that end of the member which carries the above-mentioned annular flange or plate a collar of suitable form and weight.

While the invention may be carried into practice in various ways according to the position in which the tank is to be placed and the formation thereof which is convenient, the accompanying drawing illustrates a construction that may be adopted for use for example in an aircraft. In the drawing—

Figure 1 is a diagrammatic sectional elevation

3

of the improved tank as it appears when in its normal attitude.

Figure 2 is a similar view, but showing the tank as when it has been inverted.

The two parts of the tank, namely, the main part A and the portion B functioning as the sump, may be formed separately each part conveniently being cylindrical in cross-section the main axis of the tank running through the main part A and the sump B with these two portions coaxial. The sump is of convenient dimensions with an outlet C therefrom of suitable diameter running from the side wall B¹, the end wall B² being conveniently flat. Opposite this flat wall and in what is normally the top of the sump is an opening D which communicates with the normally upper and main part A of the tank through a narrowed part forming a "neck" E which constitutes the communicating passage between these parts. This "neck" is suitably constructed either by a part of the bottom of the main part of the tank or by a formation of the upper part of the sump around the opening D, or by both, these formations being such as to facilitate connecting together the two parts of the tank preferably in a manner which will allow them to be separated when required.

In this connecting passage is an annular groove E¹ within which lies a ring F of resilient material such as oil-resisting rubber or the like. The interior diameter of this ring of material is such that it will project a suitable distance into the communicating passage D between the two parts of the tank and thus form a resilient seat for the valve which closes this passage when the tank is inverted.

The upper part A of the tank is as mentioned conveniently cylindrical, at least over the main part of its length considered in the vertical direction. While the upper end A¹ is preferably flat the lower end A² is conical as a hopper terminating in the "neck" E where the two parts of the tank are connected together. In the side wall of the tank near the flat upper end A¹ is an inlet G through which liquid can flow either by gravity or otherwise into the tank.

Within this upper part A of the tank and attached by suitable means to the side wall at a place intermediate in the vertical length of the tank is a spider H which constitutes a support for a sleeve-like guide H¹ which then lies in the centre of the tank and coaxial therewith. In this guide lies and can slide freely a tube J having an internal diameter of suitable size while its external diameter is so much less than the diameter of the communicating passageway D across the valve seating therein as to leave an annular passageway through which the liquid can flow freely from the upper part A of the tank into the sump B. The tube J runs right through this passage D in which it lies centrally and what may be referred to as the lower end J¹ of the tube which is in the sump B may conveniently rest on the bottom B² of the sump when the whole tank is in its normal attitude in which it is shown in Figure 1. The upper end of the tube then lies in the main part of the tank a suitable distance from the upper and flat end A¹ and below the level of the inlet opening G. The lower end J¹ of the tube is conveniently flared outwards and carries externally a ring of material K so shaped as to constitute a valve head. For example this valve head may be made of lead with conical exterior and of such diameter that it will effectively seat itself in the valve seating F in the

4

"neck" E between the two parts of the tank when the latter is inverted. The mass of the valve head K added to that of the tube J itself will cause the latter to slide in its guide H¹ to the extent necessary to bring the valve on to its seat E¹ as shown in Figure 2. When, however, the tank again assumes a normal attitude the weight of the valve K and tube J will cause the latter to slide downwards taking the valve off its seat and leaving the annular passageway D clear for the flow of liquid from the main part A of the tank into the sump B. When the tank has been inverted and this annular passageway D closed by the valve K, the sump B will be in direct communication with what is then the lower part of the main portion A of the tank, as can be seen in Figure 2, where liquid will always lie in such quantity as to ensure that end of the tube being well below the surface of the liquid. The continued inflow and withdrawal of the liquid will keep the sump full. The level of the liquid in the tank is indicated at L—L in Figure 1 and Figure 2.

The operation and arrangement will be assisted if at what is normally the upper end of the sliding tube J there is fixed an annular plate M of a diameter such that its periphery M¹ will lie a short distance from the cylindrical side wall of the main part A of the tank. This plate provides such an obstruction to the free flow from the inlet G to the outlet C as to create a slight pressure difference at the two sides of the plate which when the tank is inverted assists the weight in keeping the valve K on its seat F. This plate or at least its periphery is conveniently slightly dished upwards towards the top of the tank. A convenient construction is to mount this annular disc on a collar N which can be slipped on to the end of the tube J and there fixed. If this collar is of such substantial construction as to have appreciable mass it will add to the weight of the whole tube J and thus assist in its sliding in its guide H¹. Sufficient clearance is left around the periphery M¹ of this disc for the normal free flow of liquid coming into the tank through the inlet G and passing thence into the lower part of the tank and so into the sump B. If, however, the tank is inverted and the sliding tube J has seated the valve K and closed the ordinary annular communication passage D within the "neck," the disc M will lie a short distance from the inlet opening G in the main part A of the tank and except for the clearance between its periphery M¹ and the wall of the tank A the disc will form a subsidiary chamber A³ in what is then the lowest part of the tank, as may be seen in Figure 2, this chamber being in direct communication with the sump B above it through the tube J. This subsidiary chamber A³ and the sump B can thus always be kept full of liquid while the tank is inverted. If desired the disc M may have holes M² through it as shown.

What we claim as our invention and desire to secure by Letters Patent is:

1. A tank for liquids comprising a main part which when the tank is in its normal attitude forms the upper part of the whole tank, a part which then lies below the main part of the tank and constitutes a sump, an outlet from the sump through which the contents of the tank can be withdrawn, an inlet into the main part through which liquid flows into the tank, a passage forming a communication between these two parts of the tank and through which liquid can flow directly and freely while the attitude of the tank

5

is normal with the main part uppermost, a tubular element extending through said passage and beyond it on both sides into the main part and sump respectively, said tubular element being smaller than said passage and providing separate paths through said passage respectively inside and outside said element, and means automatically effective upon inversion of the tank for stopping the portion of the passage outside the tubular element and the liquid path therethrough.

2. A tank for liquids comprising in combination a main part which when the tank is in its normal attitude forms the upper part of the whole tank, a part which then lies below the main part of the tank and constitutes a sump, an outlet from this sump through which the contents of the tank can be withdrawn, an inlet into the main part through which liquid flows into the tank, a communicating passage between these two parts of the tank, a tubular member running through this passage and having a diameter less than that of the passage thus leaving an annular space around the tubular member for the flow of liquid from the main part of the tank into the sump, a guide which carries this tubular member and in which it can slide, a formation constituting an annular valve around the end of the said tubular member which lies in the said sump, and a seating for this valve in the said communicating passage with which seating this valve will engage and close the space around the tubular member when the whole tank is inverted and the said tubular member is caused by its weight to slide in its guide so that liquid can then only pass into the sump through the tubular member from what has then become the lower portion of the main part of the tank.

3. A tank for liquids comprising in combination the parts as set out in claim 2 in which the annular valve on the end of the said tubular member is given such mass that its weight added to that of the tubular member will ensure the sliding of that member in its guide in one direction or the other as determined by the attitude of the tank.

4. A tank for liquids comprising in combination a main part which when the tank is in its normal attitude forms the upper part of the whole tank, a part which then lies below the main part of the tank and constitutes a sump, an outlet from this sump through which the contents of the tank can be withdrawn, an inlet into the main part through which liquid flows into the tank, a communicating passage between these two parts of the tank, a tubular member running through this passage and having a diameter less than that of the passage thus leaving an annular space around the tubular member for the flow of liquid from the main part of the tank into the sump, a guide which carries this tubular member and in which it can slide, a formation constituting an annular valve around the end of the said tubular member which lies in the said sump, a disc mounted on the opposite end of the tubular member which lies in the main part of the tank to the side wall of which the disc nearly extends leaving only a small space through which liquid can flow from the inlet and that end portion of the main part of the tank to the communicating pas-

6

sage, and a seating in the communicating passage for the annular valve with which seating this valve will engage and close the space around the tubular member when the whole tank is inverted and the said tubular member is caused by its weight to slide in its guide so that liquid can then only pass into the sump through the tubular member from what has then become the lower portion of the main part of the tank.

5. A tank for liquids comprising in combination the parts as set out in claim 4 in which the disc on the one end of the said tubular member has perforations therein and is connected to the tubular member through a collar which has substantial mass and thereby adds to the weight of the whole tubular member and aids it in sliding through the said guide when inversion of the whole tank occurs.

6. A tank for liquids comprising in combination a main part which is cylindrical and when the tank is in its normal attitude forms the upper part of the whole tank, a part which then lies below the main part of the tank and constitutes a sump this sump being cylindrical but of less diameter than the main part of the tank with which it is coaxial, an outlet from this sump through which the contents of the tank can be withdrawn, an inlet into the main part through which liquid flows into the tank, a centrally disposed communicating passage between these two parts of the tank, a tubular member concentric with the two parts of the tank into which its end portions extend as it runs through the said communicating passage the diameter of which is greater than the external diameter of the tubular member so that there is an annular space around that member for the flow of liquid from the main part of the tank into the sump, a guide which projects from the side wall of the main part of the tank and carries the tubular member and in which the latter can slide, a formation constituting an annular valve around the end of the said tubular member which lies in the said sump, a disc mounted on the opposite end of the tubular member which lies in the main part of the tank the diameter of the disc being somewhat less than the internal diameter of that part of the tank so as to leave an annular space around the edge of the disc through which liquid can flow from the inlet and that end portion of the main part of the tank to the communicating passage, and a seating for the said valve in the said communicating passage with which seating this valve will engage and close the space around the tubular member when the whole tank is inverted and the tubular member is caused by its weight to slide in its guide so that liquid can then only pass into the sump through the tubular member from what has then become the lower portion of the main part of the tank.

7. A tank for liquids comprising in combination the parts as set out in claim 2 in which the seating for the valve in the communicating passage is constituted by a ring of resilient material fixed in this passage.

CECIL LOUIS COWDREY.
JOHN ADRIAN CHURCHILL.