



(86) Date de dépôt PCT/PCT Filing Date: 2014/03/05

(87) Date publication PCT/PCT Publication Date: 2014/09/18

(45) Date de délivrance/Issue Date: 2021/07/20

(85) Entrée phase nationale/National Entry: 2015/09/14

(86) N° demande PCT/PCT Application No.: EP 2014/054212

(87) N° publication PCT/PCT Publication No.: 2014/139840

(30) Priorité/Priority: 2013/03/13 (GB1304520.8)

(51) Cl.Int./Int.Cl. *B64D 37/32* (2006.01)

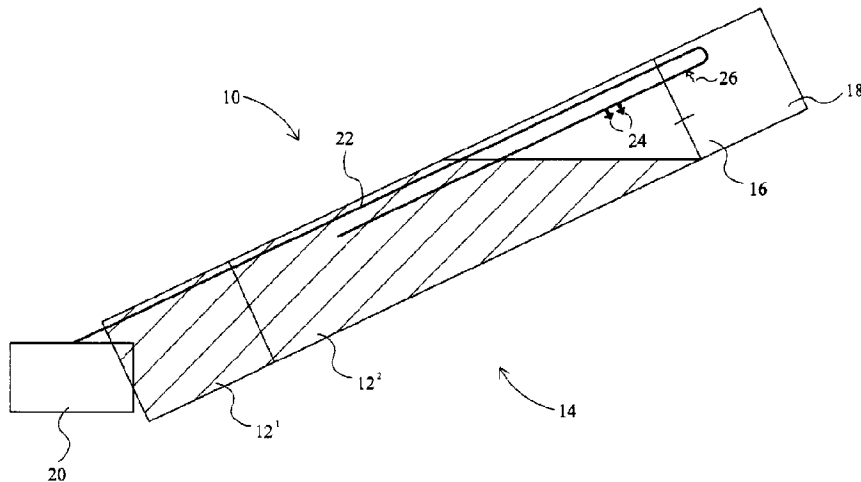
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(54) Titre : SYSTEMES D'INERTAGE DE RESERVOIR A CARBURANT D'AERONEF

(54) Title: AIRCRAFT FUEL TANK INERTING SYSTEMS



(57) **Abrégé/Abstract:**

An aircraft fuel tank inerting system includes at least one main fuel tank in the wing and an associated surge tank. An inerting system has a source of inerting fluid, a flow passage for supplying the inerting fluid to the main fuel tank and discharging it into the main fuel tank through at least one discharge outlet. A pressure relief arrangement in the flow passage discharges inerting fluid into the surge tank if the pressure in the main fuel tank exceeds a predetermined threshold such that inerting fluid may be safely vented to atmosphere via the surge tank without over-pressurising the main fuel tank. The flow passage passes through the main fuel tank into the surge tank and then back into the main fuel tank to open into the main fuel tank, and the pressure relief arrangement is disposed in a portion of the flow passage in the surge tank.

Abstract

An aircraft fuel tank inerting system includes at least one main fuel tank in the wing and an associated surge tank. An inerting system has a source of inerting fluid, a flow passage for supplying the inerting fluid to the main fuel tank and discharging it into the main fuel tank through at least one discharge outlet. A pressure relief arrangement in the flow passage discharges inerting fluid into the surge tank if the pressure in the main fuel tank exceeds a predetermined threshold such that inerting fluid may be safely vented to atmosphere via the surge tank without over-pressurising the main fuel tank. The flow passage passes through the main fuel tank into the surge tank and then back into the main fuel tank to open into the main fuel tank, and the pressure relief arrangement is disposed in a portion of the flow passage in the surge tank.

AIRCRAFT FUEL TANK INERTING SYSTEMS

5 This invention relates to aircraft fuel tank inerting systems for fixed wing aircraft.

In fixed wing aircraft, the fuel is usually stored in tanks in the main wing. A typical configuration includes a centre tank and a one or multi-compartmented main tank in each wing. In many configurations it is common to have a surge tank located outboard of, and serving, each main wing tank. The main tanks vent through vent lines into the surge
10 tank. Each surge tank vents to atmosphere through an overboard vent which typically includes a NACA intake designed to maintain a modest pressurisation of the tanks when the aircraft is in flight, but to allow venting when required.

Aircraft fuel tanks are now subject to fuel tank flammability requirements
15 (FAR25.981b). One conventional approach to meeting this requirement is to provide an inerting system in which Nitrogen Enriched Air (NEA) is generated by an On Board Inert Gas Generating System (OBIGGS) which is then pumped into the fuel tanks.

We have determined that, under certain operating conditions, for example when cornering
20 on the ground with a full fuel load, or when the aircraft is subject to negative G, the vent lines from the main tank to the surge tank can become blocked. This creates a potential hazard because, if the inerting system continues to pump NEA into the tanks, there can be a pressure build up within the fuel tanks which loads them beyond their structural limits and possibly driving fuel out of the tanks. Therefore we have designed an aircraft fuel tank
25 inerting system intending to at least to reduce this potential hazard.

Accordingly, in one aspect, this invention provides an aircraft fuel tank inerting system

for a winged aircraft including at least one main fuel tank in the wing and an associated surge tank, wherein the inerting system comprises a source of inerting fluid, a flow passage for supplying said inerting fluid to said main fuel tank and discharging it into said main fuel tank through at least one discharge outlet, wherein said flow passage includes a pressure relief arrangement adapted to discharge inerting fluid passing along the flow passage into said surge tank if the pressure in said main fuel tank and/or said flow passage exceeds a predetermined threshold such that the inerting fluid may be safely vented to safely vented to atmosphere via the surge tank without over-pressurising the main fuel tanks.

10 The surge tank may typically be disposed outboard and adjacent said main fuel tank, and conveniently include a vent to ambient.

The flow passage may conveniently comprise a duct running through or adjacent the main tank. Thus said flow passage or duct may pass through said main fuel tank into said surge tank and then back into said main fuel tank, with said pressure relief arrangement being disposed in a portion of said flow passage or duct in said surge tank. Said pressure relief arrangement may include a pressure relief valve in said duct responsive at least in part to the pressure within said duct to open at a predetermined threshold. Alternatively or in addition said pressure relief arrangement may comprise a relief valve disposed in said duct, venting into said surge tank and responsive at least in part to the pressure in the main tank.

In another aspect this invention provides a method of inerting an aircraft including at least on main fuel tank in the wing and an associated surge tank, which comprises the steps of:

25 providing a source of inerting fluid,

providing a flow passage for supplying said inerting fluid to said main fuel tank and discharging it therein,

wherein a pressure relief arrangement is provided to discharge inerting fluid passing along the flow passage into said surge tank if the pressure in said flow passage and/or said main fuel tank exceeds a predetermined threshold inerting fluid may be safely vented to atmosphere via the surge tank without over-pressuring the main fuel tanks.

By way of example only, two specific embodiments of this invention will now be described in detail, reference being made to the accompanying drawings in which: -

Figure 1 is a schematic view of a first embodiment of an aircraft fuel tank inerting system in accordance with this invention, and

Figures 2(a) and (b) are views of a second embodiment of an aircraft fuel tank inerting system in accordance with this invention.

Referring initially to Figure 1, there is shown schematically one wing of an aircraft within which are provided the inner and outer compartments 12^1 , 12^2 respectively of a main fuel tank 14. Outboard of the main fuel tank 14, in the wing tip region, is a surge tank 16. Each of the main fuel tanks can vent through vent lines (not shown) into the surge tank. The surge tank 16 has an overboard vent 18 on its underside, through which it may vent to atmosphere. The overboard vent 18 may typically be formed with a NACA inlet to provide a modest pressurisation of the surge tank 16 in flight. An OBIGGS generates nitrogen enriched air (NEA) and delivers it to a duct 22 which passes on an outward limb through the inner and outer compartments of the main tank 14, and into the surge tank 16 before returning back on a return limb into the outer compartment of the main tank 14. The return limb of the duct 22 has a number of outlets 24 through which NEA may discharge into the

ullage of the main tank 14, but the outward limb has no discharge outlets.

The NEA provided by the OBIGGS 20 contributes to a low oxygen atmosphere in the ullage to prevent or reduce the risk of explosion. As noted in the introduction, occasionally, the vent lines between the main tanks 12 and 14 and the surge tank may become blocked due to the aircraft undertaking a particular manoeuvre, and if the OBIGGS continues to pump NEA into the ullage the stated problems may arise. In order to address this, the duct 22 carrying the NEA passes through and beyond the main tank 14 and then into the surge tank 16 before it returns to the main tank 14. A pressure relief valve 26 is disposed in a portion of the duct 22 in the surge tank. The pressure relief valve 26 is set so that, once there is a predetermined level of back pressure, it opens to discharge the NEA into the surge tank 16 where it can discharge through the output vent 18 to atmosphere.

It will be appreciated that in the above embodiment, the duct 22 delivering NEA to the main tank has a pressure relief valve 26 that discharges into the surge tank. The pressure relief valve responds to the pressure in the internal duct pressure at that point to open to discharge into the surge tank 16 when the pressure exceeds a preset limit, which may be fixed or variable.

Turning now to Figures 2(a) and (b), similar parts will be given similar reference numbers.

As previously, NEA from an OBIGGS or other suitable supply 20 is delivered to a duct 22 which passes through the main tank 14, into the surge tank 16 and back into the main tank 14 to discharge through one or more outlets 24. A relief valve 36 is operable to open an aperture in a portion of the duct 22 in the surge to allow NEA to pass into the surge tank and then be vented overboard. The relief valve 36 is operated by a bellows arrangement which is exposed on one side to the pressure acting in the main tank and on the other side to

a reference pressure (which may be fixed or variable). In this manner, once the main tank pressure has exceeded the reference pressure, the relief valve 36 will open and so the NEA passing along the duct 22 will vent into the surge tank to escape through the vent. In addition, depending on the relative pressures, some of the ullage atmosphere may pass back into the outlets 24 of the duct and vent through the relief valve.

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CLAIMS

1. An aircraft fuel tank inerting system for a fixed wing aircraft including at least one main fuel tank in the wing and an associated surge tank, the inerting system comprising:
 - a source of inerting fluid; and
 - a flow passage for supplying the inerting fluid to the main fuel tank and discharging it into the main fuel tank through at least one discharge outlet,
 - wherein the flow passage includes a pressure relief arrangement adapted to discharge inerting fluid passing along the flow passage into the surge tank based on a pressure in the main fuel tank exceeding a predetermined threshold so that inerting fluid is ventable to atmosphere via the surge tank without over-pressurizing the main fuel tank,
 - wherein the flow passage passes through the main fuel tank into the surge tank and then back into the main fuel tank to open into the main fuel tank, and
 - wherein the pressure relief arrangement is disposed in a portion of the flow passage in the surge tank.
2. The aircraft fuel tank inerting system according to claim 1, wherein the flow passage includes a duct.
3. The aircraft fuel tank inerting system according to claim 2, wherein the pressure relief arrangement includes a pressure relief valve in the duct responsive at least in part to a pressure within the duct to open at a predetermined threshold.
4. The aircraft fuel tank inerting system according to claim 2, wherein the pressure relief arrangement comprises a relief valve disposed in the duct, the relief valve venting into the surge tank and being responsive, at least in part, to the pressure in the main fuel tank.
5. The aircraft fuel tank inerting system according to claim 1, wherein the surge tank is disposed outboard and adjacent the main fuel tank.
6. The aircraft fuel tank inerting system according to claim 1, wherein the surge tank

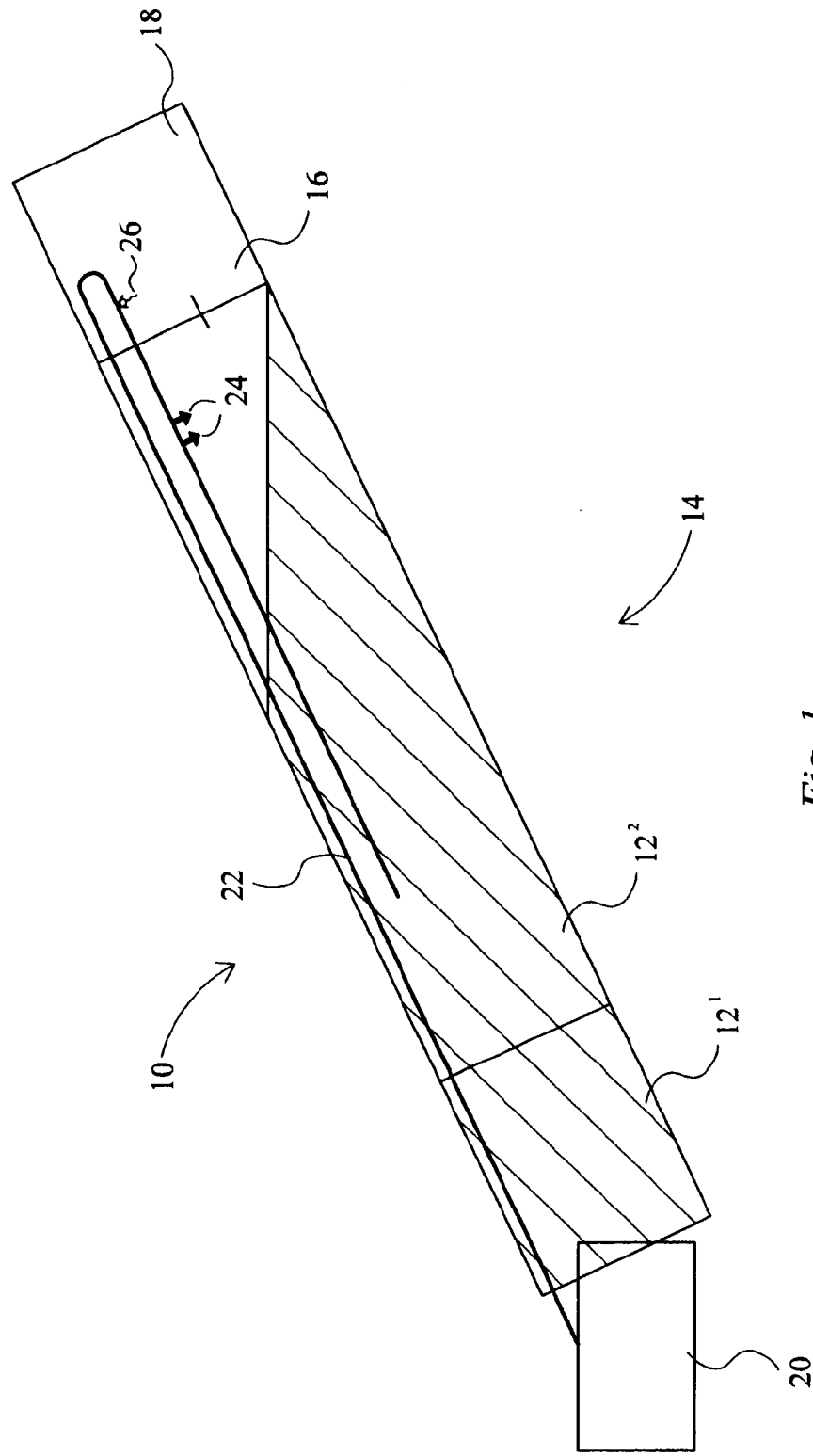
includes a vent to ambient.

7. The aircraft tank inerting system according to claim 1, further comprising a vent line separate from the flow passage and adapted to vent the main fuel tank into the surge tank.

8. A method of inerting an aircraft including at least one main fuel tank in the wing and an associated surge tank, the method comprising:

- providing a source of inerting fluid,
- providing a flow passage for supplying the inerting fluid to the main fuel tank and discharging it therein, and
- providing a pressure relief arrangement to discharge inerting fluid passing along the flow passage into the surge tank based on a pressure in the main fuel tank and/or the flow passage exceeding a predetermined threshold so that inerting fluid is ventable to atmosphere via the surge tank without over-pressurizing the main fuel tank,
- wherein the flow passage passes through the main fuel tank into the surge tank and then back into the main fuel tank to open into the main fuel tank, and
- wherein the pressure relief arrangement is disposed in a portion of the flow passage in the surge tank.

9. The method according to claim 8, further comprising providing a vent line separate from the flow passage and adapted to vent the main fuel tank into the surge tank.



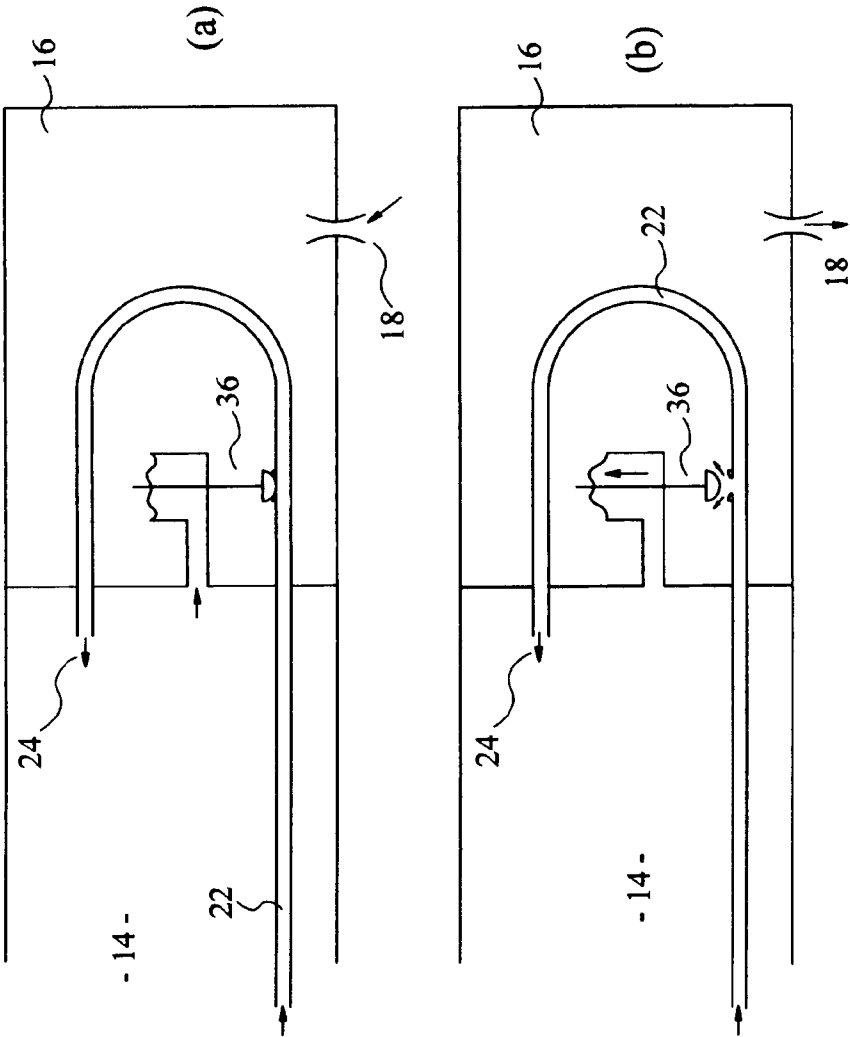


Fig. 2

