

[54] WINDOW WASH SYSTEM

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[57]

ABSTRACT

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A window wash system for the inflight cleaning of aircraft windows having a washing fluid storage tank and nozzles adjacent the windows to be cleaned. In addition to the washing fluid within the storage tank, gas under pressure is also contained therein. Through a series of valves, either washing fluid may be dispensed through the nozzles or gas may be dispensed through the entire system for purging the system. The window wash system of this invention is capable of reliable operation under adverse conditions such as high speed flight or variable temperature and pressures.

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239/305

[51] Int. Cl. B05b 1/10; B05b 15/02

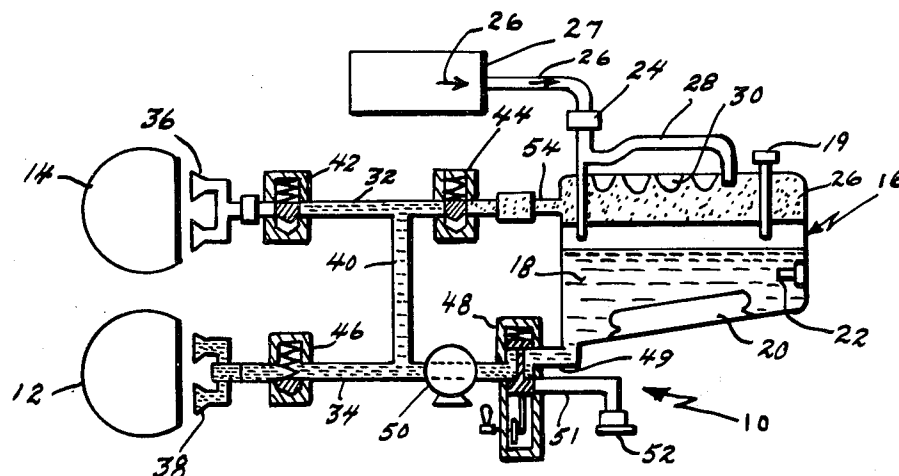
[58] Field of Search 239/130, 305, 112, 284,
239/304, 303, 302, 171; 222/148

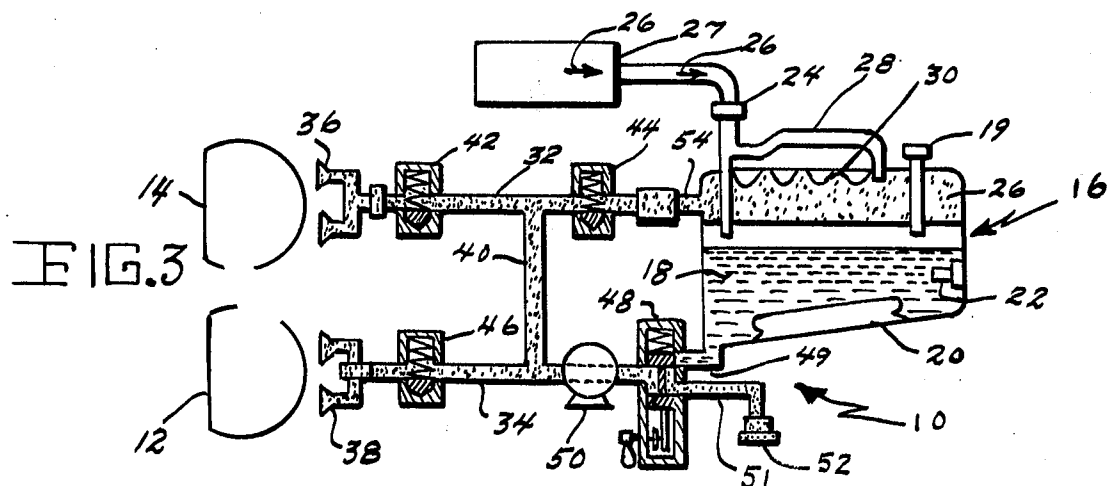
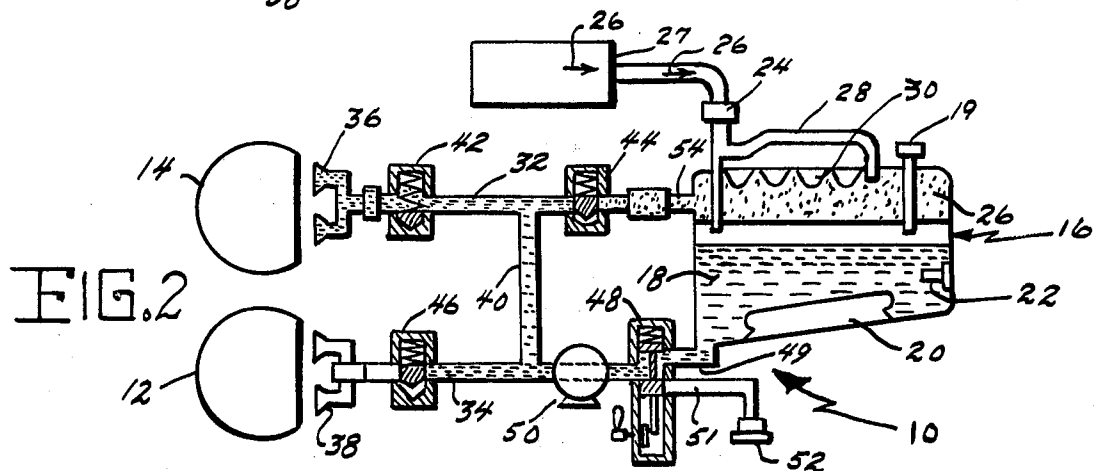
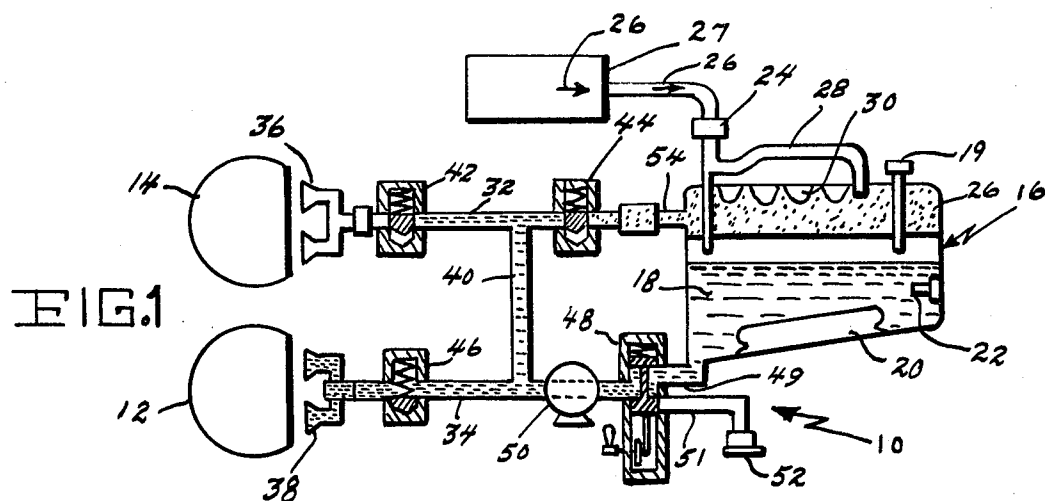
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10 Claims, 3 Drawing Figures





WINDOW WASH SYSTEM

BACKGROUND OF THE INVENTION

This invention relates generally to window wash systems, and more particularly, to an inflight window wash system for aircraft.

Many problems arise when it becomes necessary during flight to satisfactorily remove dirt and insects from the window surfaces of aircraft. For example,

a. the wash fluid must be capable of performing well even at extremely low temperatures such as -65°F ;

b. the wash fluid tank must be capable of operating at high altitudes (low ambient pressure) thereby preventing boiloff of the wash fluid;

c. a great force must be applied to the wash fluid to increase its effectiveness; and

d. the entire system must be capable of operating in the presence of high speed air velocities encountered during flight.

Up to the present time although many window wash systems have been utilized, none of these systems have overcome all the above mentioned problems in an economical and high reliable manner.

SUMMARY OF THE INVENTION

The instant invention is a window wash system capable of use in the inflight washing of aircraft windows and which alleviates the problems set forth in detail hereinabove. Although the window wash system is primarily designed for the inflight cleaning of Forward Looking Infra-Red (FLIR) and Steerable Television (STV) turret windows it is easily adaptable to all aircraft windows as well as windows in general.

The window wash system of the present invention incorporates therein a window wash pump which supplies hot (135° – 155°F) wash water at a nominal pressure of 500 psig. The wash water flows from the pump through a filter into two spray nozzles for either FLIR or STV turret window wash. Washing is accomplished by the impact of the high pressure spray on the window surface while the window is driven past the nozzles by rotation of the turret. It should be noted, however, that in use with stationary or fixed windows, the nozzles of this invention may be mounted on moveable or rotatable platforms.

After completion of a wash cycle, the wash valve and bleed air valve open and the wash selector valve returns to the pump-to-drain position. Pressurized low temperature bleed air is then piped from the cabin air conditioning pack to the air pressure regulator. The air pressure is reduced by the regulator and piped to the water tank heat exchanger where the air is warmed to wash water temperature. The warmed air passes through the bleed air valve to purge the window wash system for prevention of freezing damage after each was operation.

It is therefore an object of this invention to provide a window wash system capable of cleaning the windows of aircraft during high speed flight.

It is another object of this invention to provide a window wash system which provides window wash fluid at a warm temperature.

It is a further object of this invention to provide a window wash system which eliminates the boil-off of window wash fluid at high altitude.

It is still another object of this invention to provide an inflight window wash system for aircraft which is

highly reliable in operation, economical to produce and which utilizes conventional, currently available components that lend themselves to standard mass producing manufacturing techniques.

For a better understanding of the present invention together with other and further objects thereof, reference is made to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic illustration of the inflight window wash system of this invention showing the FLIR window wash cycle;

FIG. 2 is a schematic illustration of the inflight window wash system of this invention showing the STV window wash cycle; and

FIG. 3 is a schematic illustration of the inflight window wash system of this invention showing the system purge cycle.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference is now made to FIGS. 1–3 of the drawing which show in various modes of operation the window wash system 10 of this invention. As pointed out hereinabove the window wash system 10 of the instant invention is designed primarily for the cleaning of the Forward Looking Infra-Red (FLIR) and Steerable Television (STV) turret window 12 and 14 respectively. However, window wash system 10 is also capable of inflight cleaning of all windows of a high speed aircraft.

The turret window wash system 10 of this invention utilizes a pressurized tank 16 for storing the window wash fluid 18. The window wash fluid 18 may be any suitable solvent, however, best results are obtained when water is used as the fluid. Water leaves no greasy residue, is non-flammable and is an effective fluid for insect removal. Although water does have the disadvantage of a high freezing point and a relatively high vapor pressure at operating temperature, the other fluids with a more satisfactory freezing point and vapor pressure have one or more of the disadvantages of flammability, greasy residue or ineffectiveness for insect removal. Since water proved to be the most satisfactory fluid, window wash system 10 of this invention includes therein provisions for heating and pressurization to prevent freezing and vaporization respectively.

Water 18 enters tank 16 through a filler cap and safety valve 19. In addition, tank 16 contains a conventional blanket heater 20 therein in order to heat the tank water 18 to a nominal temperature range of 135° to 155°F . This temperature range is more efficient for insect removal than water temperature just above freezing. The water temperature is thermostatically controlled by any suitable switching arrangement 22. For example, a plurality of bimetallic switches can be utilized to operate the heater in such a manner as to maintain the water temperature between 100° and 170°F .

Also operatively connected to tank 16 is an air pressure regulator 24. Pressurized low temperature bleed air (indicated by arrow 26) is piped from the cabin air conditioning pack 27, for example, to air pressure regulator 24. The air pressure is reduced by regulator 24 and fed through pipe 28 to water tank heat exchanger

30 where the air is warmed to wash water temperature and remains within tank 16 until use thereof at a later time in a manner to be explained hereinbelow.

A pair of lines or pipes 32 and 34 connect air 26 and water 18 to a pair of nozzles 36 and 38. Interconnecting lines 32 and 34 is conduit 40. Nozzles 36 and 38 are located adjacent STV window 14 and FLIR window 12, respectively. It should be noted that although only two such nozzles are shown any suitable number may be used with this invention. In addition, if desirable, the windows 14 and 12 may remain fixed while nozzles 36 and 38 are mounted on conventional rotatable or slideable mountings.

Contained within line 32 are a pair of conventional valves such as an electrically controlled STV wash valve 42 and an electrically controlled bleed air valve 44. Located within line 34 are a pair of suitable valves such as electrically controlled FLIR wash valve 46 and electrically controlled wash select valve 48. Adjacent valve 48 and also located with line 34 is any suitable pump 50 which moves the fluid 18 during the window wash operation of system 10.

Window wash pump 50 supplies hot (135°-155°F) wash water 18 at a nominal pressure of 500 psig to the two spray nozzles 36 and 38 for either STV or FLIR turret window wash. The electric wash selector valve 48 operates in either of two positions. When valve 48 is in the open position as shown in FIGS. 1 and 2 wash water 18 flows from tank 18 through wash water inlet line 49 to pump 50, while line 51 to overboard drain 52 is closed. Low temperature bleed air 26 flows continuously through pump 18 to the overboard drain 52 when wash select valve 48 is in the closed position and bleed air valve 44 is in the open position as shown in FIG. 3. The electrically controlled FLIR wash valve 46 closes to block wash water flow to the FLIR turret nozzle 38 when the STV turret wash cycle is in operation as shown in FIG. 2. STV wash valve 42 closes to block wash water flow to the STV turret nozzle 36 when the FLIR turret wash cycle is in operation as shown in FIG. 1. When either FLIR or STV wash cycles are in operation bleed air valve 44 closes to prevent wash water flow into the bleed air supply line 54.

MODE OF OPERATION

Reference is now made to FIGS. 1-3 for the operation of window wash system 10 of this invention.

In operation wash water 18 flows from tank 16 through line 49 to pump 50 by passing through an open wash select valve 48. As seen in FIGS. 1 and 2 of the drawing when wash select valve 48 is in the open position bleed air valve 44 and line 51 to drain 52 is closed. The wash water 18 flows from pump 50 at a nominal pressure of 500 psig into either spray nozzle 36 or 38 depending upon which valve 42 or 46 is in the open position as set forth hereinabove. Washing is accomplished by the impact of the high pressure spray on the window surface while windows 12 and 14 are driven past nozzles 36 and 38 by rotation of the turret (not shown). The time for a wash cycle is nominally 30 seconds.

After completion of a wash cycle, the wash select valves 42 and 46 and the bleed air valve 44 open while the wash selector valve 48 closes inlet line 49 and opens line 51 leading to drain 52 as shown in FIG. 3. Pressurized low temperature bleed air 26 is then piped from the cabin air conditioning pack 27 to air regulator

24. The warmed air 26 passes through the bleed air valve 44 to purge the window wash system 10 for prevention of freezing damage after each wash operation. Bleed air 26 flows through the window wash system 10 continuously unless the cabin air conditioning system is shut down. It should be noted, however, that if desired the bleed air may be furnished from an independent source. Another function of bleed air 26 is to pressurize the vapor space in water tank 16 for prevention of water boil-off at high altitude. Positive pressure is also provided at the pump inlet line 49 to prevent cavitation.

The high velocity water jets emanating from nozzles 36 and 38 make it possible to use this type of system in the presence of high speed air velocities encountered in flight. High-speed air velocities are not a major problem in the FLIR and STV turret windows since the window wash operation is accomplished with the windows facing aft and the nozzle spray protected by fairings located directly behind the FLIR and STV turrets. Nevertheless, system 10 of the present invention is also applicable to inflight washing of aircraft windshields where high velocity airstreams would otherwise be a problem.

Although this invention has been described with reference to a particular embodiment, it will be understood to those skilled in the art that this invention is also capable of a variety of alternative embodiments within the spirit and scope of the appended claims.

We claim:

1. A window wash system for inflight cleaning of aircraft windows comprising means for storing a washing fluid and a gas therein, means for dispensing said washing fluid, first means connecting said storage means to said dispensing means, second means connecting said storage means to said dispensing means and to said first connecting means, means located within said first connecting means for controlling the flow of washing fluid from said storage means to said dispensing means and means located within said second connecting means for controlling the flow of gas from said storage means to said dispensing means and to said first connecting means whereby depending upon the condition of said pair of controlling means either said washing fluid flows through said dispensing means or said gas flows through said dispensing means and said pair of connecting means.

2. A window wash system for inflight cleaning of aircraft windows as defined in claim 1 further comprising a drain connected to said controlling means located within said first connecting means.

3. A window wash system for inflight cleaning of aircraft windows as defined in claim 2 wherein said controlling means located within said first connecting means comprises a pump and a valve, whereby said valve in one position permits the flow of the wash fluid from said storage means into said first connecting means and blocks said drain while said valve in second position prevents the flow of wash fluid from said storage means into said first connecting means and opens said drain.

4. A window wash system for inflight cleaning of aircraft windows as defined in claim 3 further comprising means for regulating the pressure of said gas within said storage means.

5. A window wash system for inflight cleaning of aircraft windows as defined in claim 4 wherein said controlling means located within said second connecting

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means comprises a valve, which at the time said valve in said first connecting means is in said one position prevents the flow of gas from said storage means into said dispensing means and said first connecting means, and, at the time said valve in said first connecting means is in said second position permits the flow of gas from said storage means into said dispensing means and said first connecting means.

6. A window wash system for inflight cleaning of aircraft windows as defined in claim 5 further comprising means located within said storage means for heating said washing fluid.

7. A window wash system for inflight cleaning of aircraft windows as defined in claim 6 further comprising a means located within said storage means for regulat-

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ing said heating means.

8. A window wash system for inflight cleaning of aircraft windows as defined in claim 7 wherein said dispensing means comprises a first and second nozzle.

9. A window wash system for inflight cleaning of aircraft windows as defined in claim 8 further comprising means located within said first connecting means for regulating the flow through said first nozzle and means located within said second connecting means for regulating the flow through said second nozzle.

10. A window wash system for inflight cleaning of aircraft windows as defined in claim 9 wherein said washing fluid is water.

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