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MINIMIZING FIRE RISK WHEN OPERATING ROCKETS, GAS-GENERATORS OR THE LIKE

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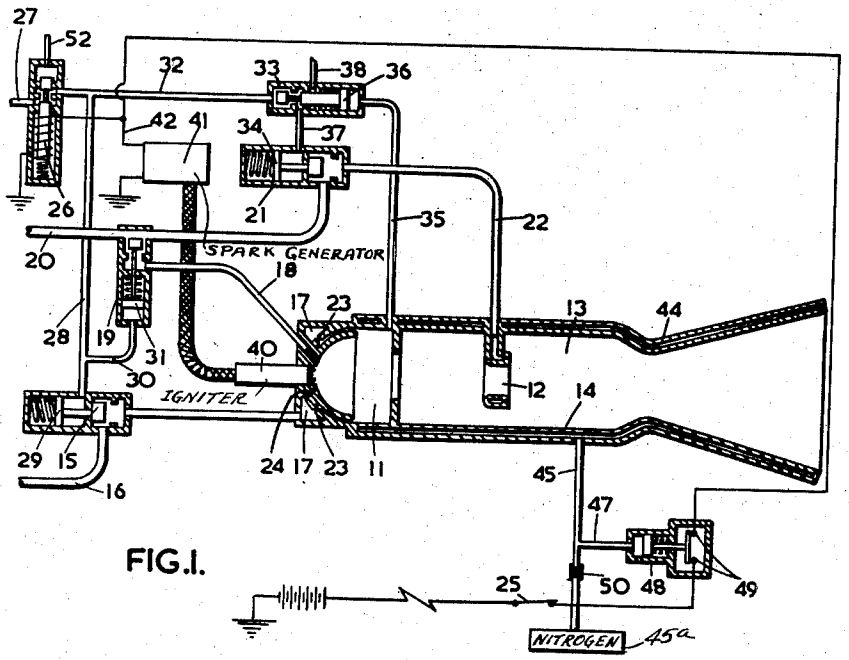


FIG.1.

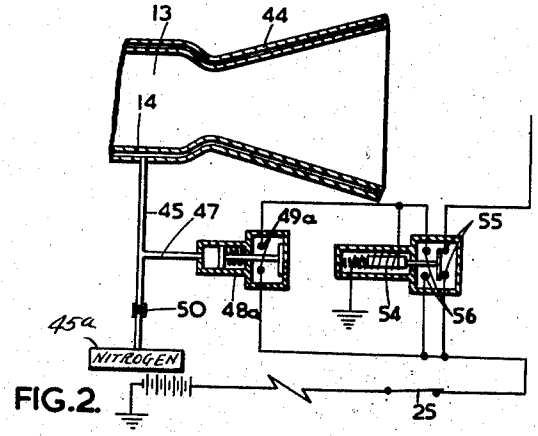


FIG.2.

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MINIMIZING FIRE RISK WHEN OPERATING ROCKETS, GAS-GENERATORS OR THE LIKE

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4 Claims. (Cl. 60—39.09)

This invention relates to rocket motors, gas-generators or the like devices having chambers in which combustion ingredients are burned, and particularly to those which are installed on aircraft.

If for some untoward reason the operating temperature in such a device should rise to such an extent that the walls are likely to be burned through, there is a risk of flame issuing from the resulting aperture and igniting any surrounding structure, which may cause disastrous results.

The main object of the invention is to prevent such fire hazard in an effective manner and to engender confidence in the personnel under whose control the device is.

According to the invention, the exterior of the device is enclosed by a fluid-tight jacket to which is fed a fluid at a pressure higher than that obtaining during operation within the device so that, in the event of a communicating aperture being established between the interior of the device and the jacket (by burning-through of the encompassing wall of the device), the higher pressure in the jacket will restrain the flaming gases from passing outwardly through the aperture, i. e., the flaming gases will be constrained to move in their normal direction to the normal outlet of the device admixed with higher pressure fluid passing inwardly from the jacket.

The invention further involves the provision of means for cutting off the supply of combustion ingredients to the device, said means being responsive to a fall in the pressure of the fluid fed to the fluid-tight jacket.

Thus, the supply passage for the fluid in the jacket (which may be an inert gas such as nitrogen) may also communicate with a pressure-responsive switch adapted under the pressure to close an electric circuit for a solenoid-valve controlling means whereby a supply of combustion ingredients can be fed to the device. The drop in pressure, which is occasioned by any flow of the higher-pressure fluid into the interior of the device, causes the pressure-responsive switch (biased to the open position) to be actuated to de-energize the solenoid-valve and so interrupt the supply of combustion ingredients to the device. To ensure that this would occur substantially simultaneously with the inflow of higher-pressure fluid into the device there may be provided an appropriate restriction in the supply passage upstream of the communication with the pressure-responsive switch.

In the accompanying drawings:

Figure 1 is a diagram, in sectional elevation, of a rocket motor and of control means therefore when adapted according to the invention; and

Figure 2 is a fragmentary view illustrating a modified form of the control means.

Like references are applied to both figures to denote corresponding parts.

Referring now to Figure 1, **11** indicates a gas generator in the form of an evaporator chamber portion of the rocket motor, **12** the main fuel burner, which is downstream of the evaporator portion, and **13** the combustion chamber of the rocket motor. It will be understood in

practice that the casing **14** will be surrounded by a jacket (omitted for the sake of clearness) for a cooling fluid (for example, the main fuel supply for the rocket motor) circulated through the jacket space in a manner which is now well known.

With the parts in the positions shown, a valve **15** for liquid oxidizer is open, the oxidizer being delivered from a main oxidizer line **16** to an annular chamber **17** at the upstream end of the evaporator portion **11**, after which it is passed through holes **23** into the portion **11** where it is mixed with and evaporated by the combustion of a small portion of the oxidizer, passed through holes **24**, and of a portion of the liquid fuel delivered along a pipe line **18** from an auxiliary fuel valve **19** supplied from a main fuel pipe line **20**. The rest of the fuel from the main pipe line **20** is passed by a main fuel valve **21** to the burner **12** by way of a pipe line **22**.

Closure of a main switch **25** energizes the winding **26** of a solenoid valve, thus opening this against a return spring to enable the valve to pass high-pressure fluid from a pipe line **27**. Some of the high-pressure fluid passed by the solenoid valve travels along a pipe line **28** and reacts on a piston **29** of the oxidizer valve to hold this open against its return spring, while a branch line **30** from the pipe line **28** delivers the pressure to a piston **31** of the auxiliary fuel valve, thereby holding the latter open against its spring bias. The high-pressure fluid is also delivered along a pipe line **32** to a control valve **33** and thence to actuate a piston **34** of the main fuel valve and hold the latter open.

The pressure in the evaporator portion **11** is applied along a pipe line **35** to a piston **36** in the control valve **33** to move it to the position shown against a return bias when the evaporator portion is functioning sufficiently to provide the necessary pressure, and it is only then that the main fuel valve piston **34** becomes actuated by the fluid pressure in the pipe line **37** and moved to the position shown—i. e., the burner **12** will not be supplied with fuel until a predetermined pressure is being generated in the evaporator portion **11**. Movement of the control valve in this way disconnects a vent **38** from the pipe line **37**.

Thus, with the parts in the position shown, the rocket motor is operating as long as fuel and oxidizer are being delivered to the pipe lines **20** and **16** respectively. **40** represents an igniter in the evaporator portion which is supplied by a conductor from a spark generator **41**, the primary circuit for which is fed from a conductor **42** when the main switch **25** is closed.

In the present instance the casing **14** and its jacket (not shown) for cooling fluid is enclosed by a fluid-tight jacket **44** having a supply line **45**, the jacket **44** being sealed at its ends and elsewhere as necessary to the cooling jacket around the casing **14**. As stated, the supply line **45** is fed from a source of pressure, such as a bottle **45***a* of nitrogen under pressure which is higher than that within the rocket motor during the operation of the rocket motor. Consequently, if the casing **14** and its surrounding cooling jacket should burn through, the communicating aperture between the interior of the rocket motor and the space of the jacket **44** will allow the higher-pressure fluid from the supply line **45** to pass into the interior of the rocket motor, thus preventing the flaming gases in the rocket motor from passing outwardly through the aperture and constraining them to move in their normal direction.

Figure 1 also discloses a means for cutting off the supply of the combustion ingredients to the rocket motor when a communicating aperture is established as aforesaid, this means being responsive to a fall in the pressure of the fluid in the supply line **45**. Thus, the latter is connected by a line **47** to a pressure-responsive switch

48 which is biased to the open position but is held closed (as shown) by the pressure in the supply line 45 when conditions are normal, its switch contacts 49 being in series with the control switch 25. However, when a communicating aperture as aforesaid is established, there will be an immediate fall in pressure in the supply line which will enable the pressure-responsive switch 48 to open its contacts 49, and, to make sure that the contacts 49 will remain open in these conditions, it is helpful to include in the supply line 45, upstream of the line 47, a constriction, as indicated at 50.

Thus, should the temperature within the rocket motor rise so high as to burn through the fluid-cooled casing 14, the circuit of the solenoid valve will be disconnected at the contacts 49 and the solenoid will be de-energized, thereby cutting off the valve-operating pressures; and, at the same time, it opens a vent 52 to allow the fluid pressure to escape from the pressure-responsive valves so that these can close under their spring pressures and prevent a further supply of the combustion ingredients to the rocket motor, the pressure on the main fuel valve piston 34 being vented at 38 by the control valve 33.

As an obvious alternative, as shown by Figure 2, the pressure-responsive switch 48*a* could be biased to a closed position in which it completes a circuit for the winding 54 of a relay. In normal operating conditions the pressure-responsive switch has its contacts 49*a* open, as shown, thus de-energizing the relay to a position in which a circuit is completed for the winding of the solenoid valve through its contacts 55, the latter contacts being in this instance in series with the switch 25. But on a communicating aperture being established between the interior of the jacket-cooled rocket casing 14 and the enclosing jacket 44, the relay becomes energized to open the circuit for the solenoid-actuated valve at the contacts 55 and to provide, for itself, a holding circuit at the contacts 56.

What I claim as my invention and desire to secure by Letters Patent of the United States is:

1. A device such as a rocket motor having a chamber in which combustion ingredients are burned, a fluid-tight jacket enclosing the exterior of said chamber, a pipe line connected to the interior of said jacket, the jacket forming with the chamber wall an annular chamber closed except for the connection of the pipe line thereto, means for supplying to said line fluid which is at a higher pressure than that obtaining in said chamber during operation of the device, and means for cutting off the supply of combustion ingredients to said chamber, said last-mentioned means being responsive to a fall in the pressure of the fluid in the interior of said jacket.

2. A device such as a rocket motor having a chamber in which combustion ingredients are burned, a fluid-tight jacket enclosing the exterior of said chamber, a pipe line connected to the interior of said jacket, the jacket forming with the chamber wall an annular chamber closed except for the connection of the pipe line thereto, means for supplying to said line fluid which is at a higher pressure than that obtaining in said chamber during operation of the device, said pipe line also in connection with a pressure-responsive switch, said switch arranged to control the circuit of a solenoid valve controlling a further supply of fluid pressure, and pressure-operated valves responsive to said further supply of fluid pressure for controlling the supply of combustion ingredients to said chamber.

3. A device, according to claim 2, and including a constriction in said pipe line disposed upstream of the connection of said line to the pressure-responsive switch.

4. A rocket motor having a chamber in which combustion ingredients are burned, a solenoid valve, fluid-pressure valves controlling the supply of the combustion ingredients to said chamber, said fluid-pressure valves operable by a source of pressure controlled by the solenoid valve, a fluid-tight jacket surrounding the exterior of said chamber, a pipe line supplying fluid to the interior of said jacket from a source which is at a pressure higher than would obtain in said chamber during operation of the rocket motor, the jacket forming with the chamber wall an annular chamber closed except for connection of the pipe line thereto, a constriction in said pipe line, and a pressure-responsive switch connected to said pipe line between said constriction and the jacket space, said switch adapted to control the circuit of the solenoid valve.

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