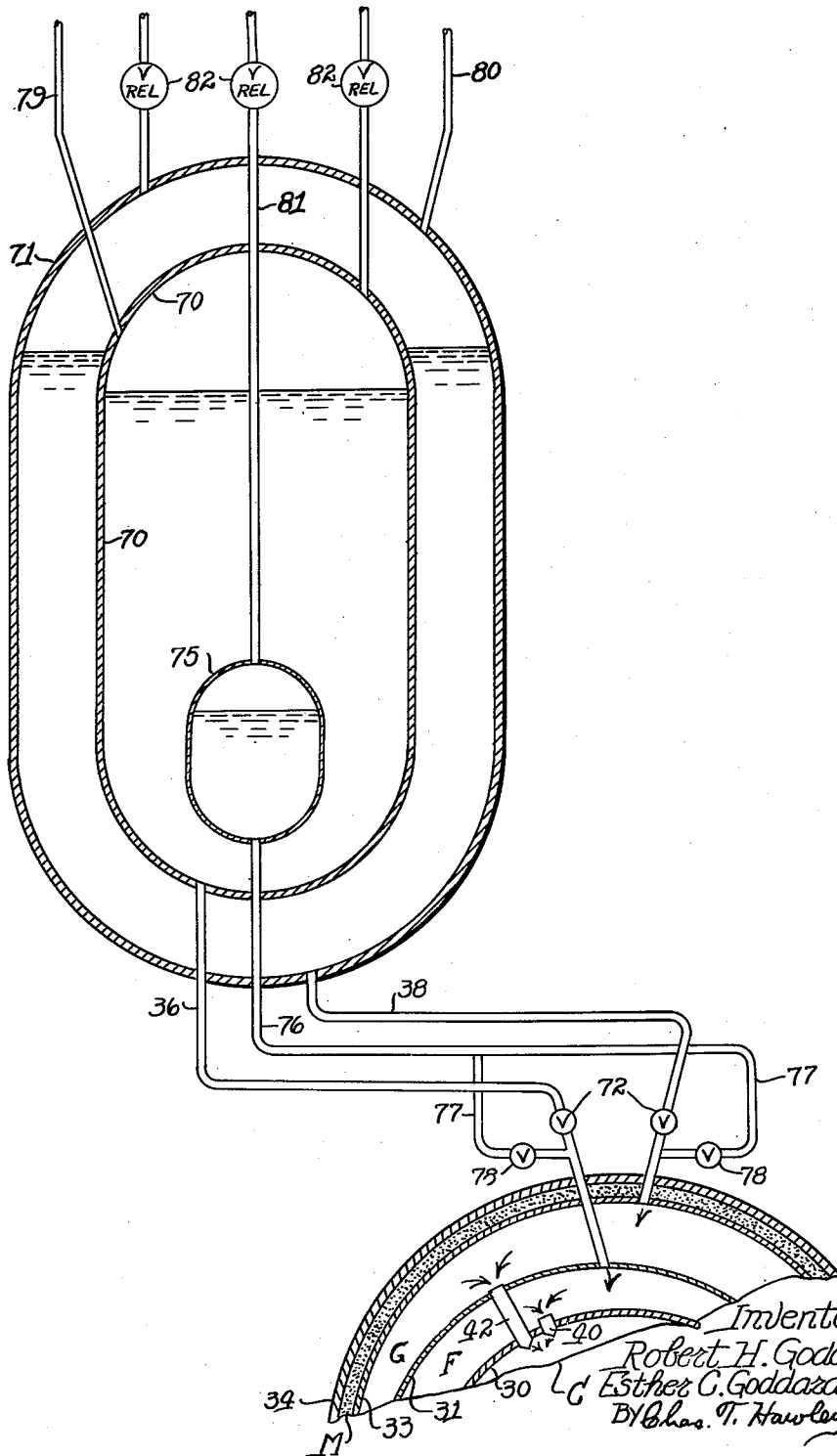


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SCAVENGING SYSTEM FOR ROCKET MOTORS
UTILIZING LIQUID NITROGEN
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SCAVENGING SYSTEM FOR ROCKET MOTORS UTILIZING LIQUID NITROGEN

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3 Claims. (Cl. 60—44)

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This invention relates to apparatus for feeding combustion liquids to a combustion chamber and is a division of Goddard application Serial No. 366,316, filed November 19, 1940, which issued March 12, 1946 as Patent No. 2,396,567.

The invention is particularly adapted for use in rocket apparatus or in other jet-propelled apparatus in which continuous combustion takes place in a combustion chamber having a normally open rearward discharge nozzle, and in which the combustion elements are supplied in liquid form and at very low temperatures. For a more complete disclosure of such apparatus, reference is made to the Goddard Patent No. 2,396,567, of which this is a divisional application.

The present application relates particularly to the construction shown in Fig. 15 of said original application and is concerned with the feeding of low-temperature combustion liquids to such a combustion chamber and with the scavenging of the connections to said combustion chamber on discontinuance of feed by filling said connections with an inert liquid or gas.

The invention is of particular utility where the combustible, oxidizing and scavenging fluids are all liquids but only at very low temperatures. As an illustrative example, liquid propane may be used as the combustible liquid, liquid oxygen as the oxidizing agent, and liquid nitrogen as the inert scavenging agent. All of these products are normally gaseous and are liquid only at extremely low temperatures.

The invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claims.

A preferred form of the invention is shown in the drawing which is a sectional elevation of one form of apparatus embodying the invention.

The invention is shown as associated with a combustion chamber C which comprises an inner chamber wall 30, an intermediate wall 31, and an outer wall 33, said latter wall being surrounded by a casing 34 spaced therefrom by any suitable insulating material M.

The space F between the inner wall 30 and the middle wall 31 is designed to receive liquid fuel, as propane, from an inner pressure storage tank 70 and to deliver said fuel to the chamber C in the form of sprays through short nozzle tubes 40. The space G between the middle wall 31 and the outer wall 33 is similarly adapted to receive liquid oxygen from the pressure storage space around the tank 70 and within an outer enclosing tank 71. The liquid oxygen is fed from the

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space G to the chamber C in the form of sprays delivered through relatively long tubular nozzles 42.

One only of each nozzle 40 and 42 is shown in the drawing but it will be understood that a multiplicity of such nozzles are provided, as shown and described in the original specification.

Pipes 36 and 38 connect the tanks 70 and 71 to the spaces F and G, which latter spaces form in effect jackets for the combustion chamber C. Valves 72 control the feed through the pipes 36 and 38. The tanks 70 and 71 are filled through feed pipes 79 and 80, and pressure relief valves 82 are provided for safety.

A small inner storage tank 75 is enclosed within the fuel tank 70 and is preferably located near the lower end thereof, as clearly shown in the drawing. This tank 75 is provided with a filler pipe 81 and with a delivery pipe 76 having branches 77 connected through valves 78 to the outlet portions of the pipes 36 and 38 beyond the valves 72. The inner tank 75 contains liquid nitrogen or some other inert low-temperature liquid under pressure. Any usual shut-off valve (not shown) is to be provided above the relief valve in the pipe 82, as the tank 75 must be held under pressure.

The boiling point of liquid oxygen being somewhat lower than the boiling point of propane, the immersion of the fuel tank 70 in the liquid oxygen maintains the propane below its boiling point and thus prevents formation of vapor which might cause gas-bind in the fuel feed pipe 36.

As a violently explosive mixture may easily be formed in the combustion chamber C if any remnants of oxygen and propane are left therein after combustion is stopped, the liquid nitrogen from the tank 75 is utilized for scavenging or clearing the portions of the pipes 36 and 38 below the valves 72, and also for neutralizing the jacket spaces F and G surrounding the combustion chamber.

To effect this operation, the valves 72 are closed to shut off further combustion, and the valves 78 are then opened to allow liquid nitrogen to flow into the lower ends of the pipes 36 and 38, thus forcing out any remnants of oxygen or propane which may have been left therein.

As the liquid nitrogen flows into the jacket spaces F and G, it will quickly start to vaporize and will force out of the jacket spaces F and G substantially all oxygen or propane which may have been left therein. If any remnants of oxygen and propane still remain, they will be so di-

luted by the inert nitrogen gas as to be incapable of forming an explosive mixture.

The tanks 70 and 71 may be conveniently filled by first filling the outer tank 71 with liquid oxygen, and then injecting propane gas into the tank 70, where it is condensed by the very low temperature of the surrounding liquid oxygen.

Having thus described the invention and the advantages thereof, it will be understood that the invention is not to be limited to the details herein disclosed, otherwise than as set forth in the claims, but that what is claimed is:

1. In combustion apparatus including a double jacketed combustion chamber, that improvement in feeding apparatus which comprises an outer tank for a low-temperature oxidizing liquid, an inner tank for a low-temperature combustible liquid, feeding connections from said tanks to separate chamber-jacketing spaces, means to control the flow of said liquids to said jacket spaces, feeding connections from said jacket spaces to said combustion chamber, and separate means to supply a low temperature inert liquid to scavenge all of said feeding connections and said jacket spaces after flow of said combustion liquids is discontinued.

2. In combustion apparatus including a double jacketed combustion chamber, that improvement in feeding apparatus which comprises an outer tank for a low-temperature oxidizing liquid, an inner tank for a low-temperature combustible liquid, feeding connections from said tanks to separate chamber-jacketing spaces, means to control the flow of said liquids to said jacket spaces, feeding connections from said jacket spaces to said combustion chamber, an auxiliary tank within said inner tank for an inert liquid, and feeding connections from said auxiliary tank to said first-named feeding connections, whereby all of said connections and said jacket spaces are

scavenged by said inert liquid after flow of said combustion liquids is discontinued.

3. In combustion apparatus including a combustion chamber, that improvement in feeding apparatus which comprises an outer tank for a low-temperature oxidizing liquid, an inner tank for a low-temperature combustible liquid, feeding connections from said tanks to said combustion chamber, valves to control the feed of said liquids through said connections, an auxiliary tank within said inner tank for an inert liquid, pipes connecting said auxiliary tank to said feeding connections beyond said control valves, and additional valves to control the flow of said inert liquid through said pipes, whereby said connections are scavenged after flow of said combustion liquids is discontinued.

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