60-253 CROSS REFERENCE SEARCH ROOM

Feb. 21, 1967 J. L. CULPEPPER 3,304,722

MEANS FOR SUPPLYING COLD GAS TO A PROPULSION JET IN OUTER SPACE

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Fig. 1

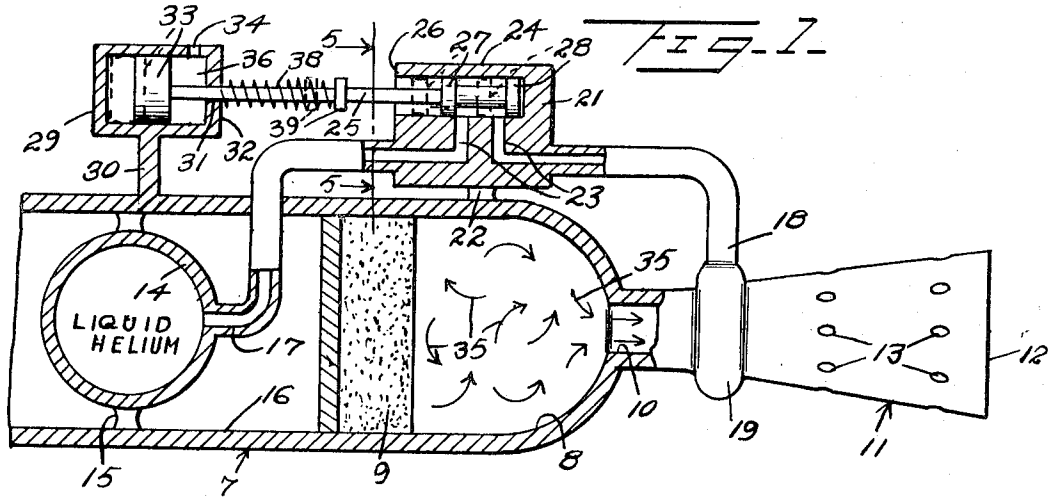


Fig. 2

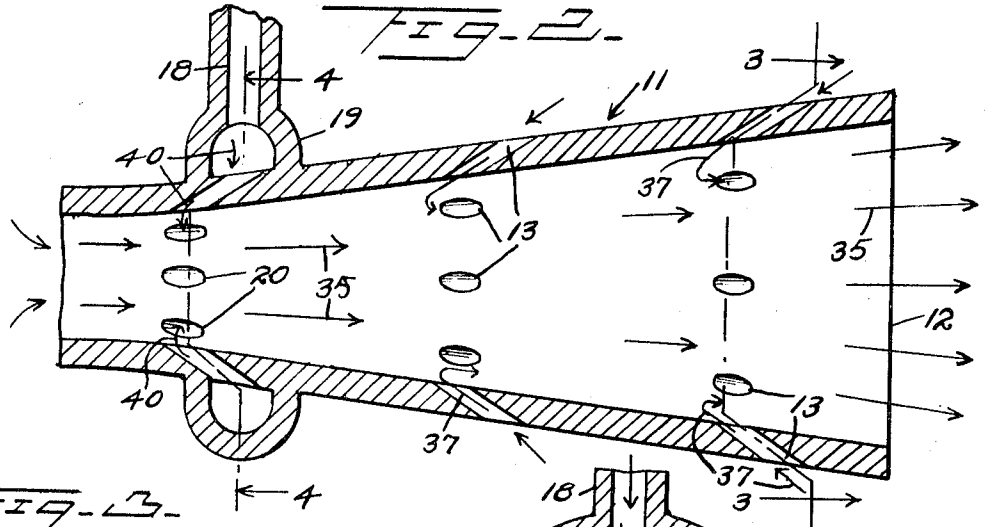


Fig. 3

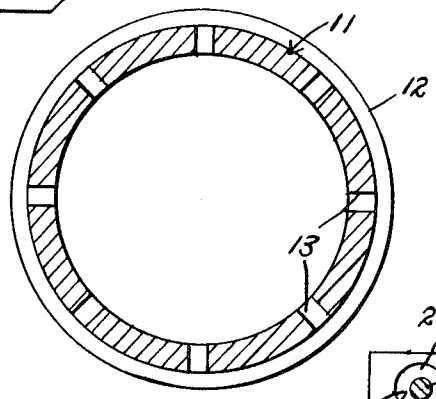


Fig. 4

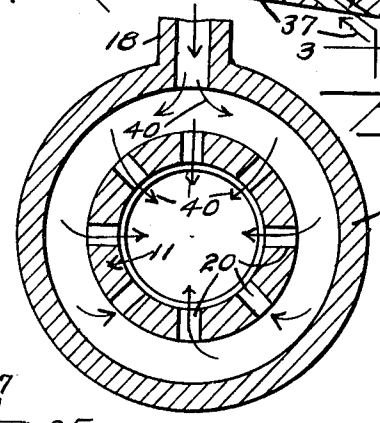
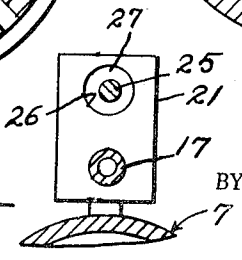


Fig. 5



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MEANS FOR SUPPLYING COLD GAS TO A PROPULSION JET IN OUTER SPACE

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This invention relates to an improved exhaust nozzle for a jet-type propulsion unit and more particularly to a means for admitting cool gas to the nozzle to be mixed with the hot exhaust gases passing rearwardly therethrough, for increasing the thrust of the vehicle and for cooling the nozzle.

An other object of the invention is to provide means whereby the exhaust nozzle will be supplied with cool air while the vehicle is in the earth's atmosphere and with another form of cool gas when the vehicle has passed beyond the earth's atmosphere.

A further object of the invention is to provide a nozzle construction wherein the air or other cool gas will be sucked into the exhaust nozzle by the accelerating and expanding gases passing rearwardly through the nozzle to be compressed by said exhaust gases; and wherein the cool gases initially travel in a direction opposite to the direction of movement of the exhaust gases and will be caused to accelerate rapidly in the direction of the movement of the exhaust gases upon intermingling therewith after entering the nozzle, so that a plasma contained in the cool gas which has a tendency to lag will exert a thrust on the vehicle in the direction opposite to the direction of travel of the exhaust gases.

Various other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawing, illustrating a presently preferred embodiment thereof; and wherein:

FIGURE 1 is a longitudinal sectional view partly in side elevation of a portion of a jet propulsion unit equipped with the improved rocket nozzle;

FIGURE 2 is an enlarged fragmentary longitudinal substantially central sectional view of the nozzle;

FIGURE 3 is a cross sectional view of the nozzle taken substantially along the line 3—3 of FIGURE 2;

FIGURE 4 is a cross sectional view thereof taken substantially along the line 4—4 of FIGURE 2, and

FIGURE 5 is an enlarged fragmentary cross sectional view taken substantially along a plane as indicated by the line 5—5 of FIGURE 1.

Referring more specifically to the drawing, the numeral 7 designates a portion of a casing of a jet-type propulsion unit which includes a combustion chamber 8, shown containing a solid-type propellant 9. However, it is to be understood that other types of fuel may be utilized. The rear end of the chamber 8 opens into the throat 10 of a conical exhaust nozzle 11 which is flared from said throat to its rear exit end 12.

The nozzle 11 is shown provided with a plurality of ports 13 which are spaced from the throat 10, and all of which are shown inclined forwardly or toward the throat 10 from their outer to their inner ends. For the purpose of clarity, the size of the ports 13 have been exaggerated. Preferably, a greater number of ports 13 would be provided with the ports made substantially smaller than as illustrated.

A tank or container 14, which is preferably spherical, is shown fixedly mounted by suitable supports 15 in a chamber 16 of the casing 7 which is disposed in advance of the combustion chamber 8. A conduit 17 has one end communicating with the tank 14 and extends therefrom outwardly from the chamber 16 through a part of the casing 7, and thence rearwardly of the casing. The conduit 17 has an inturned opposite end 18 which is connected to and communicates with a manifold 19, as best seen in FIGURE 2. The manifold 19 is formed on and around a part of the nozzle 11 between the throat 10 and the ports 13. The nozzle 11 has a ring of ports 20 communicating with the manifold and opening into the nozzle, and which ports 20 are likewise inclined toward the throat 10. The ports 20 have likewise been shown enlarged for the sake of clarity and a greater number of smaller ports would preferably be provided.

A valve housing 21 is mounted externally on the chamber 8 by a support 22 and is interposed in the conduit 17, so that adjacent portions 23 of said conduit 17 open into a chamber 24 of the housing 21. The rear portion of a valve stem 25 extends into the chamber 24 through an open forward end 26 thereof and has two spaced valves 27 and 28 fixed thereto and fitting slidably in the chamber 24.

A cylinder 29 is mounted externally of the chamber 16 and forwardly of the housing 21 on a support 30 which extends outwardly from the casing 7. A forward part of the valve stem 25 extends reciprocably through a central opening 31 in a rear wall 32 of a cylinder 29 and is secured to a piston 33 which is reciprocably mounted in said cylinder. The cylinder 29 is closed except for the opening 31 and a port 34 which is disposed adjacent the rear wall 32.

The vehicle is propelled through the earth's atmosphere by the extremely hot gases of combustion, as indicated by the arrows 35, which are generated in the combustion chamber 8 from the fuel 9 and which are initially compressed in passing through the throat 10 from the chamber 8 and thereafter permitted to expand as said gases accelerate in passing rearwardly through the nozzle 11 and outwardly from its exhaust end 12, for propelling the vehicle from right to left of FIGURE 1. While the vehicle is traveling in the earth's atmosphere, atmospheric pressure will enter the cylinder chamber 36 through the port 34 for retaining the piston 33, the valve stem 25, and valves 27 and 28 in their dotted line positions of FIGURE 1. Thus, the valve 27 will seal the forward end 26 of the chamber 24 and the valve 28 will be disposed between and will seal off the passage ends 23 from one another, so that none of the helium from the tank 14 can pass through the conduit 17 to the manifold 19. The accelerating gases 35 in passing rearwardly through the nozzle 11 will create a suction in the ports 13 for drawing cool air inwardly therethrough, as indicated by the arrows 37. The cool air in passing inwardly through the ports 13 will initially be traveling in a direction opposite to the gases 35, and upon entering the nozzle the direction of travel of the cool air will be suddenly reversed as it mingles with and is propelled rearwardly by the exhaust gases. Due to the flaring shape of the nozzle 11 toward its rear end 12, the exhaust gases will not be compressed by the air. However, the cool air becoming mixed with the exhaust gases will substantially increase the thrust exerted by the nozzle and will also cool the nozzle. In addition, the plasma contained in the cool air or other gases and which is not subject to undue turbulence has a tendency to lag when the air or gas is accelerated rapidly. Accordingly, when the air is rapidly accelerated in a rearward direction in the nozzle 11, the lagging plasma exerts a forward thrust on the nozzle in a direction opposite to the direction of movement of the air and exhaust gases.

A light coiled compression spring 38 is disposed on the stem 25 between the valve housing 21 and cylinder 29 with one end bearing against the cylinder wall 32 and its opposite end bearing against a stop collar 39 which is fixed to the stem. Atmospheric pressure in the chamber 36 is sufficient to overcome the pressure of the spring 38 to

hold said spring compressed and the collar **39** in its dotted line position of FIGURE 1 in the aforementioned closed, dotted line positions of the valves **27** and **28**. When the vehicle passes out of the earth's atmosphere, pressure in the chamber **36** will diminish and the spring **38** will then cause the piston **33**, the stem **25**, and the valves **27** and **28** to move to their full line positions of FIGURE 1, with the adjacent passage ends **23** being disposed between the valves **27** and **28**. When this occurs, a part of the liquid helium in the tank **14** evaporates and the resulting gas passes through the conduit **17** and chamber **24** to the manifold **19** from whence it enters the nozzle **11** through the ports **20**, as indicated by the arrows **40**. The helium gas travels through the ports **20** in the same manner as the air enters through the ports **13** to function in the same manner as the air, so that its plasma content will exert a forward thrust in the same manner as heretofore described. The ports **20** must be a sufficient distance from the combustion chamber **8** so that the cool gases will not interfere with the jet being formed by the exhaust gases **35**; and the ports **20** and **13** must be in a flaring portion of the nozzle so that the air or helium gas in entering the nozzle will not tend to compress the jet formed by the exhaust gases.

Various modifications and changes are contemplated and may obviously be resorted to without departing from the function or scope of the invention, as hereinafter defined by the appended claims.

I claim as my invention:

1. In a jet-type propulsion unit, a substantially conical rocket nozzle having a restricted throat at its forward end adapted to communicate with and receive exhaust gases from a combustion chamber, said nozzle having a plurality of ports extending therethrough and arranged uniformly therearound for admitting cool air from the atmosphere to the interior of the nozzle for increasing the thrust of the exhaust jet and for cooling the nozzle, a manifold mounted on and surrounding a part of said nozzle, a conduit having an outlet end discharging into said manifold and an inlet end adapted to be connected to a source of supply of a cold gas, valve means interposed in said conduit, means responsive to atmospheric pressure for holding said valve means closed, means for opening the valve means when the atmospheric pressure is diminished for supplying the gas to the manifold through said conduit, and said nozzle having ports communicating with the manifold and opening into the nozzle through which the cold gas enters the nozzle to mix with the exhaust gases to increase the thrust exerted thereby and to cool the nozzle.

2. In a jet-type propulsion unit, a substantially conical rocket nozzle having a restricted throat at its forward end adapted to communicate with and receive exhaust gases from a combustion chamber, said nozzle having a plurality of ports extending therethrough and arranged uniformly therearound for admitting cool air from the atmosphere to the interior of the nozzle for increasing the thrust of the exhaust jet and for cooling the nozzle, said nozzle having additional intake ports, a conduit for supplying cold gas to the nozzle through said last mentioned ports, a valve interposed in said conduit, and means responsive to atmospheric pressure for closing said valve when the propulsion unit is operating in the earth's atmosphere and air is being supplied to the nozzle through the first mentioned ports.

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