Jan. 13, 1959 R. S. BUCK 2,867,977

SELF-STABILIZED BURNER

Filed Oct. 2, 1953

FIG. 1

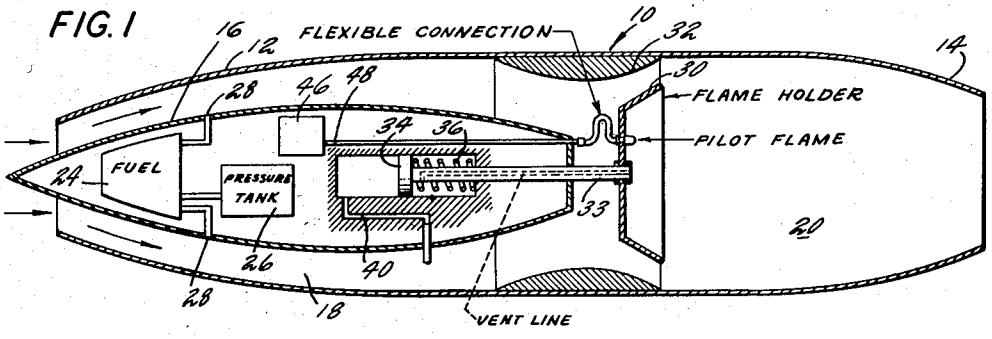


FIG. 2

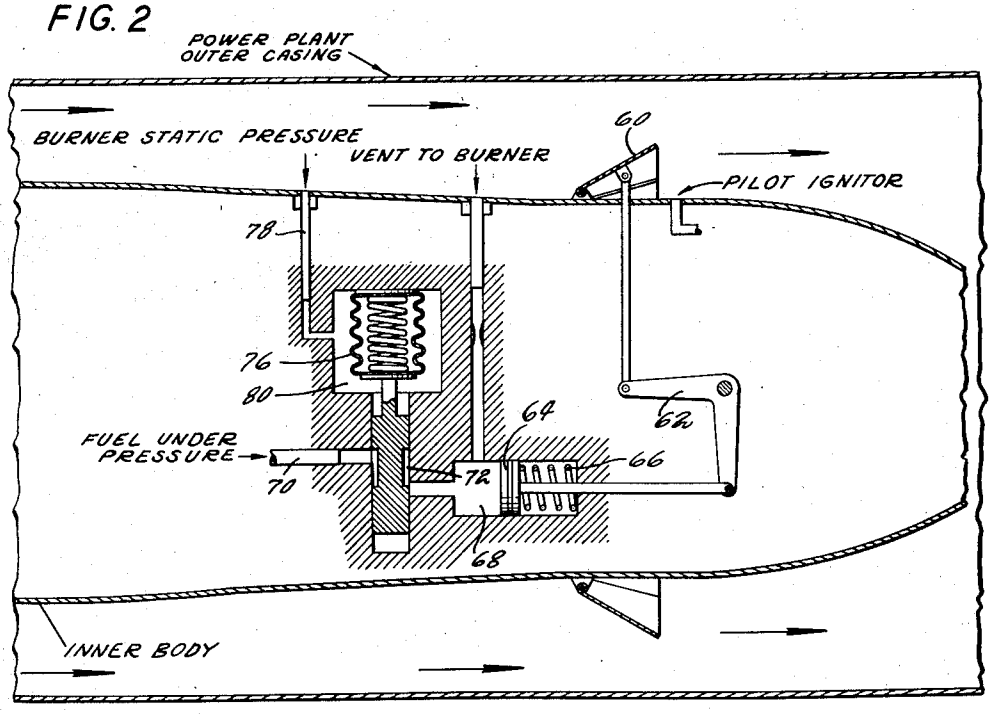
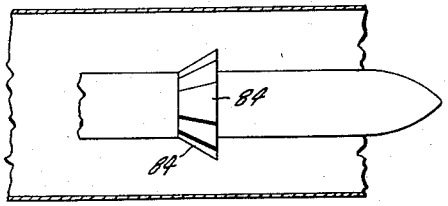


FIG. 3



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SELF-STABILIZED BURNER

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3 Claims. (Cl. 60—35.6)

This invention relates to ramjet power plants and the like and more particularly to flamespreaders for such power plants.

It is an object of this invention to provide a flamespreader for a ramjet burner which is movable to vary the area of blockage created by the flamespreader.

Another object of this invention is to provide a movable flamespreader for a ramjet burner including mechanism for automatically controlling the movement thereof in response to pressure in the power plant or any other desirable parameter of operation.

These and other objects will become readily apparent from the following detail description of the drawing in which:

Fig. 1 is a cross-sectional view of a ramjet power plant having a flamespreader device according to this invention.

Fig. 2 is an enlarged schematic illustration of a modified form of the flamespreader actuating mechanism; and

Fig. 3 is a partial illustration of the general form which the flamespreader of Fig. 2 may take.

Combustion efficiency in a ramjet power plant may be affected by various factors. First of all it has been found by tests that if the burner inlet pressure of a ramjet power plant is reduced, a reduction in burner efficiency results. This trend is accelerated in lower burner inlet pressures. The greatest burner inlet pressure variation results from variations in altitude for a given Mach number of the vehicle in which the power plant is located. Smaller changes in burner inlet pressure may be effected by changes in fuel-air ratio which can result when pressure pulses move upstream of the burner where these pulses can effect fuel flow out of fuel injection nozzles. This invention is intended to solve the foregoing problems.

Referring to Fig. 1, a ramjet power plant is generally indicated at **10** and includes an outer casing **12** which terminates in an aft exhaust nozzle **14**. An inner streamline body **16** is located within the casing **12** so that a diffuser passage **18** is formed therebetween which is intended to increase the pressure of the airflow therethrough prior to exhausting such air into the combustion chamber **20**.

A main fuel tank **24** has a pressurizing tank **26** connected thereto so that fuel may be fed into the diffuser passage **18** by means of injection nozzles **28**. The fuel is injected as far as possible upstream of the burner so that a thorough mixing of the fuel and air is achieved.

The inner body **16** terminates adjacent the burner section **20** and carries a flameholder **30** which is in the form of a flanged member which has its outer periphery intended for cooperation with the restriction **32** in the casing **12**. The flamespreader or flameholder **30** is mounted on a rod **33** which in turn is fixed to a movable piston **34**. A spring **36** urges the piston **34** and the flameholder **30** toward the left which tends to decrease the flow area defined between the flamespreader **30** and the restriction **32**. This in effect increases the amount of flow blockage produced by the flamespreader **30**. A line **40** senses the pressure adjacent the inlet to the combustion chamber. This pressure is conducted to the left side of the piston **34** so that it urges the piston **34** and the flamespreader **30** toward the right to increase the flow passage or in other words decrease the amount of blockage produced by the flamespreader.

As stated above, it has been found that a reduction in burner inlet pressure reduced the burner efficiency. It has been found that by increasing the amount of blockage produced by the flamespreader when a reduction of burner pressure occurs the burner efficiency can be maintained at a higher level than is possible with a fixed blockage flameholder. Thus it will be apparent that when the inlet pressure in the line **40** is reduced the piston **34** will be moved toward the left by the spring **36** to increase the amount of blockage produced by the flamespreader or flameholder **30**. The spring side of the piston **34** is vented to the combustion chamber by means of a passage in the rod **33**.

As also noted above, variations in fuel-air ratio can cause changes in burner inlet pressure while also pressure surges can be built up so that an unstable operation ensues. In other words, pressure waves can originate in the combustion chamber and tend to move upstream. With a fixed blockage flameholder construction these pressure surges can move upstream where they will effect the flow from the fuel nozzles **28** thus in turn varying the fuel-air ratio so that the original pressure fluctuations may be amplified to further reduce efficiency due to rough combustion. With this construction of flameholder, in the event a pressure wave tends to move upstream from the burner, this pressure will act on the flameholder tending to close off the air passage between the flameholder and the restriction **32**, or in other words, increase the blockage so as to reduce, momentarily at least, the pressure in the combustion chamber. In the event that the pressure waves find their way upstream where they might produce a feedback on the fuel system the passage **40** will sense the pressure wave prior to its moving upstream of the diffuser to decrease the blockage produced by the flamespreader so as to relieve the flow upstream thereof to reduce any feedback component from the pressure pulses.

A tank **46** may be provided within the inner body **16** for carrying combustible ingredients which can be piped via the line **48** to a point **50** on the downstream side of the flameholder **30** to provide a continuous pilot flame on the problem area on the downstream side of the flameholder.

Fig. 2 illustrates a modified form of flameholder actuating mechanism. Here for example a flameholder element **60** is operatively connected to a bellcrank **62** which in turn is intended to be actuated by a piston **64**. The piston **64** is urged toward the left by a spring **66** and toward the right by pressure admitted to the chamber **68**. Fuel under pressure from the line **70** is controlled by a pilot valve **72** which will maintain a predetermined pressure in the chamber **68** dependent upon the position of the pilot valve. The pilot valve is actuated by an evacuated bellows **76** which is exposed on its outer surface to the static pressure in the burner which pressure is conducted to the outer surface of the bellows via a line **78** and into chamber **80**. The mechanism just described is intended to operate similar to that shown in Fig. 1 with the exception that fuel under pressure is utilized as the motive force for controlling the piston **64**. The flameholder member **60** is shown schematically and is one of a plurality of overlapping flap members such as **84** illustrated in Fig. 3. The actual operating linkages for a plurality of flaps may take any form as for example well known devices for operating aircraft engine cowl flaps. These flap members may be actuated similar to the Fig. 1 and Fig. 2 devices and opened and closed similar to an iris action.

Although several embodiments of this invention have

been illustrated and described herein it will be apparent that various changes and modifications may be made in the construction and arrangement of the various parts without departing from the scope of this novel concept.

What it is desired to obtain by Letters Patent is:

1. In a ramjet power plant having a diffuser, a combustion chamber downstream of said diffuser and receiving gases from said diffuser, an exhaust nozzle for discharging gases from said combustion chamber, means for injecting fuel into said combustion chamber, means for igniting the fuel-air mixture located downstream of said injecting means, a flamespreader adjacent said igniting means comprising a member blocking a portion of the passage formed by said combustion chamber, and means for automatically adjusting the position of said member in any one of a number of positions in a range including mechanism for sensing the pressure of the gases approaching said combustion chamber, the amount of blockage of said passage being proportional to the pressure sensed by said sensing mechanism.

2. In a ramjet power plant having a diffuser receiving air from the airstream, a combustion chamber forming a passage downstream of said diffuser and receiving gases from said diffuser, an exhaust nozzle for discharging gases from said combustion chamber, means for injecting fuel into the power plant, means for igniting the fuel-air mixture located downstream of said injecting means, a flamespreader adjacent said igniting means comprising at least one member blocking a portion of the passage formed by said combustion chamber and creating a protected area on the downstream side thereof, means for automatically positioning said member to vary the amount of blockage of said passage, a source of fluid under pressure, said positioning means including a fluid operated servo device connected to said member, means

for controlling the amount of fluid flowing from said source to said servo to position said member, and means for sensing the pressure of the gases approaching said combustion chamber for positioning said controlling means in a plurality of positions in proportion to the value of said pressure.

3. In a ramjet power plant having an outer casing, a streamlined body within said casing forming an annular diffuser passage between said body and said casing, a combustion chamber receiving gases from said diffuser and having an exhaust nozzle therefor, said inner body terminating adjacent the upstream end of said combustion chamber, means for injecting fuel into said passage upstream of said combustion chamber, a flamespreader adjacent the downstream end of said inner body comprising at least one imperforate flangelike member extending transversely of the axis of fluid flow through the power plant and blocking a portion of said passage, means for moving said member relative to said inner body for varying the amount of blockage of said pasage by proportional increments, means for biasing said member in a decrease blockage direction, and means responsive to the pressure of the gases approaching said combustion chamber for urging said member in a blockage increase direction proportional to the pressure of said gases.

References Cited in the file of this patent

UNITED STATES PATENTS

2,655,787	Brown	Oct. 20, 1953
2,696,709	Oulianoff	Dec. 14, 1954

FOREIGN PATENTS

648,497	Great Britain	Jan. 3, 1954