

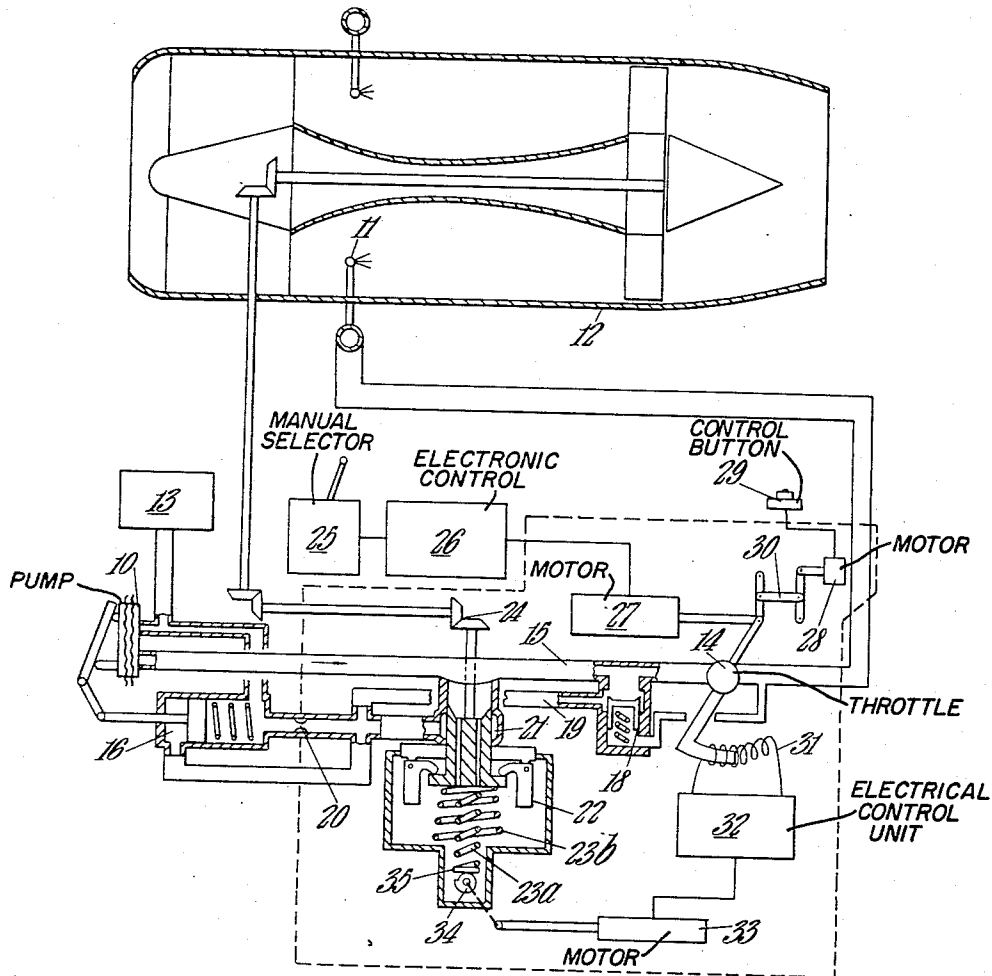
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FUEL SYSTEMS FOR GAS TURBINE ENGINES

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FUEL SYSTEMS FOR GAS TURBINE ENGINES
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ABSTRACT OF THE DISCLOSURE

A fuel system for a gas turbine engine having a throttle arranged on the downstream side of a fuel pump and an engine speed responsive governor for protecting the engine from overspeeding by limiting the amount of fuel delivered. A main manually operable power means for varying the throttle setting and an auxiliary manually operable power means for varying the throttle setting due to failure of the main power means are provided. Also included are means energized when the auxiliary power means is energized and responsive to changes in the throttle setting and arranged to modify the response of the governor to engine speed.

This invention relates to fuel systems for gas turbine engines and of the kind comprising a fuel pump which is capable of delivering fuel to the engine through a throttle, an engine-speed responsive governor for protecting the engine against overspeeding by limiting the quantity of fuel delivered thereto, a main manually operable power means for varying the setting of the throttle in accordance with certain predetermined requirements, and an auxiliary manually operable power means also for varying the setting of the throttle, with said auxiliary power means being intended for use in the event of failure of the main power means.

The object of the present invention is to provide a fuel system of the kind specified, in a convenient form.

According to the present invention, a fuel system of the kind specified is characterized by the provision of apparatus energized when the auxiliary power means is energized, and being responsive to changes in the throttle setting to modify the response of the governor to engine speed.

A specific example of the invention will now be described with reference to the accompanying drawing which is a diagrammatic representation of a fuel system for a gas turbine engine for installation in an aircraft.

In this example the fuel system comprises a variable stroke swash-plate type pump 10 for delivering fuel to burners 11 in an engine 12, the fuel being supplied from a tank 13. There is a throttle 14 disposed in supply pipe 15 between the pump 10 and the burners 11, and the stroke of the pump 10 is controlled by a piston and cylinder type servo mechanism 16 one end of which is subjected to pump inlet pressure and this end also containing a spring, and the other end of the mechanism 16 is subjected to the pressure at the downstream side of the pump as modified by a valve 18, through a pipe 19.

This valve 18 per se is responsive to changes in the pressure drop across the throttle 14. Fuel in the pipe 19 can also reach the inlet of the pump 10 through a restriction 20. With this arrangement, should the quantity of fuel delivered by the pump exceed that which can pass the throttle 14, the excess fuel will be spilled through the valve 18 and will also exert a pressure on the servo mechanism 14 to reduce the pump stroke until the correct quantity of fuel is being delivered to the engine. The pump stroke is likewise increased if the quantity of fuel being delivered is inadequate.

The system also has a further valve 21 which can also

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permit flow of fuel from the supply pipe 15 through the restriction 20 to the pump inlet. This valve 21 is operated by an engine speed responsive governor 22 which, in this example is of the fly-weight type, and has springs 23a and 23b, the loading of which determine the engine speed at which the valve 21 opens, with the valve and governor being rotatable by the engine 12 through suit-gearing indicated by numeral 24.

The system also includes main power means for varying the setting of the throttle 14, comprising a manually operable selector 25 for energizing an automatic electronic control 26 incorporating means responsive to the various functions which dictate safe engine control during acceleration, deceleration and steady running conditions of the engine. The main power means also includes an alternating current electric motor 27 which is connected to the throttle 14.

The system further includes an auxiliary power means in the form of a direct current electric motor 28 which can be run at a slow speed under the direct control of the aircraft pilot through a button 29. This motor 28 cannot be run at a speed which will induce stalling of the engine due to excess fuelling. The auxiliary power means for setting the throttle 14 is part of an emergency stand-by system in an aircraft, for use in the event of the failure of the main power means and is supplied from a separate power source (not shown). The two motors 27 and 28 are capable of moving the throttle 14 independently and the drive takes place through a leverage mechanism 30 or alternatively through a differential gearbox.

For use only when the auxiliary power means is energized, there is provided apparatus comprising a device 31 which in this example, is a variable inductance but may alternatively be a variable capacitance, which senses changes in the setting of the throttle 14 and generates an electrical signal which is fed to an electrical control unit 32 arranged to energize an electric motor 33 which, in turn varies the position of a cam 34 which engages a movable abutment 35 for the spring 23a of the governor 22.

With this arrangement, changes in the throttle setting are used to vary the response of the governor 22 to engine speed and thus the speed at which the valve 21 will open to permit spill. It will be appreciated that normally, when the main power means is in operation, the governor 22 acts as a topspeed governor only, but when the auxiliary power means is in use, the governor 22 response is modified to minimize the risk of overspeeding at throttle settings below the maximum as well as at the maximum speed of the engine.

When the auxiliary power means is in operation due to failure of the main power means, or for any other reason, the pilot can thus select any fuel flow rate as may be required under varying conditions.

At a point during throttle movement, the engine speed ceases to be determined solely by the flow permitted by the throttle and is determined at least in part by the governor 22. The engine speed at which this occurs is dependent upon aircraft speed, altitude, and climatic conditions. In most instances the upper 10% of the speed range of the engine is subject to control by the governor 22, this being the range over which, most of the time, an aircraft engine is run. Thus speed selection over this range is by the pilot's button 29 but the governor 22 ensures that the selected speed is maintained substantially constant. The invention is not to be confined to any strict conformity to the showings in the drawings but changes or modifications may be made therein so long as such changes or modifications mark no material departure from the spirit and scope of the appended claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A fuel system for a gas turbine engine comprising a fuel pump, a throttle arranged on the downstream side of the pump, an engine speed responsive governor arranged to protect the engine from overspeeding by limiting the amount of fuel delivered thereto, a main manually operable power means for varying the throttle setting, an auxiliary manually operable power means for varying the throttle setting in the event of failure of the main power means, and apparatus energized when the auxiliary power means is energized, and responsive to changes in the throttle setting to modify in variable manner the response of the governor to engine speed.

2. The fuel system as claimed in claim 1 in which said

governor is provided with biasing means and said apparatus includes electrical signal producing means, with said signal being responsive to changes in the throttle setting, and said signal being transmitted to a device for varying the biasing means of the governor, changes in said biasing means varying the response of the governor to engine speed.

References Cited

UNITED STATES PATENTS

2,683,965	7/1954	Nagely	60—39.28
2,820,340	1/1958	Dolza et al.	60—39.28 XR

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