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MEANS FOR CONTROLLING THE SPEED OF JET-PROPELLED AIRCRAFT, MISSILES OR OTHER AERIAL BODIES BY REGULATING THE FUEL SUPPLIED THERETO IN ACCORDANCE WITH SHOCK WAVES PRODUCED BY THE MOTION THEREOF

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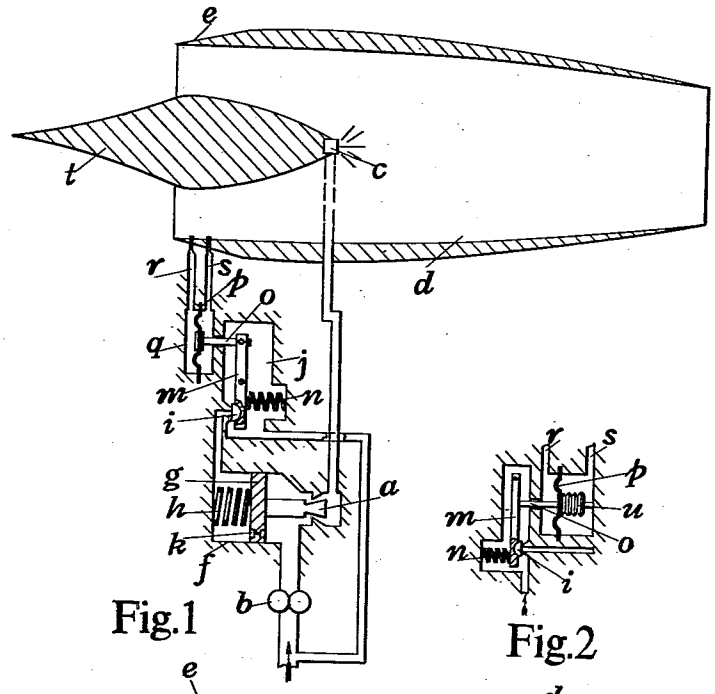


Fig.1

Fig.2

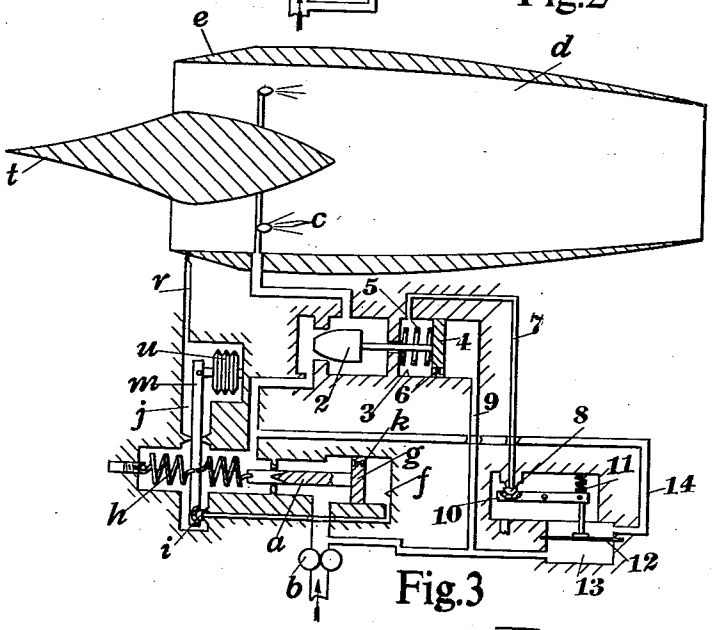


Fig.3

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4 Claims. (Cl. 60—35.6)

This invention relates to means for controlling the supply of liquid or gaseous fuel to ram jet-propelled aircraft, missiles or other aerial bodies when moving at or above sonic speeds.

The invention comprises means responsive to change of position of the shock wave for controlling the fuel supply.

In the accompanying drawings:

Figures 1–3 illustrate diagrammatically two embodiments of the invention.

Referring to Figure 1, there is provided a liquid-operated servo-mechanism for actuating a throttle *a* which regulates the rate of supply of liquid fuel from a pump *b* to the burner *c* in the combustion chamber *d* of the hollow aerial body *e*. The servo-mechanism comprises a cylinder *f* containing a piston *g* which is loaded by a spring *h*, the piston being formed on or secured to one end of the throttle *a*. One end of the cylinder *f* is in communication with the pump. The other end is in communication with a vent valve *i* contained in a chamber *j* which latter communicates with the inlet side of the pump. Both ends of the cylinder *f* are in communication with each other through a restricted orifice *k* which may be conveniently provided in the piston.

The valve *i* is carried by a lever *m* loaded by a spring *n*, and the lever is connected by a stem *o* to a diaphragm (or piston) *p* which divides a chamber *q* into two compartments. These compartments communicate by way of passages *r*, *s* into the interior of the body *e* at a position near its front end, the entrances to the passages being arranged at a convenient distance apart.

When the body is moving at a given speed the shock wave lies ahead of the passages *r*, *s* and the open ends of the said passages are then subject to substantially equal air pressures. In this condition, the valve *i* is closed and the throttle *a* occupies its fully open position allowing a full supply of liquid fuel to pass to the burner *c*. But with increase of speed the shock wave moves inwardly and when it occupies a position between the passages *r*, *s*, the passage *s* is subject to a higher air-pressure than the passage *r*. The difference of pressure then acting on the diaphragm *p* causes the valve *i* to open, and under the preponderating liquid pressure which then acts on the piston *g* in opposition to the spring *h*, the throttle *a* is moved towards its closed position for restricting the rate of supply of fuel to the burner.

An alternative means for actuating the valve lever *m* is shown in Figure 2. In this example, the compartment communicating with the passage *s* contains an evacuated capsule *u* attached to the diaphragm *p*, so that the effective area of the adjacent side of the diaphragm is less than that of the other side. In this case the diaphragm responds to the ratio of the pressures acting on its opposite sides, and the arrangement enables the passages *r*, *s* to be more widely spaced than the arrangement shown in Figure 1.

It will be understood that the servo-mechanism described above may be employed to actuate other known means for varying the pump output.

In the example shown in Figure 3, the throttle *a* and associated servo-mechanism is essentially similar to that shown in Figure 1, but in this example only one passage as *r* is provided in communication with the forward end of the interior of the body *e*, and the pressure therein acts on an evacuated elastic capsule *u* for actuating the lever *m* of the servo-vent valve *i*. Variation of the pressure in the passage *r* results in variation of the amount of opening of the valve *i* and the consequent variation of the position of the throttle *a*, increased air pressure being accompanied by increased fuel supply to the combustion chamber.

To regulate the rate of flow of fuel to the burner in response to variations of air pressure there is provided between the throttle *a* and the burner *c*, a second throttle **2**. This is actuated by a second servo-mechanism comprising a cylinder **3**, and a piston **4** connected to the throttle **2** and loaded by a spring **5**. The two ends of the cylinder are in communication with each other through a restricted orifice **6**. The end of the cylinder containing the spring communicates by way of a passage **7** with the vent valve **8** and the other end communicates with the pump outlet by way of a passage **9**. The vent valve is actuated by a lever **10** loaded by a spring **11**, the lever being connected to a diaphragm (or piston) **12** which divides a chamber **13** into two compartments. One of these compartments communicates with the delivery side of the pump *b*, and the other by way of a passage **14** with the fuel passage at the outlet side of the throttle *a*. Variations of the difference of fuel pressure at the inlet and outlet sides of the throttle *a* thus serve to vary the extent of opening of the throttle **2**.

When the shock wave lies ahead of the passage *r* the pressure in the said passage will affect to a variable extent the opening of the throttle *a*. But at a higher speed the shock wave lies behind the passage *r*, and the latter is then subject to the lower air pressure existing ahead of the shock wave, whereupon the valve *i* closes and the throttle *a* is moved to or towards its fully closed position. Movement of the throttle *a* varies the fuel pressure difference acting on the diaphragm (or piston) **12**, and the consequential movement of the latter varies the position of the vent valve **8** for causing the piston **4** of the second servo-mechanism to move the second throttle **2** towards its closed position with increase in the aforesaid pressure difference and vice versa.

The invention is, however, not limited to the examples above described as the effect of change of position of the shock wave may be utilised in other ways for regulating the rate of supply of fuel to the burner.

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

1. In a ram-jet propelled body provided with propulsion means whereby said body is movable at or above sonic speeds, means for detecting a change in the position relative to said body of the shock wave produced by the motion of said body, and fuel regulating means operable under the control of the detecting means to reduce the supply of fuel to said propulsion means when a change in the position of the shock wave results from the motion of said body exceeding a predetermined speed.

2. In a ram-jet propelled body provided with propulsion means whereby said body is movable at or above sonic speeds, means operable by air pressure for detecting a change in the position relative to said body of the shock wave produced by the motion of said body, means for conducting operating air from the neighbourhood of the front end of said body to the detecting means, a liquid operated servo-mechanism controlled by said detecting means, and fuel regulating means oper-

able by said servo-mechanism to reduce the supply of fuel to said propulsion means when a change in the position of the shock wave results from the motion of said body exceeding a predetermined speed.

3. In a ram-jet propelled body provided with propulsion means whereby said body is movable at or above sonic speeds, means operable by air pressure for detecting a change in the position relative to said body of the shock wave produced by the motion of said body, means for conducting operating air from spaced positions in the neighbourhood of the front end of said body to the detecting means, a liquid operated servo-mechanism controlled by said detecting means, and fuel regulating means operable by said servo-mechanism to reduce the supply of fuel to said propulsion means when a change in the position of the shock wave results from the motion of said body exceeding a predetermined speed.

4. In a ram-jet propelled body provided with propulsion means whereby said body is movable at or above sonic speeds, means operable by air pressure for detecting a change in the position relative to said body of the shock wave produced by the motion of said body, means for conducting operating air from the neighbourhood of

the front end of said body to the detecting means, a liquid operated servo-mechanism controlled by said detecting means, a first fuel regulating throttle valve operable by said servo-mechanism to reduce the supply of fuel to said propulsion means when a change in the position of the shock wave results from the motion of said body exceeding a predetermined speed, a second fuel regulating throttle valve, and a second liquid operated servo-mechanism for actuating said second throttle valve in response to the difference in fuel pressures at the inlet and outlet sides of said first throttle valve.

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