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R. J. IFIELD
MEANS FOR EFFECTING AND CONTROLLING THE
SUPPLY OF LIQUID FUEL TO PRIME MOVERS

2,667,918

Filed April 20, 1948

2 Sheets-Sheet 1

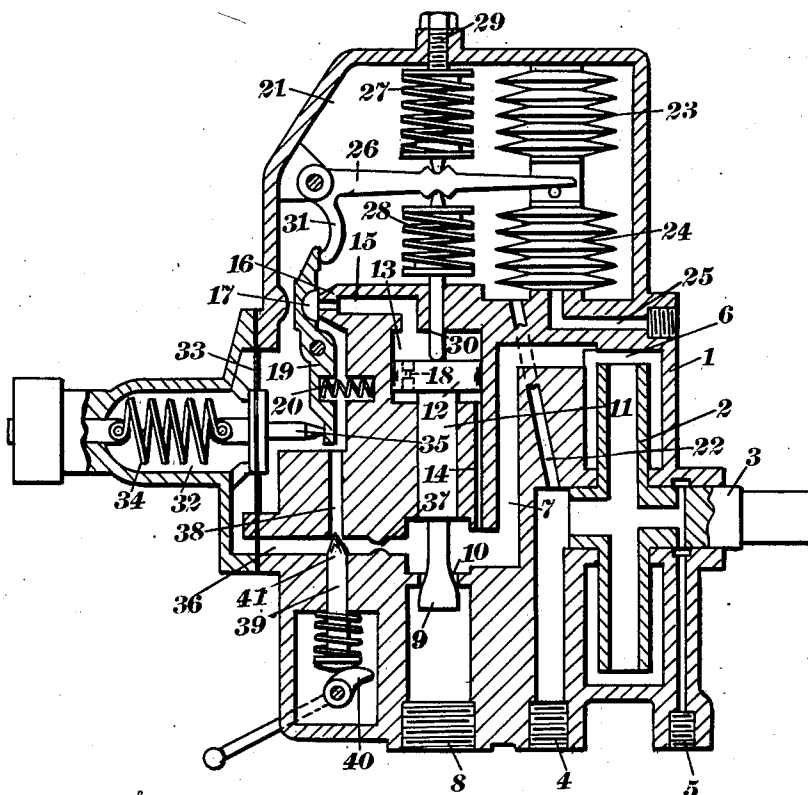


Fig.1

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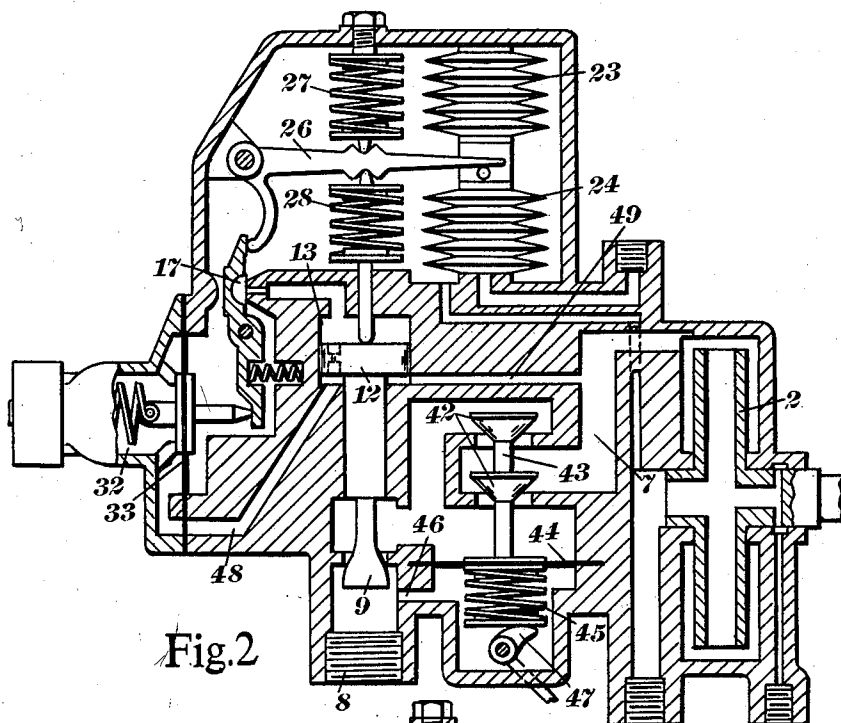


Fig. 2

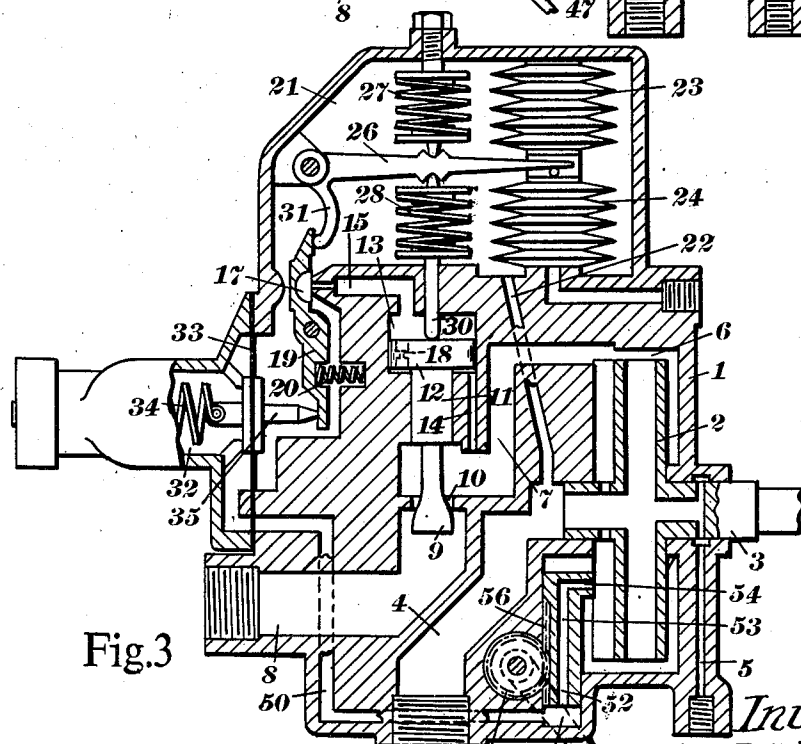


Fig. 3

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UNITED STATES PATENT OFFICE

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MEANS FOR EFFECTING AND CONTROLLING
THE SUPPLY OF LIQUID FUEL TO PRIME
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7 Claims. (Cl. 158—36.3)

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This invention has for its object to provide improved means for effecting and controlling the supply of liquid fuel to the combustion chamber of a jet-propulsion, turbine, or other prime mover.

In the accompanying drawings:

Figure 1 is a sectional elevation, more or less diagrammatic, of means or apparatus constructed in accordance with the invention for effecting and controlling the supply of liquid fuel to the combustion chamber of a jet-propulsion, turbine, or other prime mover;

Figure 2 is a similar view of a modified arrangement of the above means or apparatus.

Figure 3 is a similar view of a further modified arrangement.

In carrying the invention into effect according to one convenient mode as shown in Figure 1, there is provided a suitable housing 1 containing a rotary radial-flow centrifugal pump having an impeller 2 mounted on a shaft 3, the delivery pressure of the pump being proportional to the square of the speed of the impeller. A liquid fuel supply passage 4 in the housing leads to the centre of the pump impeller, and another passage 5 in the housing also communicating with the centre of the pump serves to return excess liquid and entrapped air to the supply tank. A chamber 6 in the housing and surrounding the periphery of the impeller 2 is connected by a passage 7 to an outlet 8 which is adapted to be connected by a pipe to the burner in the combustion chamber. In this passage is arranged a choke for controlling the quantity of liquid which can pass to the outlet.

The choke comprises a conical or like stem 9 co-operating with an annular throat 10 in the housing, the said stem being formed on or secured to a plunger 11 which at the end remote from the choke has formed on or secured to it a piston 12 slidable in a cylindrical chamber 13 in the housing. One end of this chamber communicates by way of a passage 14 with the side of the choke 9 adjacent to the pump. The other end of the said chamber communicates by way of another passage 15 with a vent 16 forming the seating of a spring loaded and pivoted control valve 17 which is responsive to barometric and liquid pressure conditions, and also with the first mentioned end of the said chamber 13 by way of a restricted orifice 18. The valve 17 is carried by a pivoted lever 19 which is loaded by a spring 20.

The control valve 17 is located in a chamber 21 in the housing which communicates with the pump inlet passage by a passage 22, and in

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this chamber are contained a pair of coaxial capsules 23 and 24, the interior of one of which (23) is evacuated, and the interior of the other 24 being open to the atmosphere by way of a passage 25. Between the capsules is connected the outer end of the long arm 26 of a bell crank lever which is loaded at opposite sides by a pair of coaxial springs 27 and 28. One end of the spring 27 is supported adjustably by a bolt 29 in the housing, and the opposite end of the spring 28 is supported by a stem 30 which rests on one side of the piston 12 above mentioned. The short arm 31 of the lever is arranged to act on one end of the lever 19 and to impart an opening movement to the control valve 17.

Adjacent to the other end of the control valve lever 19, the chamber containing the valve is separated from another chamber 32 by a flexible diaphragm 33 which is loaded by an adjustable spring 34 contained in the latter chamber 32 and has formed on or secured to it a stem 35 acting on the valve lever. This second chamber 32 is in communication with the pump side of the choke 9 by way of a passage 36 in which is formed a restricted orifice 37, and between this orifice and the said chamber is provided a bypass passage 38 leading to the valve chamber, this passage being controlled by an adjustable regulator whereby a liquid pressure difference can be set up at the opposite sides of the diaphragm. The regulator consists in one form of a spring loaded stem 39 movable by a cam 40 which is operable by the attendant, the stem 39 having a conical end 41, whereby the effective area of the entrance to the passage 38 can be varied.

Alternatively, instead of a single valve 17 as above described, responsive to a barometric device and a liquid-pressure difference device, I may employ a pair of valves adapted for independent actuation by the said devices.

The mode of operation of the apparatus above described is as follows:

The pump which is driven from any convenient source of motion, supplies liquid fuel to the outlet 8 through the choke. Normally the control valve 17 is closed, and the choke 9 is locked against movement by the liquid entrapped between the one side of the piston 12 and the valve 17. In the event of a change of barometric pressure, due for example, to a change of altitude, necessitating a reduction in the amount of fuel delivered by the pump, the change of pressure in the capsule 24 permits the spring loading on the valve lever 26 to impart an open-

ing movement to the valve 17. Liquid pressure acting on the piston 12 can now move the piston in the direction for restricting the choke, until the liquid supply is suitably adjusted. Automatic limitation of the maximum quantity of fuel which can be supplied by the pump to maintain a predetermined speed of the prime mover is effected by the pressure difference acting on the diaphragm 33 associated with the control valve. Increase of the speed beyond the selected limit results in an increase of the pressure difference acting on the diaphragm and this will cause the valve 17 to be opened and allow the choke 9 to be moved for reducing the flow through the outlet. The amount of pressure difference acting on the diaphragm is under the control of the regulator 39 which is operable by the attendant, and consequently the rate of supply of the liquid to the burner can also be varied by him to suit different requirements.

When it is required that the quantity of fuel supplied by the pump shall remain substantially constant for any given setting determined by the barometric device, the modified mode of carrying the invention into effect shown in Figure 2 may be employed. The arrangement is generally similar to that shown in Figure 1 and similar parts are given the same reference numerals. Between the outlet passage 7 from the pump impeller 2 and the choke 9 in the outlet passage 8 there is provided a second choke in the form of a balanced valve which serves to control the flow between these two points. A pair of valve heads 42 are carried on a stem 43 secured to a diaphragm 44 which is loaded by a spring 45. One side of the diaphragm is subject to the pressure on the inlet side of the choke 9 and the other side, by the provision of a passage 46, is subject to the pressure on the outlet side of the said choke. A manually operable cam 47 is arranged to act on the loading spring 45. It will be noted that the regulator 39 shown in Figure 1 is omitted and the chamber 32 of diaphragm 33 is connected directly to the cylinder 13 by a passage 48, the said cylinder being also in communication with the delivery side of the centrifugal pump by a passage 49. In this modification the speed regulating device comprising the diaphragm 33 which is responsive to liquid pressure difference may be omitted if desired, excepting when it is also desired to limit the maximum speed of the prime mover, in which case it is retained as shown in Figure 2.

In the operation of this arrangement, the pump impeller 2 supplies liquid fuel to the outlet 8 through the two chokes comprising the balanced valve 42 and the choke member 9. Normally the control valve 17 is closed and the choke 9 is locked against movement by the liquid entrapped between one side of the piston 12 and the valve 17. In the event of a change of barometric pressure which necessitates for example a reduction in the amount of fuel delivered by the pump, the change of pressure in the capsule 24 permits the spring loading on the valve lever 26 to impart an opening movement to the valve 17. Liquid pressure acting on the piston 12 can now move the piston in the direction for restricting the flow past the choke 9 until the liquid fuel supply is suitably adjusted. If, owing to fluctuation in the speed of the pump impeller 2 the quantity of fuel supplied by the pump should vary for any given setting of the choke 9 as above described, the consequential variation

in the pressure difference acting upon the diaphragm 44 will result in a movement of the balanced valve 42 to maintain the flow at a constant value. As previously mentioned, if the diaphragm 33 is retained as in the arrangement illustrated, this will prevent an increase in speed beyond a selected or predetermined limit by opening the valve 17 when such limit is exceeded.

In a further mode of carrying the invention into effect as shown in Figure 3, the general arrangement is similar to that of Figure 1, the same reference numerals being used to denote similar parts, but the pressure difference applied to the diaphragm which effects the speed control is obtained by tapping the centrifugal pump at different radial positions. Referring to the drawing, the housing 1 contains the pump impeller 2 on a shaft 3, the fuel being supplied to the centre of the impeller by a passage 4 and excess being returned by a passage 5. A chamber 6 surrounding the impeller communicates by a pipe 7 to a throat 10 controlled by a choke 9 and thence to an outlet 8 which is adapted to be connected to the burner or burners in the combustion chamber of the prime mover. The choke 9 is formed on or secured to a plunger 11 secured to a piston 12 slidable in a cylinder 13. A passage 14 connects one end of the cylinder 13 to the side of the choke adjacent to the pump. The other end of the cylinder 13 communicates by a passage 15 to the seating of the valve 17. A restricted orifice 18 is provided in the piston 12 and the valve 17 is carried by a lever 19 loaded by a spring 20. The control valve 17 is located in a chamber 21 communicating with the pump inlet by a passage 22, and the said chamber also contains an evacuated capsule 23 and a similar capsule 24 open to atmosphere. A long arm 26 of a bell crank lever is connected between the capsules and is loaded by coaxial springs 27 and 28. The spring 28 is supported by a stem 30 resting on the piston 12. The short arm 31 of the bell crank lever acts on the lever 19 of the control valve 17. A flexible diaphragm 33 loaded by an adjustable spring 34 has a stem 35 acting on the lever 19. The chamber 32 on one side of the diaphragm 33 is connected by a passage 50 to a chamber 51 communicating with a passage 52 in a movable wall 53 forming part of one side of the chamber containing the pump impeller 2. The passage 52 communicates with a port 54 in the wall and the latter is movable radially by means of a manually operable pinion 55 engaging a rack 56 formed in the wall 53. Thus by adjusting the wall 53 radially the pressure communicated to the chamber 32 of the diaphragm 33 may be varied, the pressure acting on the opposite side of the diaphragm being that of the pump inlet as communicated through the passage 22. The operation of this arrangement is the same as that described in connection with Figure 1 except for the mode of applying the variable pressure to the diaphragm 33.

By this invention a liquid fuel supply pump in combination with the desired controlling means can be provided in a simple and compact form. The invention is not however, restricted to the examples described, as subordinate details of construction or arrangement may be varied to suit different requirements.

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

1. Means for effecting and controlling the sup-

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ply of liquid fuel to a prime mover, comprising the combination of a centrifugal fuel pump whose delivery pressure is a function of its speed, an outlet for liquid fuel delivered by the pump, a variable choke located between the delivery side of the pump and the outlet, a cylinder communicating at one end with the delivery side of the pump and provided at the other end with a vent, a spring loaded piston united with the choke and slidable in the cylinder to vary the choke and thereby vary the fuel flow past the choke, a restricted passage interconnecting the spaces in the cylinder at opposite sides of the piston, a valve for controlling the cylinder vent, means responsive to barometric pressure for actuating the valve and thereby permitting movement of the piston, a second choke located between the delivery side of the pump and the first mentioned choke, a spring loaded member for varying the second choke in response to a liquid pressure difference created by the first choke, and manually operable means acting on the spring loaded member for regulating the said pressure difference.

2. Means for effecting and controlling the supply of liquid fuel to a prime mover, comprising the combination of a centrifugal fuel pump whose delivery pressure is a function of its speed, an outlet for liquid fuel delivered by the pump, a variable choke located between the delivery side of the pump and the outlet, a cylinder communicating at one end with the delivery side of the pump and provided at the other end with a vent, a spring loaded piston united with the choke and slidable in the cylinder to vary the choke and thereby vary the fuel flow past the choke, a restricted passage interconnecting the spaces in the cylinder at opposite sides of the piston, a valve for controlling the cylinder vent, means responsive to barometric pressure for actuating the valve and thereby permitting movement of the piston, a spring loaded member responsive to a liquid pressure difference for initiating movement of the piston to vary the choke independently of barometric pressure, a passage through which one side of the said member is posed to the pressure of liquid delivered by the pump, a second passage through which the other side of the said member is exposed to the inlet side of the pump, and manually operable means for varying the radial position at which the delivery side of the pump communicates with the first passage for regulating the liquid pressure difference acting on the said member.

3. Means for effecting and controlling the supply of liquid fuel to a prime mover, comprising the combination of a centrifugal pump whose delivery pressure is a function of its speed, an outlet for liquid fuel delivered by the pump, a variable choke located between the delivery side of the pump and the outlet, a cylinder communicating at one end with the delivery side of the pump and provided at the other end with a vent, a spring loaded piston united with the choke and slidable in the cylinder to vary the choke and thereby vary the fuel flow past the choke, a first restricted passage interconnecting the spaces in the cylinder at opposite sides of the piston, a valve controlling the cylinder vent, means responsive to barometric pressure for

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actuating the valve and thereby permitting movement of the piston, a spring loaded member responsive to a liquid pressure difference for initiating movement of the piston to vary the choke independently of barometric pressure, a second restricted passage through which one side of the said member is exposed to the pressure of liquid fuel delivered by the pump, a by-pass passage communicating with said second restricted passage and with a space at the other side of the said member, and manually operable means for controlling the liquid flow through the by-pass passage so that the said member is subjected to a liquid pressure difference determined by the manually operable means.

4. Means for effecting and controlling a liquid fuel supply according to claim 3, in which the valve controlling the cylinder vent is normally closed so that the choke is locked against movement by the liquid entrapped between the one side of the piston and the said valve.

5. Means for effecting and controlling a liquid fuel supply according to claim 1, in which the valve controlling the cylinder vent is normally closed so that the choke is locked against movement by the liquid entrapped between the one side of the piston and the said valve.

6. Means for effecting and controlling a liquid fuel supply according to claim 2, in which the valve controlling the cylinder vent is normally closed so that the choke is locked against movement by the liquid entrapped between the one side of the piston and the said valve.

7. Means for effecting and controlling the supply of liquid fuel to a prime mover, comprising the combination of a centrifugal pump whose delivery pressure is a function of its speed, an outlet for liquid fuel delivered by the pump, a variable choke located between the delivery side of the pump and the outlet, a cylinder communicating at one end with the delivery side of the pump and provided at the other end with a vent, a spring loaded piston united with the choke and slidable in the cylinder to vary the choke and thereby vary the fuel flow past the choke, a restricted passage interconnecting the spaces in the cylinder at opposite sides of the piston, a valve controlling the cylinder vent, means responsive to barometric pressure for actuating the valve and thereby permitting movement of the piston, means for actuating the valve to cause the fuel flow past the choke to be varied in response to a liquid pressure difference dependent upon the outlet pressure of the pump, and manually operable means for regulating the said liquid pressure difference.

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