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HYDRAULICALLY OPERATED SPEED GOVERNOR FOR JET ENGINES WITH ELECTRICALLY OPERATED SAFETY DEVICE

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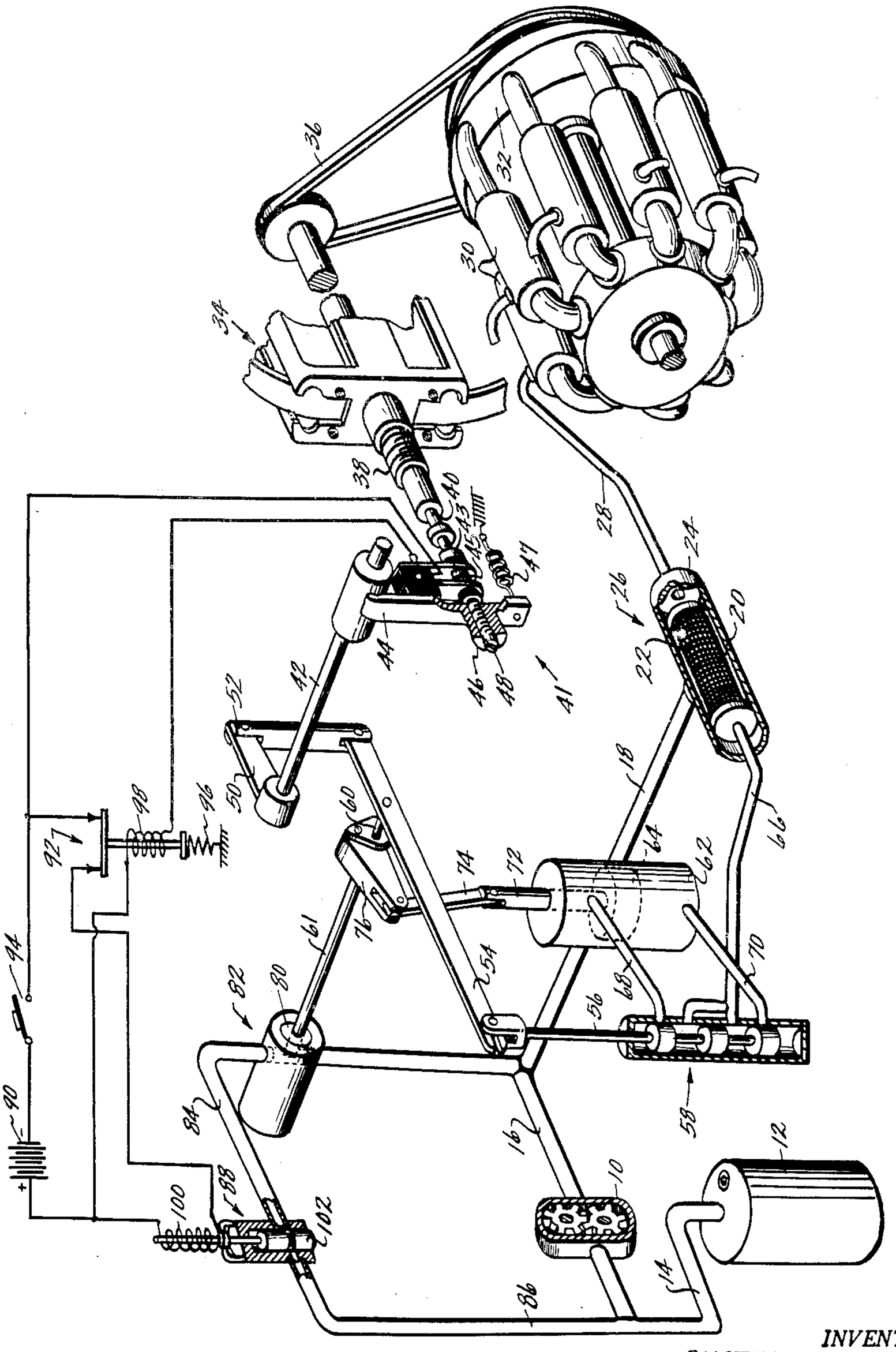

INVENTOR.
AUSTIN G. SILVESTER
BY Wade Kourtz and Frederick W. Cottleman
ATTORNEYS—

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HYDRAULICALLY OPERATED SPEED GOVERNOR FOR JET ENGINES WITH ELECTRICALLY OPERATED SAFETY DEVICE

Austin G. Silvester, Schenectady, N. Y., assignor to the United States of America as represented by the Secretary of the Air Force

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2 Claims. (Cl. 158—36.3)

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This invention is an improvement of the device shown in my prior Patent No. 2,411,065 of November 12, 1946, and relates to speed governing mechanism for gas turbines and jet engines.

The governing mechanism shown in the above patent is generally employed for the purpose specified and generally operates satisfactorily so long as there is no dirt in the fuel system, yet has been known to become inoperative for the purpose intended when even a small chip of dirt in the fuel lodged in the pilot valve of the relay system in the governor, thereby causing the pilot valve to stick and in consequence rendering the governor inoperative to control the speed. If this should happen in a position where closed bypass valve was indicated, the engine would shut down, which if it happened during take-off would have fatal results.

The present invention consists of an addition to the conventional governor and is designed to obviate the above fault in the conventional governor and provide a mechanism which will in effect eliminate the governor from the fuel system in the event it should fail to function normally as for instance if it should operate to shut the engine down.

An object of the invention is to provide a simply constructed and inexpensive mechanism which will obviate the faults above enumerated. I attain this and other objects in the device hereinafter described, reference being had to the drawing wherein the single figure of the drawing is a schematic perspective view of the conventional jet governor with the safety attachment which is the subject of this invention, applied thereto.

Like reference characters refer to like parts throughout the drawing.

For a proper understanding of the operation of the mechanism which is the subject of this invention, that portion of the specification of Patent No. 2,411,065, supra, from column 2, lines 35 through 55, through column 3, lines 1 through 31, should preferably be understood.

Referring now to the drawing, a fuel pump 10 takes fuel from a tank 12 through pipe 14 and discharges it for the greater part through pipes 16 and 18 into the space 20 between the cartridge 22 and casing 24 of the filter 26. A pipe 28 conveys fuel from the inside of the cartridge 22 to the burner 30 of a jet engine 32.

A flyweight governor 34 is rotated by the engine 32 through any suitable power transmitting means such as the belt 36. The shaft 38 of the governor 34 is bored to slidably receive the axially sliding spindle 40. The flyweight governor 34 is adapted, upon outward movement of its weights, to slide the spindle axially toward the left in the drawing, and upon inward movement of the weights to slide the spindle axially toward the right.

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Secured to one end of a shaft 42 is the hub of a lever arm 44. The arm 44 extends downwardly and is provided near the lower end with a tapped hub 46. An adjusting screw 48 in the tapped hub 46 extends through the lever from left to right. An electric switch 41 is insulatedly supported on the arm 44, and when its contacts 43 and 45 are closed as they are during normal operation, fills the space between the end of the adjusting screw 48 and the end of the sliding spindle 40. A spring 47 normally holds the end of the adjusting screw 48 against the governor operated switch assembly 41 and the switch assembly 41 against the end of the sliding spindle 40. The switch 41 is biased to separate its contacts 43 and 45 when they are not held together by the spring 47 as shown.

Secured to the other end of the shaft 42 is a horizontally disposed lever arm 50 which is hinged at its swingable end to a vertically disposed link 52.

The lower end of the vertically disposed link 52 is hinged to one end of a long horizontal lever 54, the other end of the long lever 54 being hinged to the upper end of the stem 56 of the pilot valve 58, The long lever 54 is fulcrumed on a shaft 60 which is eccentrically supported on the end of a shaft 61 for reasons hereinafter described.

A valve operating cylinder 62 has a piston 64, the spaces above and below the piston being supplied with pressurized fuel from the inside of the filter cartridge 22 through pipes 66, 68 and 70, the stem 56 of the pilot valve 58 being so constructed that when the stem 56 is in the medial position shown, no pressurized fuel will flow into the cylinder 62. If, however, the stem 56 is moved to the upper position, fuel will flow through the pipes 66 and 68 into the space above the piston and the piston will move downward, while if the stem 56 is moved to the lower position, fuel will flow through the pipes 66 and 70 into the space below the piston and the piston will move upward.

The piston rod 72 is joined by a link 74 to the swingable end of a lever arm 76 which is fast on a shaft 61, supra, the rotatable member 80 of a bypass valve 82 being fast on the other end of the shaft, whereby underspeeding of the engine 32 and its governor 34 will retract the governor spin-

dle 40 toward the right, which will allow the extension spring 47 to rock the shaft 42 anticlockwise, raise the link 52, rock the lever 54 anticlockwise about its fulcrum 60, move the pilot valve stem 56 to its lower position, allowing pressurized fuel into the cylinder 62 to raise the piston 64, thereby rocking the shaft 61 clockwise and closing the governor valve 82. Moving the valve 82 to closed position by rotation of the shaft 61 causes the eccentric shaft 60 to return the stem 56 of the pilot valve 58 to the medial position.

As long as the main governor valve 82 was partly open, a portion of the pressurized fuel flowed from the discharge side of the pump through pipe 16 and governor valve 82, through pipe 84, through a normally open solenoid valve 88 and through pipe 86 to the suction side of the pump 10 whereby the more nearly the governor valve 82 is closed the more fuel must flow through pipe 18, filter 26 and pipe 28, and therefore the greater will be the pressure build up and amount of fuel flow at the point where the pipe 28 feeds fuel into the burner 30.

Thus far the device has been described as being operated hydraulically. It has happened, however, that coincidentally with underspeeding of the engine 32 a chip or other foreign matter would get into the pilot valve 58 and stick its stem 56 whereby the hydraulic mechanism failed to function, governor valve 82 remained open the engine being thereby shut down. The result of this happening on takeoff is well known and it is to forestall such an occurrence that the electrical components shown have been added. These components comprise a battery 90 or equivalent source of electric power, the normally closed relay 92, the normally open solenoid valve 88, the governor operated electric switch 41 hereinbefore described and a master switch 94.

When the device is not in operation and the master switch 94 is open as shown, there is no current in the electric system and the spring 96 of the relay 92 will hold the relay closed. As soon as the master switch is closed current will flow from the + battery terminal through the relay coil 98 and the switch 41 and the relay will open. If thereafter the combination of an underspeeding engine 32 and a stuck pilot valve 58 occur simultaneously, the governor operated switch 41 will open which will break the circuit through the relay coil 98 and the relay spring 96 will close the relay 92 whereby a circuit is established through the coil 100 of the solenoid valve 88, whereby the plunger 102 of the solenoid valve will be moved endwise and the solenoid valve will be closed whereby less fuel will be recirculated through pipe 16, valve 82, pipe 84, valve 88 and pipe 86 and more fuel will be directed to the burner 30 through pipes 18 and 28 and the engine speed will thereby again be brought up to normal.

According to the foregoing description, when the speed of the engine 32 rises above a predetermined value, the sliding spindle 40 is moved leftward whereby the governor valve 82 is opened hydraulically whereby a sufficient portion of the fuel being pumped is returned to the pump inlet to thereby lower the volume of fuel going to the engine, whereby the engine speed is reduced.

Also when the speed of the engine 32 falls below a predetermined value, the sliding spindle 40 is moved rightward whereby the governor valve 82 is closed hydraulically, whereby all of the fuel being pumped is directed to the engine whereby its speed is raised to normal.

It is only in the case of engine underspeeding where the sliding spindle moves rightward, that, due to some foreign matter getting into the mechanism, the spring 47 cannot swing the lever 44 to close the valve 82 hydraulically as described, that the normally open solenoid valve 88 is closed to perform the function of the inoperative valve 82.

Having thus described an embodiment of my invention, I claim:

1. In a control device for a combustion engine, a governor adapted to be connected to an engine to be driven thereby at a rate proportional to the engine speed, a pump for supplying fuel under pressure to the engine, a fuel supply means connected to the pump, fuel delivery means connected to the pump and adapted to be connected to the engine, a first adjustable normally open bypass means interposed between the fuel supply means and the fuel delivery means and operatively associated therewith, adjusting means operatively interconnecting the governor and the adjustable bypass means, a second adjustable normally open bypass means interposed between the fuel delivery means and the fuel supply means and means operatively interconnecting the adjusting means and the second adjustable bypass means, said means operatively interconnecting the adjusting means being normally held inoperative by said adjusting means but operable to open upon failure of said adjusting means.

2. In a control device for a combustion engine, a governor adapted to be connected to an engine to be driven thereby at a rate proportional to the engine speed, a pump for supplying fuel under pressure to the engine, a fuel supply means connected to the pump, fuel delivery means connected to the pump and adapted to be connected to the engine, a first normally open bypass means interposed between the fuel supply means and the fuel delivery means and operatively associated therewith, control means operatively interconnecting the governor and the first bypass means including a spindle slidingly operable by the governor, adjustable means axially aligned with the spindle, spring biased electrical contact means, interposed between the spindle and the adjustable means and normally held in closed position therebetween but operable to open upon failure of said adjustable means, a second normally open bypass means interposed between the fuel delivery means and the fuel supply means, and means operatively interconnecting the electrical contact means and the second normally open bypass means whereby on failure of the first bypass means to function, the second bypass means will close to insure proper fuel delivery.

AUSTIN G. SILVESTER.

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