July 11, 1950 C. F. SCHORN 2,514,674

FUEL PUMP

Filed Aug. 17, 1946 3 Sheets-Sheet 1

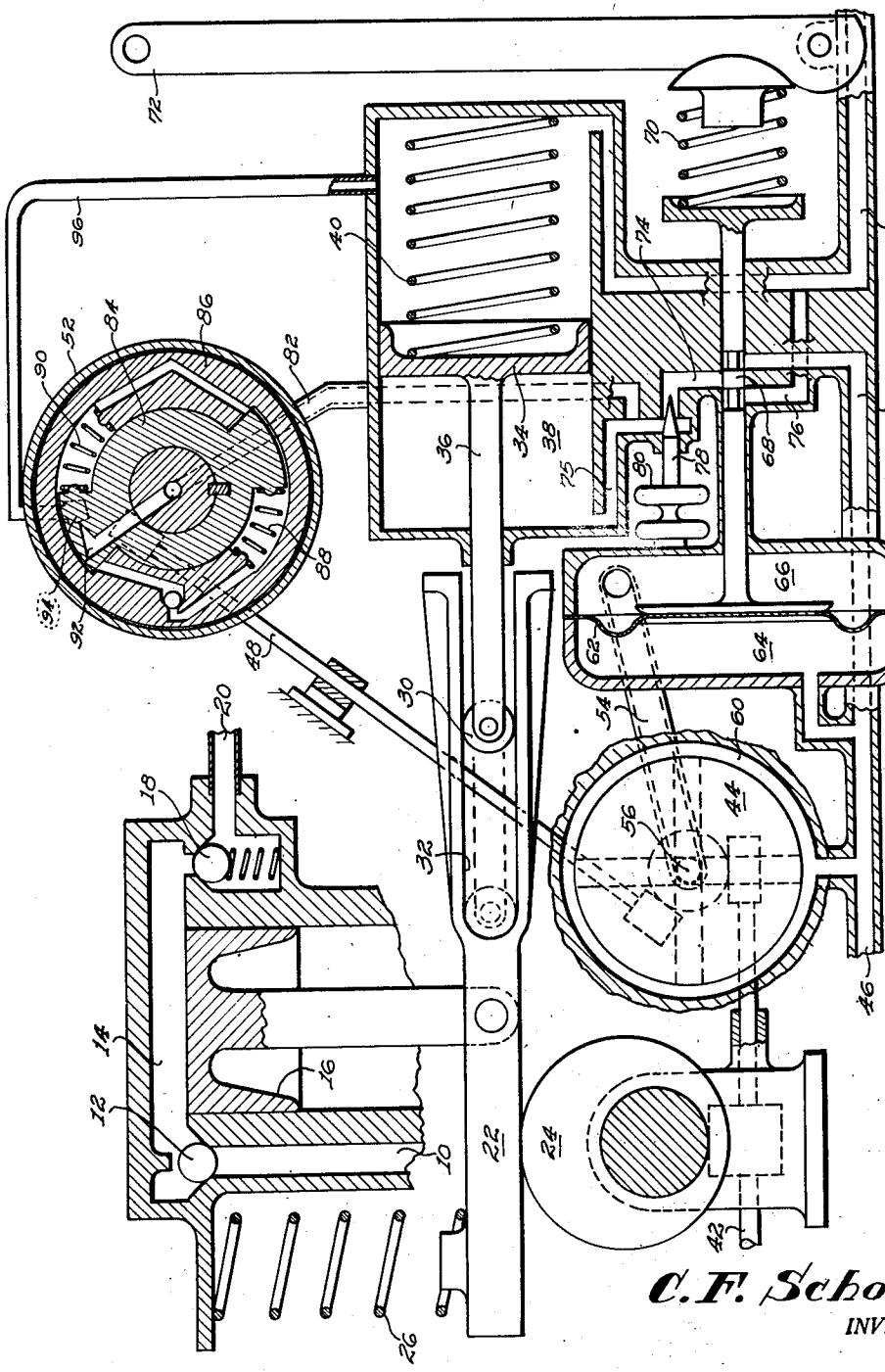


Fig. 1

C. F. Schorn
INVENTOR.

BY

Stanley M. Udale

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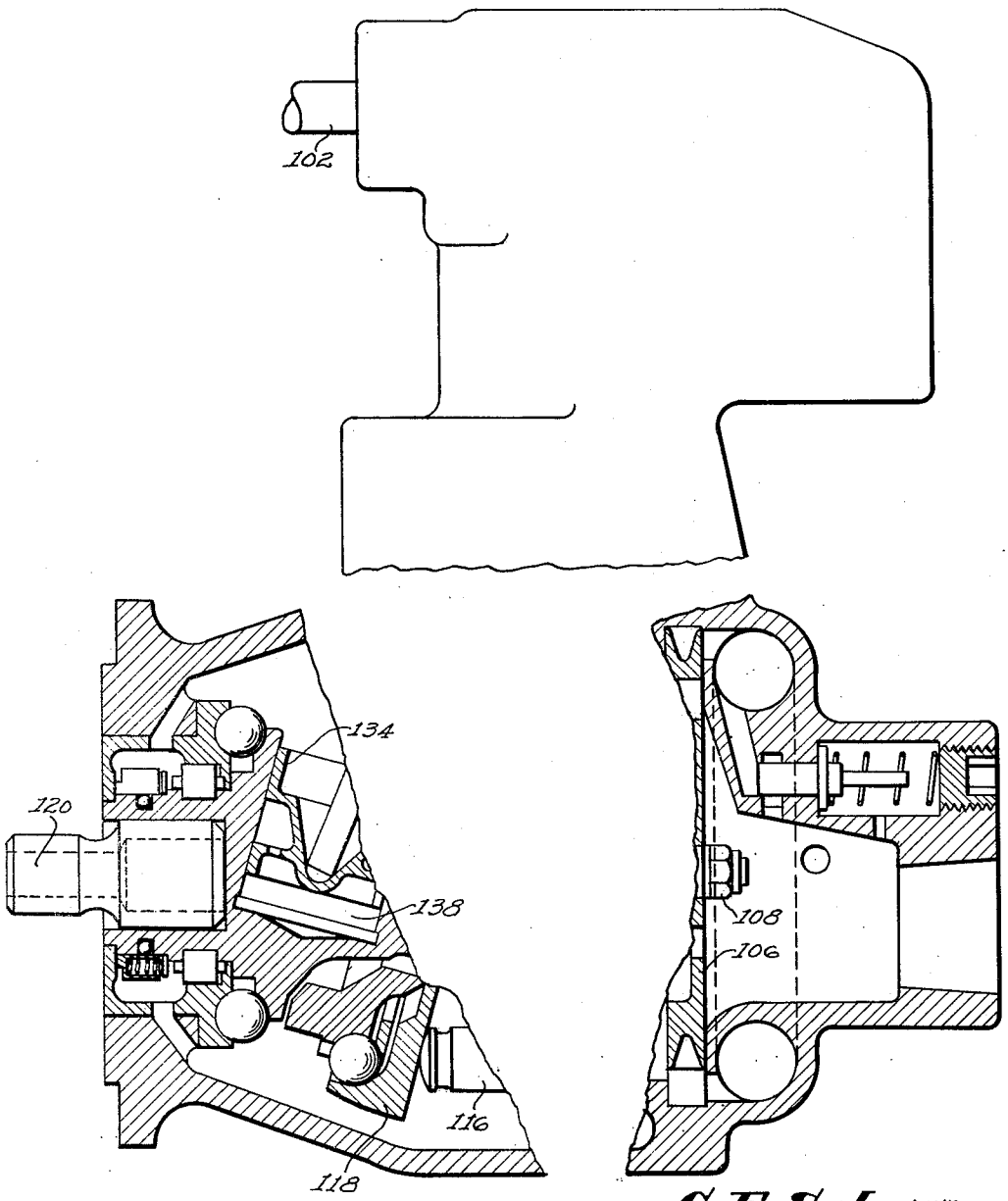


Fig. 2

C. F. Schorn
INVENTOR.

BY Harley M Udale

July 11, 1950 C. F. SCHORN 2,514,674

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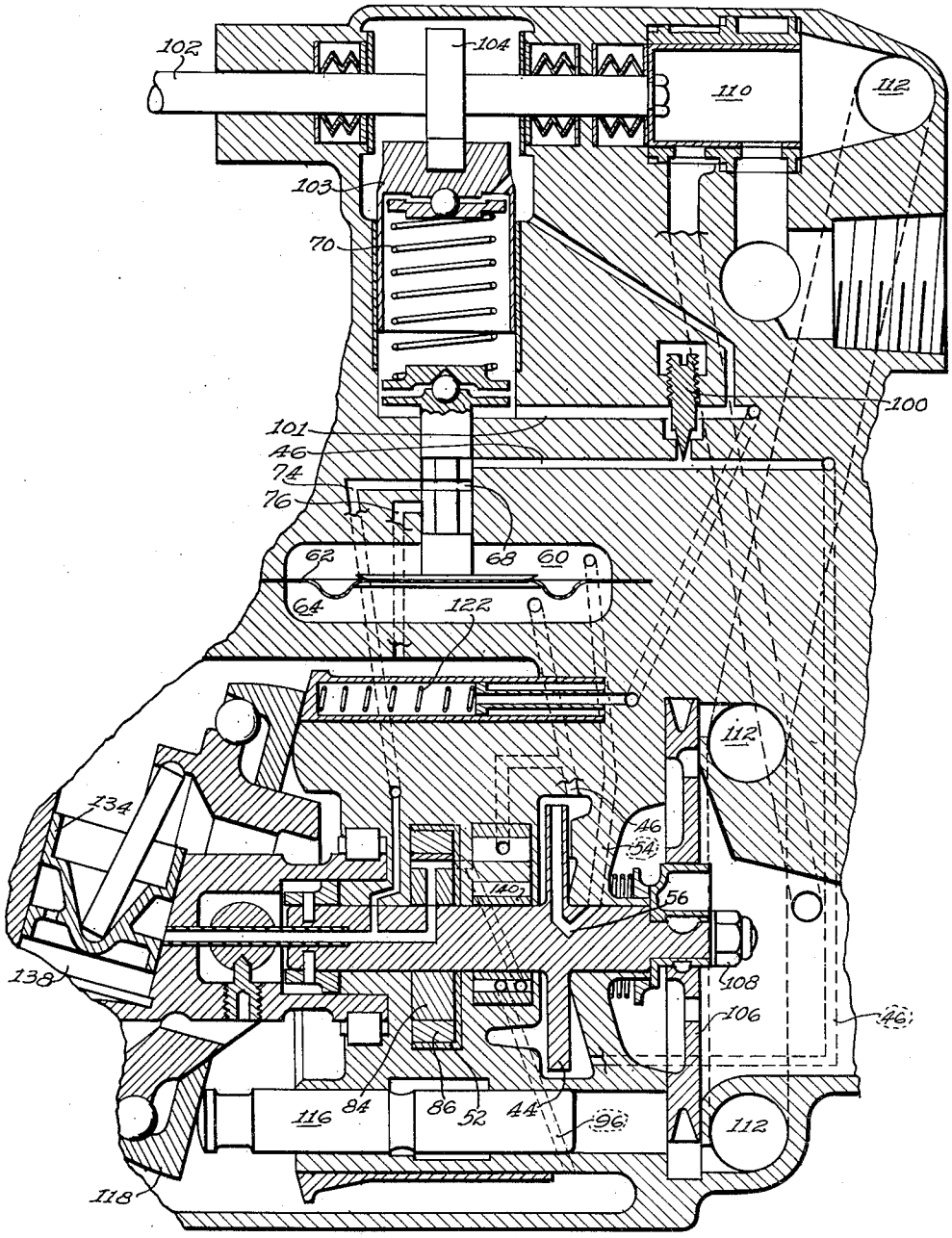


Fig. 3

C. F. Schorn
INVENTOR.

BY Manley M Udale,

Patented July 11, 1950 2,514,674

UNITED STATES PATENT OFFICE

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FUEL PUMP

Carl F. Schorn, Detroit, Mich., assignor to George M. Holley and Earl Holley

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5 Claims. (Cl. 103—38)

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The object of this invention is to control the fuel discharge of a variable stroke fuel pump so that at high speed the stroke of the pump is shortened and the discharge of the pump is diminished. The fuel operates a prime mover which drives the fuel pump at a speed proportional to that of the prime mover.

Specifically, this controlled variable stroke fuel pump is intended for use with an ordinary gas turbine but it could also be used with a Diesel engine.

Another object is to prevent the governor from overspeeding. To prevent overspeeding an acceleration device is provided which anticipates the ultimate increase in speed and checks the speed before the speed exceeds the safe speed for which the governor is set. In additional manually controlled means are provided for varying the governor speed.

Fig. 1 shows diagrammatically the essential elements of my invention.

Fig. 2 shows a fragmentary view of the device as made incorporating my invention.

Fig. 3 shows the essential elements of Fig. 2 to an enlarged scale.

In Fig. 1, 10 is a fuel entrance, 12 is a check valve in the admission to a cylinder 14. 16 is a piston in cylinder 14. 18 is a spring loaded check valve in the outlet from the cylinder 14. 20 is the fuel outlet leading to the gas turbine, Diesel engine or other prime mover. 22 is a lever which drives the piston 16. 24 is a cam which drives the lever 22. 26 is a spring which holds the lever 20 in engagement with the cam 24. 30 is a roller engaging with a forked opening 32 at the end of lever 22. 34 is a piston connected to the roller 30 by the piston rod 36. 38 is a cylinder in which the piston 34 reciprocates. 40 is a spring which pushes the roller 30 to the position in which the piston 16 has its minimum stroke.

A shaft 42 drives the cam 24 and a governor 44, of a well known type, which is immersed in oil at a high pressure derived from a source not shown and admitted from a pipe 46. A shaft 48 is driven from a gear on the governor 44 and the shaft 48 drives the acceleration device 52 by suitable gearing means as shown in Fig. 1.

The governor 44 creates a pressure difference between the pipe 54, which connects at 56 with the center of the governor 44, and the pressure in the oil entrance 46. Radial passages connect the "eye" 56 of the governor 44 with the circumferential chamber 60. The passage 54 communicates with the chamber 66 to the right of the diaphragm 62. The diaphragm 62 divides a

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chamber into two halves 64 and 66. Chamber 64 is connected to the high pressure of pipe 46. Chamber 66 is connected with the "eye" 56 of the governor 44 through the passage 54, that is, with the low pressure side. This is a well known hydraulic governor in general use.

A servomotor valve 68 is moved to the right by the diaphragm 62 and is moved to the left by the spring 70. Spring 70 is compressed by the manually operated lever 72.

The servomotor valve 68 controls the operation of the piston 34 in a well known manner. Specifically a passage 74 is connected alternatively to the pipe 46 (high pressure) and to the low pressure passage 76. In this passage 74 is a barometrically controlled valve 78 moved by an evacuated capsule 80. The passage 74 continues past the needle valve 78 and is numbered 75 as it leads into the left hand end of the cylinder 38. The right hand end of the cylinder 38 is connected to the low pressure oil pipe 76. A pipe 82 connects the "eye" of the acceleration device 52 with the passage 75. This acceleration device contains a driving element 84 and a driven element 86. This driving element 84 drives the driven element 86 through the two springs 88 and 90. The driving element 84 rotates clockwise.

A tapered port 92 is located above a port 94 in the driven element 86 so that when the springs 90 and 88 are compressed during the acceleration a path exists from 82 through 92 through 94 and so along a pipe 96 to the low pressure pipe 76. At low altitude the valve 78 is in its most open position and through the influence of this valve 78 the acceleration device contained in 52 is less effective than at higher altitudes when the valve 78 is moved to a more closed position and the pipe 74 less freely communicates with the cylinder 38.

A manually controlled lever 72 controls the pressure in the spring 70 which spring 70 balances the pressure difference acting on the diaphragm 62.

In Figs. 2 and 3 corresponding parts are given the same number. In addition 100 is an adjustable restriction for stabilizing the operation. The adjustable restriction 100 admits oil under pressure to the passage 101 which assists the spring 70 in holding the piston 103 against the cam 104. 102 is the manually operated shaft, 104 is the cam which controls the spring 70 which applies pressure to the upper end of the servomotor valve 68. The shaft 102 controls a fuel shut-off valve 110 leading to the fuel outlet 112.

Instead of the valve 12 and 18 of Fig. 1 a rotary

disc valve 106 is mounted on a shaft 108. This shaft is driven by shaft 120.

A piston 134 corresponds to piston 34 of Fig. 1. A cylinder 138 corresponds to cylinder 38 of Fig. 1. Plunger 116 (Fig. 2) corresponds to piston 16 of Fig. 1. The stroke of this piston 116 is varied by the movement of the piston 134 in the cylinder 138. The tilting disc 118 is tilted in one direction by the spring 122 and is tilted in the other dir ction by the piston 134.

High pressure flows along the lines 46 to the chamber 64 below the diaphragm 62. Low pressure oil from the "eye" 56 of the hydraulic governor 44 flows through the pipe 54 to the chamber 60 above the diaphragm 62.

The load on the diaphragm 62 is imposed by the rotation of the manually operated shaft 102, the cam 104 which engages with the piston 103 and compression spring 70 which engages with the servomotor valve 68.

The acceleration devices 52—86—84 perform the same function and low pressure fuel escapes from the port 94 (not shown) down through the passage.

The high pressure fuel for operating the control mechanism is obtained from the gear pump shown at 140.

Operation

In Fig. 1 assuming that the lever 72 is moved clockwise to reduce the discharge of the pump 12—14—16—18 the servomotor valve 68 is then moved to the right.

The high pressure oil escapes from behind the piston 34 to the passage 76. The roller 30 moves to the left as the piston 34 moves to the left. The stroke of the piston 16 is thus reduced and the discharge of fuel is therefore reduced.

When the lever 72 is moved counter-clockwise to increase fuel flow the reverse happens with this difference:

During acceleration the port 94 becomes effective and the pressure "build-up" in chamber 38, to the left of piston 34, is delayed. This delay is greater at high altitude than at sea level as the needle 78 is influenced by the barometric element 80 which moves the needle 78 to the left and opens up the passage 74 into the passage 75 so that the port 94 has very little influence at sea level. The danger from excessive "overspeeds" increases at high altitudes, hence the need for the needle 78.

In Figs. 2 and 3 the operation is similar to the operation of Fig. 1.

What I claim is:

1. A variable stroke fuel pump for a prime mover of the type in which speed is controlled by fuel flow including a centrifugal hydraulic speed regulating governor, comprising a rotating element, common driving means from said prime mover to said element and to said pump, a housing enclosing said element, a supply of governor operating fluid at high pressure, a supply of operating fluid at relatively low pressure, a passage connected to the high pressure fluid, a passage connected to the low pressure fluid both leading from said housing, the difference in pressure in said housing between said connecting passages being created by said rotating element in proportion to the square of the speed of rotation of said rotating element, a chamber, a moving wall therein responsive to the pressure differences created by said hydraulic governor in said connections, a yieldable means opposing the moving wall, a servomotor valve connected to said diaphragm, a servomotor, a source of servomotor operating fluid under pressure, a low pressure fluid source, passages therefrom to said servomotor in which said servomotor valve is located so that the servomotor is alternatively connected to the high and low pressure fluids so that it is controlled by said servomotor valve, means responsive to the servomotor for varying the stroke of said pump.

2. A device as set forth in claim 1 in which there is an acceleration device including yieldable means, a second rotating element rotated by said prime mover through said yieldable means, means responsive to said acceleration device comprising a second passage connecting the servomotor operating fluid downstream of said servomotor valve to said source of low pressure fluid, a valve in said second passage adapted to be controlled by the relative motion between the prime mover and the second rotating element during acceleration so as to temporarily anticipate the increase in speed by momentarily decreasing the pressure difference created by said governor and thus shortening the stroke of the pump before the governor reaches the speed at which a shorter stroke is called for by the governor.

3. A device as set forth in claim 1 in which there is an acceleration device including yieldable means, a second rotating element rotated by said prime mover through said yieldable means, means responsive to said acceleration device comprising a second passage connecting the servomotor operating fluid downstream of said servomotor valve to said source of low pressure fluid, a valve in said passage adapted to be controlled by the relative motion between the prime mover and the second rotating element so as to temporarily anticipate the increase in speed by shortening the stroke of the pump before the governor reaches the speed at which a shorter stroke is called for by the governor, barometric means responsive to low atmospheric pressures, a second valve in said second passage connected to and controlled by said barometric element and located in series with the acceleration responsive valve so as to increase the effect of said acceleration device at high altitude so as to reduce the rate of acceleration at high altitude.

4. A variable stroke pump for a prime mover of the type in which speed is controlled by fuel flow, hydraulic speed responsive means for varying the stroke of said pump comprising a hydraulic governor comprising a rotating element, common driving means from said prime mover to said element and to said pump, a housing enclosing said element, a supply of operating fluid at high pressure, a supply of operating fluid at relatively low pressure, a connection to the high pressure fluid, a connection to the low pressure fluid both leading from said housing, the difference in pressure in said housing between said connections being created by said rotating element in proportion to the square of the speed of rotation of said rotating element, a servomotor, a servomotor valve therefor, a source of servomotor operating fluid under pressure, a low pressure fluid source, passages therefrom to said servomotor in which said servomotor valve is located so that the servomotor is alternatively connected to the high and low pressure fluids, a chamber, a moving wall therein, passages connecting the chamber with said hydraulic governor so that the pressure difference created by said hydraulic governor is imposed on said moving wall, manually adjustable yieldable means opposing the movement of said moving wall in response to said pressure difference, said servo-

motor valve being adapted to be moved by said moving wall, said servomotor being controlled by said servomotor valve and controlling the stroke of said variable stroke pump, an accelerating responsive device including a second yieldable means, a second rotating element rotated by said prime mover through said yieldable means, a second passage connecting the servomotor operating fluid downstream of said servomotor valve to said low pressure fluid, a valve in said second passage adapted to be controlled by the relative motion between the prime mover and the second rotating element during acceleration and thus modify and anticipate the response of said servomotor to said hydraulic governor, means responsive to the pressure of the atmosphere adapted to render the said acceleration means more responsive to acceleration at low atmospheric pressure than at sea level including a second valve in said second passage from the servomotor operating fluid to said low pressure and connected to and controlled by said barometric means.

5. In a speed limiting system for a combustion engine of the type in which speed is controlled by fuel flow having a variable delivery fuel pump driven by said engine, means for limiting the delivery of said pump comprising an engine driven centrifugal governor for creating a force to vary as the square of the engine speed, fuel flow limiting means responsive to said force, a

spring, manually operated means acting through said spring to oppose said speed responsive force so as to manually select the rate of delivery of said pump and to thereby selectively control the speed of said engine and in which there are also means for limiting the delivery of fuel from said fuel pump during the acceleration of said engine, comprising a second spring, inertia means rotated by said engine so as to respond to the rate of angular acceleration of said engine, to compress said second spring, means responsive to the compression of said second spring to reduce the delivery of said fuel pump to said engine in anticipation of the action of said speed responsive force.

CARL F. SCHOPN.

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