Aug. 27, 1968 R. J. MADDALOZZO 3,398,729

DIESEL DISTRIBUTOR VALVE AND GOVERNOR THEREFOR

Filed Oct. 31, 1966

FIG. 1.

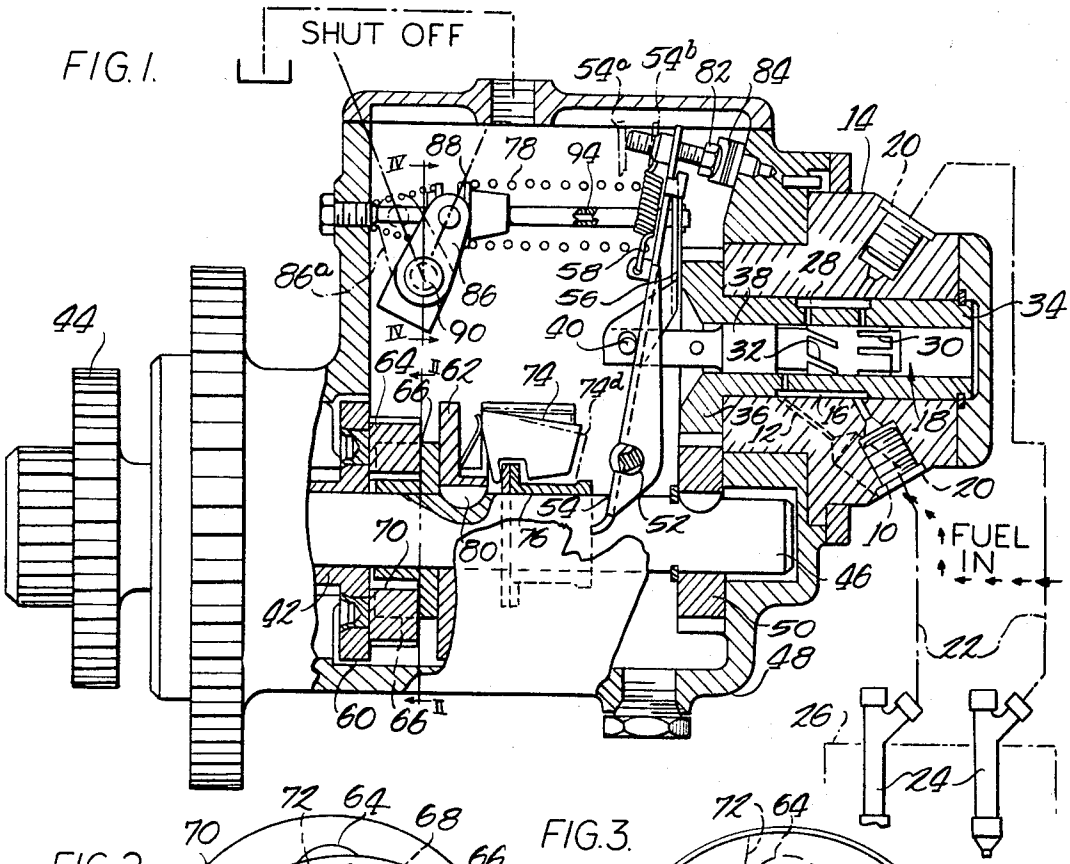



FIG. 2.

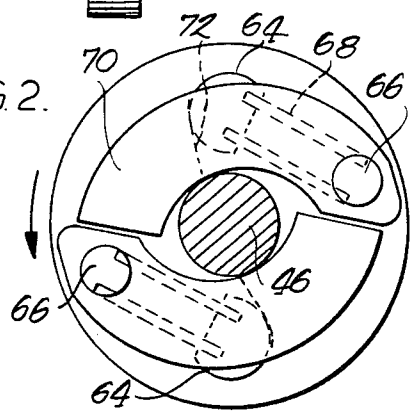



FIG. 3.

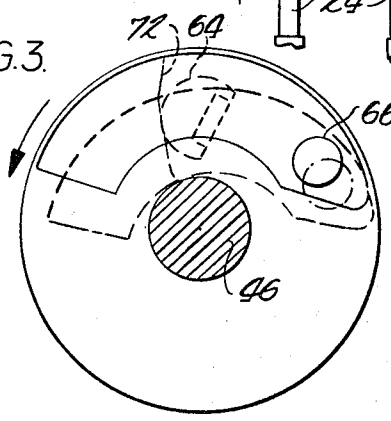
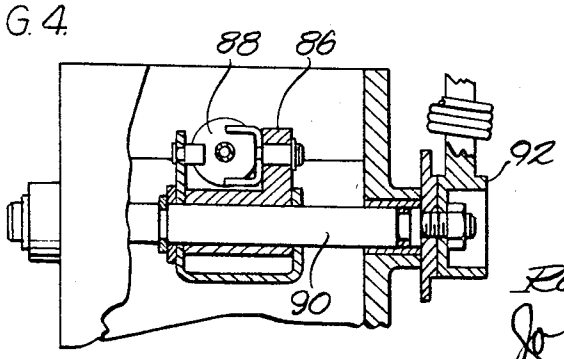



FIG. 4.




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# DIESEL DISTRIBUTOR VALVE AND GOVERNOR THEREFOR

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10 Claims. (Cl. 123—139)

## ABSTRACT OF THE DISCLOSURE

A distributor for dividing the output of an engine driven fuel pump into a plurality of streams carried by separate lines connected to injectors, one for each engine cylinder, has a ported sleeve driven in timed relation to the engine to control communication between the pump and each line. A spool valve slideable axially within the sleeve meters the fuel flow through the ported sleeve. Engine speed responsive means varies the indexed position between the sleeve and its drive to advance or retard timing. Engine speed responsive means also slides the spool within the sleeve to change the fuel metering.

This application relates to a distributor valve for the fuel pump of a diesel injection system, such system supplying timed and metered quantities of the fuel individually to each engine cylinder.

It more particularly relates to a rotary fuel distributor and to dual governor means which I provide therefor.

The governor means according to my invention automatically controls both the injection timing adjustment and the fuel metering adjustment of the valving in the distributor, accomplishing the purpose by novel means and in novel way as will now be explained in detail.

In the drawing:

FIGURE 1 is a longitudinal sectional view in side elevation showing a fuel distributor embodying the present invention;

FIGURES 2 and 3 are transverse sectional views in front elevation of a detail of FIGURE 1, specifically, progressive views along lines II—II of the governor flyweights as they are displaced; and

FIGURE 4 is a transverse sectional view in rear elevation of another detail of FIGURE 1, taken along lines IV—IV.

In the distributor construction as shown in FIGURES 1, 2, 3, and 4 of the accompanying drawing, diesel fuel under high pressure flows in a path through a series-connected inlet **10** and a diagonally disposed internal passage **12** in a distributor head **14**, through a sleeve groove **16** which is generally C-shaped as viewed in cross-section, and which is rotated within distributor valving **18**, through a set of diagonally extending individual outlets **20**, and fuel delivery lines **22** interconnecting the individual outlets and individual injection nozzles **24**, and thence into a diesel engine **26** in which the nozzles **24** spray the fuel into the cylinders.

The nozzles **24** inject on the accumulator principle. They are controlled from pulses introduced into the lines **22** by the valving **18**, the description whereof being incorporated herein by reference, as found in copending Maddalozzo patent application Serial No. 590,779 filed Oct. 31, 1966. Briefly, a small sleeve cavity or cul-de-sac **28** communicates alone with either the outlets **20** or straight, spool drain grooves **30** at instantaneous periods and at other instantaneous periods intercommunicates the outlets **20** and diagonal, spool, metering grooves **32** which are under high fuel pressure.

A driven valve sleeve **34** forms the rotor member of the valving **18** and has a gear **36** formed integrally at its first



end. The sleeve supports therein a slidable stator spool **38** carrying a pin **40** on its projecting first end, by which the spool is axially adjusted into different metering or power settings for the engine **26**.

An automatically controlled drive for the valving **18** includes a driving shaft **42**, a crankshaft connected external gear **44** which is made fast to the shaft **42**, and an intermediate shaft **46** coupling the driving shaft **42** and the driven valve sleeve **34** in a one-to-one ratio together. A governor housing **48** which carries the distributor head **14** supports the intermediate shaft **46** coaxially with the driving shaft **42**, and the head **14** supports the driven sleeve **34** parallel to the coaxial shafts. The one-to-one drive from the shaft **46** is transferred by a gear **50** on the latter meshing with the sleeve gear **36**.

A fixed knife edge **52** in the housing **48** forms the fulcrum for a tiltable governor arm **54**. The governor arm **54** carries a plate **56** which depends from a pivot thereon. The plate is biased to the right as viewed in FIGURE 1 by means of a spring **58**, and carries a fork which straddles and presses the spool pin **40** against the governor arm **54**.

By the simplified dual arrangement of a first speed responsive device **60** and a second such device **62** which are compactly side-by-side on the common shaft **46**. I am able to accomplish both the timing adjustment of the driven sleeve **34** and the metering adjustment of the slidable spool **38** by independent movement of their corresponding first ends. Therein lies a brief summary of an aspect of my invention.

More specifically, the device **60** is of a known construction including two drive pins **64** rigidly carried in axial disposition by an integral flange on the driving shaft **42**. The intermediate shaft **46** has a flange carrying two axially extending driven pins **66**, each pin **66** serving both as the spring seat for a flyweight return spring **68** and as the point of pivotal support of a radially swingable flyweight **70**. Centrifugal outward movement of each flyweight **70** causes a cam surface **72** thereon to move from the position shown in FIGURE 2 to the position shown in FIGURE 3, wiping across the driving pin **64** so as to cam the pins **64** and **66** closer together. One result is that the force of the flyweight-restoring spring **68** is overcome and it foreshortens to store energy, and the other result is that the intermediate shaft **46** and pins **66** turn slightly forward in the direction of rotation, from the position shown in FIGURE 2 to the position shown in FIGURE 3 relative to the driving shaft **42**, not shown. A ten degree range of timing advance is available as illustrated.

In the normal range between and including the dotted line shut-off position **54*a*** and the rated load position **54*b***, the governor arm **54** is controlled by governor flyweights **74** and a common collar **76** included in the device **62**, and by an upwardly offset governor spring **78** of the coil compression type. The device **62** has a key **80** making it fast to the intermediate shaft **46**. If the engine **26** is overloaded while running at rated load and speed, it slows temporarily, and the governor weights have less centrifugal force and collapse into the position shown by the dotted lines **74*d***. The governor spring **78** simultaneously expands, forcing the governor arm **54** past the rated load position **54*b*** and into the overload range to take the position as shown by solid lines. A stop **82** on the moving arm compresses an opposing, adjustable, torque-setting, leaf spring **84** and in its final clockwise movement abuts solidly against a fixed stop, not shown.

Removing the overload restores the speed of the governor device **62**, whereupon the leaf spring **84** unbends to restore the arm **54** to the rated load position **54*d***, and the governor flyweights **74** take a position (shown in solid lines) balancing the rated load force of the governor spring. A tension setting arm **86** (FIGURES 1 and 4)

supports a seat **88** carrying the adjustable end of the governor spring **78**, and is supported by a control shaft **90** in the housing **48** which carries a speed control lever **92**.

In operation, the lever **92** is rotated so as to advance the tension setting arm **86**, first, from the shut-off position shown by the broken lines **86***a*, second, into a partial power position, not shown, in which the engine is cranked, and third, into the rated load position shown in solid lines in FIGURE 1. The flyweights **70** automatically apply a speed proportional, first force in the first speed responsive device **60** to appropriately changes the timing adjustment of the driven valve sleeve **34**. The governor flyweights **74**, through the intervening, axially displaced collar **76** and tiltably displaced arm **54**, automatically apply a speed proportional, second force from the governor or device **62** to appropriately change the power adjustment of the slidable stator spool **38**.

A pull tube **94** has means, not shown, interconnecting it between the control shaft **90** and the plate **56**, enabling the plate **56** to be forcibly tilted by the operator leftwardly toward the governor arm **54**. Movement of the arm **86** into the shut-off position indicated by the broken lines **86***a* therefore provides a means of positive shut-off of the spool **38**, due to the attendant pull of the tube **94** and plate **54**.

What is claimed is:

**1.** In a rotary fuel distributor comprising a hollow distributor head having delivery line connections to individual fuel injection devices, and valving in the hollow interior of the head including a spool and a rotatively driven valve sleeve, disposed one within another and effective to direct fuel flow through the delivery connections and the individual devices in sequence, said driven valve sleeve being rotatively, advancingly and retractively movable for effecting timing adjustment, said spool being axially movable for effecting power adjustment by altering intercommunication of the sleeve with high and low pressure fuel sources:

an automatically controlled drive including the driven valve sleeve (**34**) and a driving shaft (**42**), operatively related with their axes substantially parallel to one another;

an interposed coupling common to the sleeve and shaft, and common to and carrying dual speed responsive means;

means supporting the sleeve and shaft and their interposed coupling, in the operative relationship described;

first means for applying a speed-proportional first force from the speed responsive means to change the timing of the driven valve sleeve; and

second means for applying a speed-proportional second force from the speed responsive means to change the power adjustment of the valve spool.

**2.** An automatically controlled drive as claimed in claim **1**, characterized by:

the coupling comprising a common intermediate shaft (**46**) supported by the supporting means so as to be parallel to the driven valve sleeve and coaxial with the driving shaft.

**3.** An automatically controlled drive as claimed in claim **2**, characterized by:

the dual speed responsive means (**60, 62**) being coaxially arranged side-by-side, in surrounding relation to the common intermediate shaft.

**4.** An automatically controlled drive as claimed in claim **3**, characterized by:

said spool having a first end adjacent the speed responsive means and the common shaft, and projecting beyond a corresponding first end of the driven valve sleeve;

the second one of said dual speed responsive means comprising a governor collar (**76**) which is displaced axially of the common shaft to transmit said second force from a projecting end thereof, said second means comprising a fulcrally mounted governor arm (**54**) interconnecting the projecting ends of the respective spool and governor collar.

**5.** An automatically controlled drive as claimed in claim **4**, characterized by:

said coupling comprising gear means (**50, 36**) interconnecting a first end of the common intermediate shaft and the first end of the driven valve sleeve, and means comprising the first one of the dual speed responsive means and said first means for connecting the coaxial driving and intermediate shafts so that the latter can be turned to a certain degree of advance and retraction in relation to the driving shaft.

**6.** The invention of claim **5**, characterized by:

said first one of the dual speed responsive means comprising a first flyweight (**70**) which is radially displaced at a first end to develop said first force from a second end thereof, said first means comprising a pivot pin (**66**) interconnecting the second ends of the respective flyweight and common intermediate shaft.

**7.** The invention of claim **6**, characterized by:

said second one of the dual speed responsive means comprising a second flyweight (**74**) connected to, and radially displaceable to cause the described axial displacement of the governor collar.

**8.** The invention of claim **5**, characterized by:

said interconnecting governor arm having its mounting fulcrum between one end and an intermediate, spool connected point on the opposed end portion of the governor arm, and a governor spring (**78**) acting between and engaging a spring seat on the extremity of the aforesaid opposed end portion of the governor arm.

**9.** The invention of claim **8**, characterized by:

a fuel control lever (**92**) having means of connection (**90, 86**) to the spring seat for adjusting the governor spring force against the governor arm.

**10.** The invention of claim **9**, characterized by:

a torque spring (**84**) arranged in the path of the governor arm to effect series opposing relation to the governor spring, and engageable with and being bent by the arm when the governor spring moves the arm into an overload range past the satisfied position at rated load;

said torque spring unbending to restore the arm to the satisfied position when the second flyweight force has increased effectively to balance the rated load force of the governor spring.

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