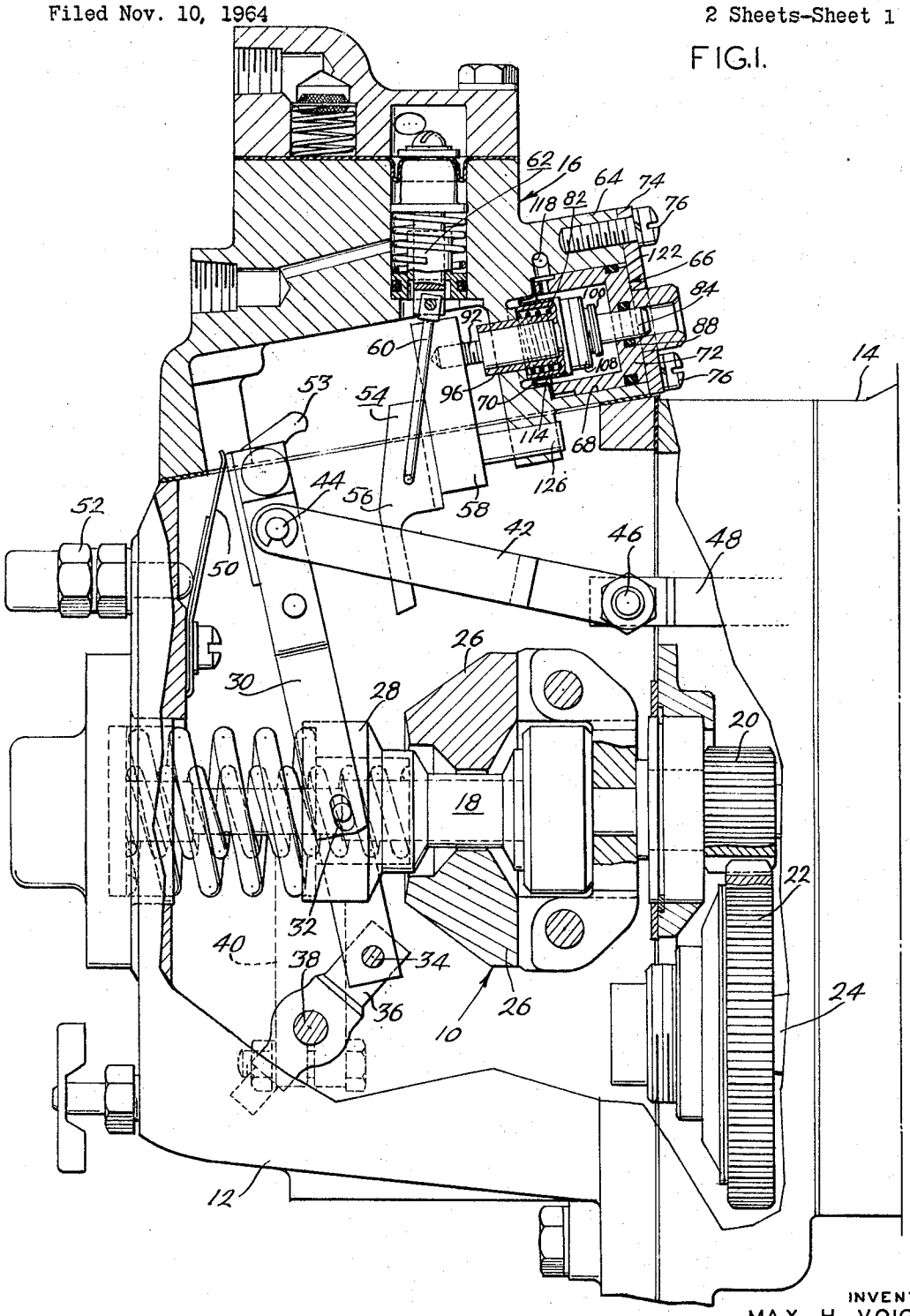
March 28, 1967 M. H. VOIGT 3,311,102

EXCESS FUEL STARTING DEVICE FOR FUEL INJECTION ENGINES

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FIG.1.



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FIG. 2.

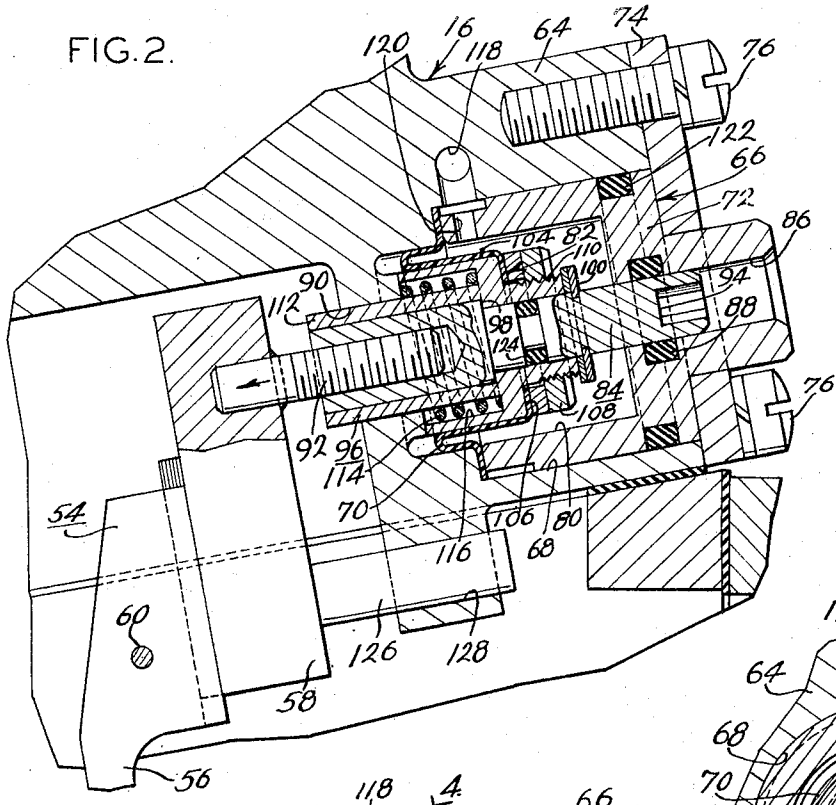


FIG. 4.

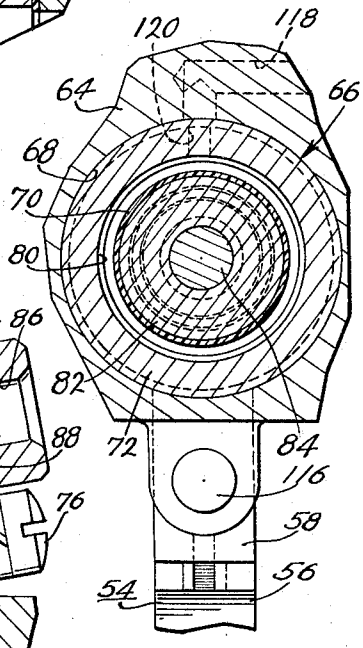
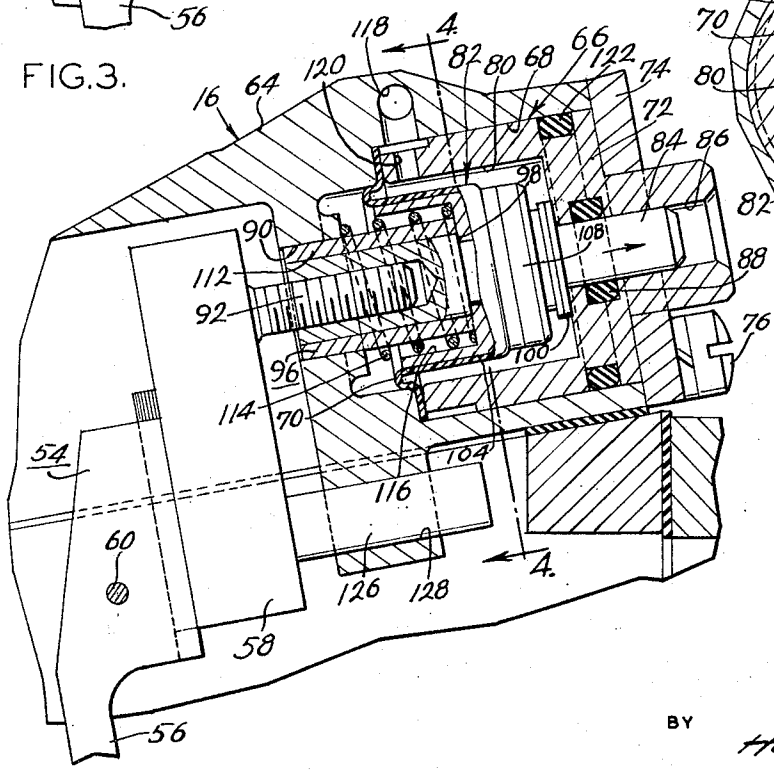


FIG. 3.



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EXCESS FUEL STARTING DEVICE FOR FUEL INJECTION ENGINES

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Filed Nov. 10, 1964, Ser. No. 410,184
1 Claim. (Cl. 123—179)

The present invention relates to a hydraulically actuated starting device for fuel injection engines which automatically permits an excess fuel delivery during cranking of the engine.

To facilitate the starting of a fuel injection engine, it is desirable during cranking to provide a fuel delivery in excess of the normal full load delivery. Since the fuel delivery is generally limited by a full load stop coacting with the engine throttle linkage, it is necessary, in order to permit an excess fuel injection, to provide a mechanism which changes the position of the full load stop during the engine cranking period. Although manually set mechanical tripping devices have heretofore been utilized for such purpose, the present invention provides a fully automatic excess fuel control which is hydraulically actuated by an engine-pressurized fluid such as the engine lubricating oil.

In view of the above, it is a primary object of the present invention to provide a fully automatic fuel injection engine starting device permitting fuel delivery in excess of the normal full load delivery during cranking to facilitate engine starting.

Another object of the invention is to provide a device as described which automatically reduces the permissible maximum fuel delivery to the normal full load fuel limit after the engine starts to prevent overfueling.

A still further object of the invention is to provide a device as described which upon engine stoppage is automatically reset to permit the desired excess fuel condition

Additional objects and advantages of the invention will be more readily apparent from the following detailed description of an embodiment thereof when taken together with the accompanying drawings in which:

FIG. 1 is a cutaway view partly in section of a fuel injection engine governor, the full load stop of the throttle linkage of which is provided with an excess fuel device in accordance with the present invention;

FIG. 2 is an enlarged view of the excess fuel device as shown in FIG. 1 with the device in the normal operating full load position;

FIG. 3 is a view as in FIG. 2 showing the device in the excess fuel position; and

FIG. 4 is a sectional view taken along line 4—4 of FIG. 3.

Referring to the drawings, the illustrated embodiment is shown in conjunction with a fuel injection engine governor **10** which is enclosed within a governor housing **12** mounted adjacent the partly shown fuel injection pump **14**. In the illustrated arrangement, a fuel correlator assembly **16** is mounted on the governor housing to vary the position of the throttle linkage full load stop in accordance with the density and viscosity of the engine fuel.

The governor briefly includes governor shaft **18** which is driven through gears **20** and **22** by the fuel injection pump cam shaft **24**. Mounted on the governor shaft are centrifugal weights **26**, the centrifugal action of which through a spring loaded linkage **28** governs the position of the fulcrum lever **30**, being connected therewith by pin **32**. The lower end of the fulcrum lever is secured by pin connection **34** to trunnion lever **36** on the operating lever shaft **38**, the operating lever being shown in broken lines at **40**.

A link **42** is pivotally attached to the upper end of the fulcrum lever **30** by means of pin connection **44**. The link is pivotally connected at **46** with the fuel control rod **48** which controls the fuel output of the fuel injection pump, movement of the control rod to the right providing an increased fuel output of the pump and conversely movement to the left decreasing the pump output. The travel of the upper end of the fulcrum lever **30** is limited to the left by the idling bumper spring **50**, the position of which may be adjusted by means of adjusting screw **52**. The movement of the fulcrum lever to the right is limited by the contact of the fulcrum lever cam **53** with the full load stop **54** which in this embodiment is in the form of a sliding wedge **56** slidably engaged with stop plate **58**. The position of the sliding wedge on the stop plate is controlled by connecting rod **60** extending from the fluid motor **62** of the fuel correlator assembly **16**. The fuel correlator varies the position of the full load stop in response to variations in density and viscosity of the fuel to permit maximum engine power without overloading. Details of construction and operation of a fuel correlator assembly of the type illustrated are set forth in the copending application Ser. No. 270,000 assigned with the present application to a common assignee.

Located in the lower part of the fuel correlator assembly housing **64** is the excess fuel starting device **66**, the details of which are most readily understood by reference to FIGS. 2–4. The device is essentially a hydraulic spring loaded piston-cylinder actuator which is activated by an engine-pressurized fluid source to control the position of the throttle linkage full load stop. The source of engine-pressurized fluid may for example be the engine lubricating oil or fuel supply. Although a variety of piston-cylinder arrangements could be employed, the illustrated embodiment shows a preferred construction utilizing a diaphragm-type piston-cylinder actuator.

The present arrangement specifically includes a cylindrical cavity **68** in the housing **64**, toward the inner end of which is secured the diaphragm **70** by cylindrical closed-end retainer element **72** which in turn is secured in place by the retainer plate **74** fastened to the housing by screws **76**. The retainer element **72** provides a cylindrical bore **80** within which the piston **82** is movably disposed. The piston consists of a piston rod **84** one end of which is slidably journaled within the concentric bore **86** of the retainer element **72** and sealed therewithin by seal ring **88**. The left end of the piston rod extends through the bore **90** in the housing **64** and is internally threaded to receive the stop plate screw **92**. The depth of engagement of the screw **92** with the piston rod may be adjusted by means of the screw driver slot **94** in the right hand end of the piston rod.

The piston **82** includes a piston element **96** fitted on the piston rod and secured against the shoulder **98** thereof by snap ring **100** in the piston rod. The piston element includes an outer cylindrical face **104** along which the diaphragm **70** extends in a folded disposition. The diaphragm is secured to the piston element along the shoulder **106** by the nut **108** on the threaded portion **110** of the piston element. An extending cylindrical portion **112** of the piston element extends through the bore **90** in the housing in close fitting sliding relationship therewith. A compression spring **114** within cylindrical slot **116** of the piston element is seated against the housing **64** and urges the piston to the right.

Conduit **118** in the housing leads to a source of engine-pressurized fluid and connects with the bore **80** by means of the inlet port **120** in the retainer element **72**. To prevent an escape of pressurized fluid from the bore **80**, seal ring **122** is provided between the retainer element **72** and cavity **68**. In addition, seal ring **124** is provided

on the piston rod to prevent fluid escape between the piston rod and piston element. A seal is not required in the bore **90** since the region behind the diaphragm should be vented to the atmosphere.

A stop plate guide pin **126** extending parallel with the screw **92** and slidably disposed within the bore **128** of the housing **64** serves to maintain the stop plate in the proper alignment.

In operation, with the engine running, the bore **80** is filled with a pressurized fluid supplied through the conduit **118** and inlet **120** which serves to act against the force of the spring **114** to maintain the piston in abutting relationship with the housing at the extreme left end of its stroke, thereby maintaining the full load stop in its normal operating full load position as shown in FIGS. 1 and 2. When the engine is halted, the fluid pressure drops and the force of the spring moves the piston and full load stop to the excess fuel position shown in FIG. 3, the piston moving to its extreme right hand position with the snap ring **100** abutting the inner end face of the retainer element **72**. Movement of the full load stop to the right permits an excess fuel injection by the fuel injection pump which should be in the order of at least 50% more fuel than at normal full load to facilitate engine starting. Upon starting of the engine, as pressure builds up in the bore of the actuator, the spring force is overcome and the piston and full load stop are moved to the left into the normal operating full load position.

From the above it can be understood that the operation of the excess fuel starting device is fully automatic, permitting an excess fuel condition during starting of the engine while limiting the throttle assembly to the normal full load limit after the engine starts to prevent overfueling.

Manifestly, changes in details of construction can be

effected by those skilled in the art without departing from the spirit and the scope of the invention as defined in an limited solely by the appended claim.

I claim:

An excess fuel starting device for a fuel injection engine having a full load stop coacting with the engine throttle linkage to limit the fuel input thereto comprising, a hydraulic actuator operatively connected to the full load stop for movement thereof from a normal operating full load position to an excess fuel starting position, said actuator comprising a housing on the engine having a cylindrical bore therein, a piston movably disposed within said bore, and a piston rod extending from said bore and operatively connected with the full load stop, a spring in said bore urging said piston and full load stop into the excess fuel position, a fluid inlet in said housing opening into said bore for introducing pressurized fluid into said bore to move said piston against the force of said spring into the normal operating full load position, and a fluid conduit for connecting said fluid inlet with a fluid source pressurized by and only during operation of the engine, said fluid source comprising the engine lubricating oil, said spring being adapted upon engine stoppage to move said piston and full load stop to the excess fuel starting position.

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