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FUEL CONTROL SYSTEM FOR OIL ENGINES

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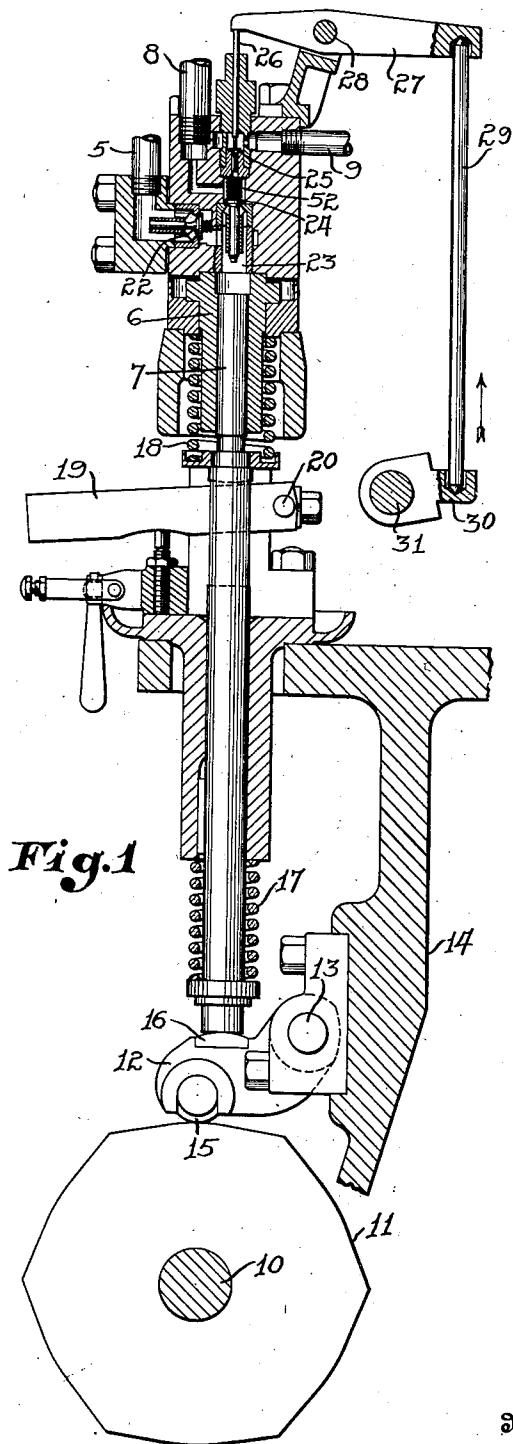


Fig. 1

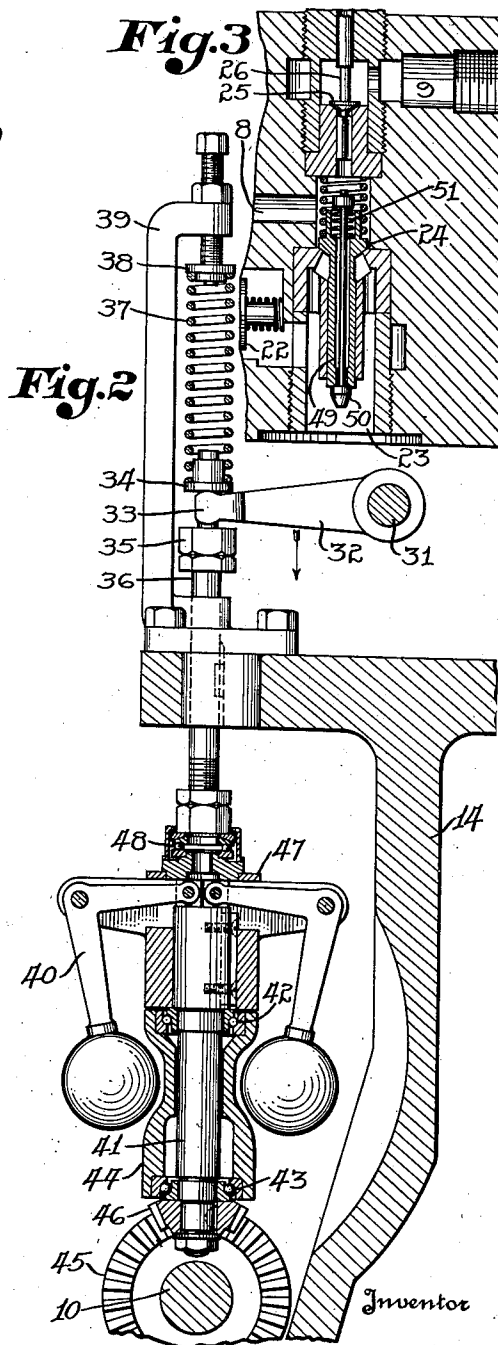


Fig. 2

Fig. 3

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FUEL CONTROL SYSTEM FOR OIL ENGINES

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This invention relates to a fuel control system for oil engines, with special reference to means for automatically controlling, in accordance with the speed of the engine, the quantity of fuel in each charge injected into the cylinder.

In various control devices heretofore used for this purpose, the governor has a considerable range of radial travel in response to various conditions under which the engine may operate. If there is a sudden change in these conditions, as for example, a change from a heavy load to a light load, there is more or less delay in the action of the governor in response thereto, and as the governor finally responds, there is an appreciable overtravel, then a reaction, and after considerable oscillation, the governor finally settles to a stable position.

With the above facts in mind, it is the object of the present invention to provide a control system in which there is an immediate and steady response to changes in operative conditions of the engine, without any overtravel of the governor. There is, in fact, no perceptible radial travel of the governor, but merely a gradual or steady change in the force exerted thereby in opposition to the spring acting upon the by-pass valve by which a portion of the potential fuel charge may be returned to the system, instead of being injected into the cylinder.

The invention also includes, in connection with the check valve of the injector, a return relief valve controlling a longitudinal port therethrough, whereby the compression of the oil built up by the forward stroke of the piston, is relieved during the retractive stroke, so that a uniformly controlled action of the injector is assured at all times regardless of the condition of the valves or valve seats.

The invention will be more particularly described in connection with the accompanying drawing, in which

Figure 1 is a sectional view taken longitudinally of the injector piston.

Figure 2 is a sectional view taken longitudinally of the centrifugal governor which controls the fuel charge.

Figure 3 is an enlarged sectional view of

the combined check valve and relief valve and adjacent parts associated with the inlet to the injector line.

In accordance with the drawing, the fuel supply system has a passageway 5 leading to a cylinder 6 in which an injector piston 7 is adapted to reciprocate to force a fuel charge through a passageway 8 into the cylinder. As the speed of the engine increases, a portion of such fuel charge escapes through a by-pass 9 and is returned to the fuel supply system. For operating the injector piston 7, a shaft 10 connected with the engine has secured thereon a cam 11. A rocker arm 12 pivoted at 13 to the engine casing 14 is provided with a roller 15 which rides on the cam 11 and with a seat 16 on which the lower end of the piston rests. The piston 7 is held against the seat 16 by suitable springs such as are indicated at 17 and 18. An arm 19 pivoted at 20 to a stationary part of the engine, extends through a slot in the piston 7 and may be actuated manually to raise the piston.

A suitable spring controlled check valve 22 controls the inlet from the fuel supply system to the chamber 23 in the upper end of the cylinder 6 and another spring held check valve 24 controls the outlet from the chamber 23 to the engine cylinder. A relief valve 25 also controls the flow of fuel into the by-pass 9 whereby it is returned to the fuel supply system. When the full fuel charge is required the valve 25 is held on its seat but when the speed of the engine reaches a predetermined maximum, the valve 25 is adapted to open and permit a portion of the fuel charge to be returned through the passage-way 9.

For automatically controlling the operation of the valve 25, its upwardly extended stem 26 is engaged by a rocker arm 27, which is intermediately pivoted at 28 to a stationary part of the engine. A rod 29 is disposed between the rear end of the arm 27 and an arm 30 which is secured to a rock shaft 31 journaled in the engine frame. A second arm 32 is secured to the rock shaft 31 and is formed with a bifurcated end 33 which is disposed between two heads 34 and 35 secured

to a rod 36 supported for reciprocatory movement in the engine casing 14. The head 35 is shown as being adjustable lengthwise of the rod 30 and is usually adjusted so that there will be a slight clearance between it and the bifurcated end 33 when the engine is at rest and the valve 25 closed.

The rod 36 is normally urged downwardly with considerable pressure which is exerted through the arm 32, rock shaft 31, arm 30, rod 29 and rocker arm 27 to hold the valve 25 closed. Such pressure is exerted by a coil spring 37 disposed between the head 34 and an opposing head 38 which is mounted in a bracket 39 and may be adjusted to secure the desired tension in the spring in accordance with the speed desired.

When the engine is running, the pressure of the spring 37 is opposed by a centrifugal governor 40 connected to a shaft 41 which is rotatably mounted in bearings 42 and 43 in a housing 44 and is driven from the shaft 10 by suitable gears 45 and 46. As the speed increases, the centrifugal force reacts upwardly on the frame 47 and similarly on the rod 36 which is connected to the frame 47 by suitable bearings 48. There is no appreciable radial travel of the governor, however, since the centrifugal force serves merely to lessen the effective pressure of the spring 37, or in other words to lessen the load on the valve 25, without changing the tension of the spring. At low speed the pressure of the spring 37 will be sufficient to hold the valve 25 closed at all times and the full charge will be directed into the cylinder. As the centrifugal force of the governor increases, however, the governor takes some of the load of the spring 37, thus reducing the pressure on the valve 25, whereupon more and more of the fuel charge is by-passed through the passageway 9.

It will be understood that the fuel charge is injected into the cylinder at a high pressure and as the valve 24 closes at the beginning of the retractive stroke of the piston, the fuel remaining in the injector line will still be under compression. It is undesirable to retain this compression between strokes of the piston. In order to insure uniform operation at all times it is expedient to provide a return valve for relieving the compression during the retractive stroke so that at each forward stroke of the piston the pressure is built up from a uniform point which is near zero. For this purpose, the valve 24 and its stem are provided with a longitudinal bore 49 through which extends the stem of a return valve 50. This valve is held normally closed by a comparatively light spring 51, but as the piston begins its retractive stroke to draw in a fresh charge through the passageway 5, the valve 50 opens long enough to relieve the pressure within the injector line.

From the foregoing description it will be

seen that as the speed of the engine increases, the action of the centrifugal governor instantly begins to take up the load of the spring 37. Owing to the extremely high pressure under which the fuel is injected, only a very small opening of the valve 25 is necessary to reduce the fuel charge, while the tension of the spring 37 remains substantially constant, and there is no appreciable radial travel of the governor.

While I have shown and described in detail the preferred embodiment of the invention, it is apparent that the same may be considerably modified without departing materially from the scope of the appended claims.

What I claim is:

1. In a fuel control device, the combination of a relief valve, substantially constant pressure means tending to hold said valve closed, and a centrifugal governor opposed to the reaction of said constant pressure means on said valve, said governor having no appreciable radial travel.

2. In a fuel control device, the combination of a relief valve, substantially constant pressure means tending to hold said valve closed, a centrifugal governor, and means actuated by said governor to oppose the pressure of said constant pressure means, thereby reducing the reaction on the valve, without any appreciable radial travel of said governor.

3. In a fuel control device, the combination of a normally closed valve, stop mechanism projecting into the path of opening movement of said valve, a spring normally acting with substantially constant pressure on said stop mechanism to prevent the valve from opening, an engine shaft, and means for progressively opposing the reaction of said spring on the stop mechanism as the speed of rotation of said shaft increases.

4. In a fuel control device, the combination of a normally closed valve, stop mechanism projecting into the path of opening movement of said valve, substantially constant pressure means normally acting on said stop mechanism to prevent the valve from opening, an engine shaft, and centrifugal means driven by said shaft and directly opposed to the reaction of said pressure means on said stop mechanism.

5. In a fuel control device, the combination of a normally closed valve, a rock shaft having two arms, means for exerting pressure on one of said arms, means for transmitting said pressure through the other arm to resist opening of said valve, and centrifugal means opposed to the reaction of said pressure exerting means on the rock shaft arms.

6. In a fuel control device, the combination of a normally closed valve, a rock shaft having two arms, means for exerting pressure on one of said arms, means for trans-

mitting said pressure through the other arm
to resist opening of said valve, a centrifu-
gal governor, and substantially non-resilient
means for transmitting force from said gov-
5 ernor to said pressure exerting means to op-
pose the reaction of the latter.

In testimony whereof I have hereunto
signed my name to this specification.

EDWARD RATHBUN.

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