Nov. 24, 1959 D. HUGHSON ET AL 2,914,056

SMOKE CONTROL MECHANISM FOR DIESEL ENGINES

Original Filed March 21, 1956 2 Sheets-Sheet 1

Fig. 1

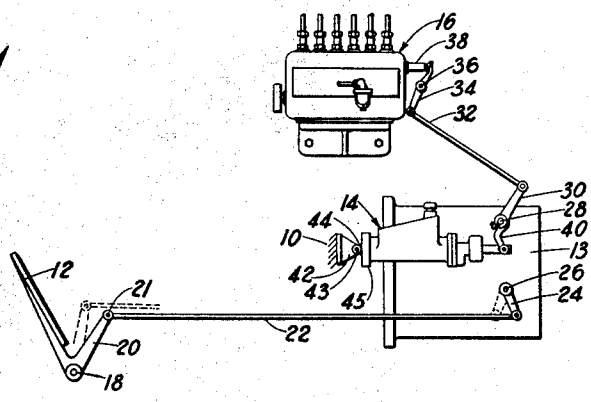


Fig. 2

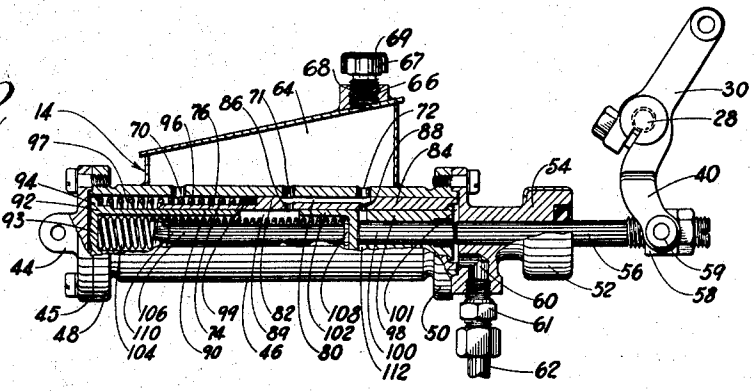


Fig. 3

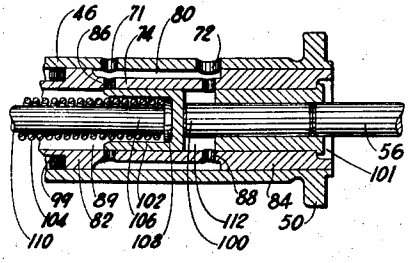
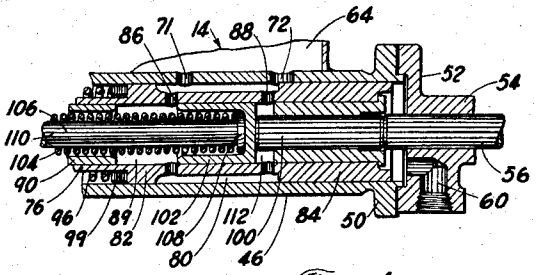


Fig. 4



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SMOKE CONTROL MECHANISM FOR DIESEL ENGINES

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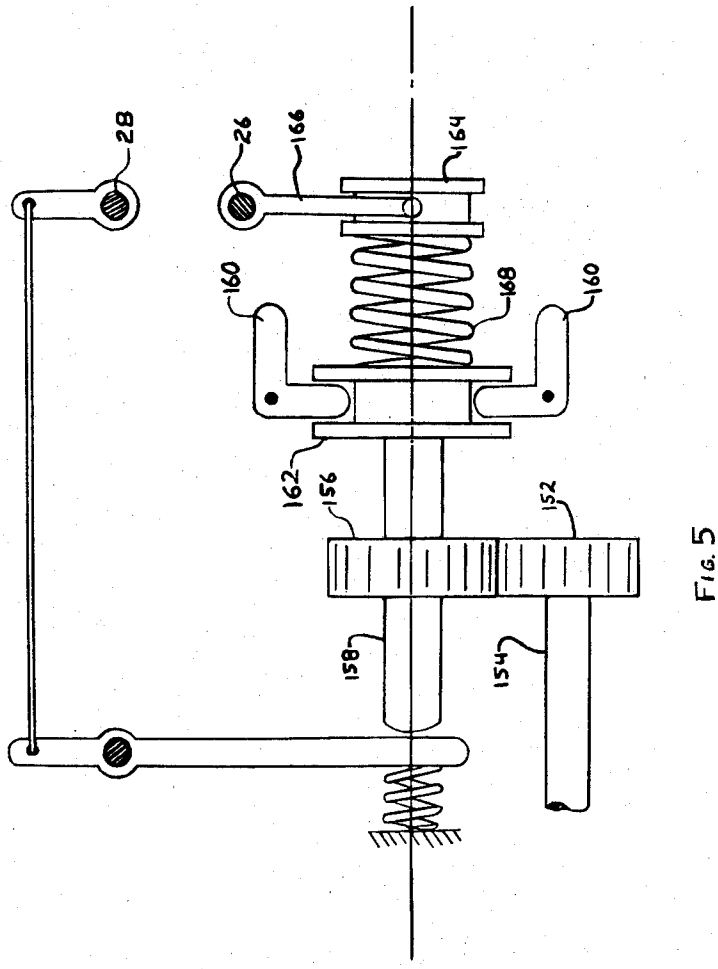


Fig. 5

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SMOKE CONTROL MECHANISM FOR DIESEL ENGINES

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Continuation of abandoned application Serial No. 573,001, March 21, 1956. This application August 22, 1958, Serial No. 756,706

7 Claims. (Cl. 123—140)

This invention relates to a governor control device and more specifically to a mechanism for substantially eliminating smoke in the exhaust of an engine during the acceleration period.

The present application is a continuation of our earlier filed U.S. application 573,001, filed March 21, 1956, Smoke Control Mechanism for Diesel Engines, now abandoned.

In current diesel engines the fuel injection pump is controlled by a governor which in turn is controlled by a throttle. Upon movement of the throttle toward a more open position, the governor will, due to the nature of its construction, drive the rack of the fuel injection pump to its fully open position. This will cause a full charge of fuel to be immediately injected into the various cylinders of the engine. As a result, the engine will smoke, will run rough, and will operate under relatively unstable conditions until the desired throttle speed has been obtained. When the throttle is pushed to even a partially open position, the governor will react the same way and permit the rack of the fuel injection pump to go to its fully open position. The engine will begin to smoke due to the surplus in fuel over the amount of air available and will begin to increase in speed. Upon obtaining the desired speed the governor will slow down and move the rack of the fuel injection pump to the desired opening whereby the engine will once again operate smoothly and the fuel will be burned completely without smoking.

It is therefore a principal object of this invention to overcome the above noted disadvantages of the prior art and to provide a mechanism whereby the fuel air mixture is gradually increased depending upon the demands of the operator until the desired increase in speed is attained.

It is a further object of this invention to provide a device for changing the speed of an engine without causing the engine to smoke or run unevenly.

It is a further object of this invention to provide a mechanism operating between the governor and fuel injection pump which will permit the speed of the governor to gradually increase to fulfill the demands of the changed throttle position.

It is another object of this invention to provide a control mechanism whereby the speed of an engine can be varied without emitting undue smoke therefrom by the operator moving only the throttle and making no other adjustments.

It is a further important object of this invention to provide a mechanism whereby the various functions of a governor control can be performed by power derived from various conventional components of an engine.

A still further object of this invention is to provide an engine with a governor control mechanism which will produce great economies in fuel consumption.

Another object of this invention is to provide an engine with a governor control mechanism which will cause

a relatively low rate of smoke production during the acceleration period whereby the internal portions of the engine will require less cleaning.

And still another object of this invention is to provide a device of compact, simple, durable, and economical construction that is highly efficient for the purposes intended.

These and other objects and advantages of the invention will be apparent when the specification is considered in connection with the drawings in which:

Figure 1 is a schematic view of the various components of an engine fuel control system embodying our invention;

Fig. 2 is an enlarged partially broken away view of a governor control mechanism;

Fig. 3 is a sectional view of part of the mechanism of Fig. 2 with the elements thereof in a different position;

Fig. 4 is a further sectional view of the mechanism of Fig. 2 with the elements thereof in another position; and

Figure 5 is a diagrammatic representation of the governor disclosed in Fig. 1.

Referring more specifically to the annexed drawings wherein like reference numerals designate similar parts throughout the several views, **10** designates a portion of an engine of any suitable type having a throttle control lever **12**, a governor **13**, a governor control mechanism **14**, and an injector pump **16** all interconnected. The engine referred to herein is of diesel design wherein the fuel is supplied to the engine by the injection pump, all of which is conventional.

The throttle lever **12** with attached arm **20** is pivoted about the axis **18** and is movable from a full load position shown in dotted lines to an idle position shown in solid lines. Arm **20** is pivotally connected at **21** to a shaft **22**, which is likewise pivotally connected to the outer end of an arm **24** fastened on the speeder shaft **26** of the governor. When the throttle lever is rotated from the idle position to the full load position, the arm **20** will move the shaft **22** to the left pivoting the speeder shaft **26** in a clockwise direction. Due to the construction of the governor **13** used in the prior art, which did not have a governor control mechanism, rotation of the speeder shaft **26** even a small amount in a clockwise direction will cause a terminal shaft **28** to be rotated the full amount in a clockwise direction. Therefore, under the prior art, when the throttle is moved from idle to full load position, the terminal shaft will rotate the full amount in a clockwise direction whereby a lever **30** fastened to the terminal shaft will move the link **32** to the right which will pivot the lever **34** about the axis **36** and cause one end of said lever **34** to drive the rack **38** to the left the full amount into the injection pump **16** whereby a full load of fuel is supplied to the combustion chambers of the engine. This sudden surge of fuel into the combustion chambers will cause the engine to smoke, sputter, and generally run rough as the engine attempts to obtain operating speeds. When the speed of the engine demanded by the throttle setting has been obtained, the governor will take over and will move the terminal shaft to the proper position whereby the fuel rack will be moved to the correct location for delivering the prope fuel for the desired speed. To overcome the above enumerated characteristic of the governor whereby the full fuel load is delivered to the engine whenever increased speed is desired, a governor control or smoke control mechanism **14** is mounted on the engine **10** in position to coact with one arm **40** of the lever **30** which is mounted on the terminal shaft **28** in such a way that the terminal shaft **28** is not permitted to take the full

rotation when the governor speed is increased as will be more fully described hereinafter.

Figure 5 illustrates diagrammatically the internal construction of governor 13 in which speeder shaft 26 and terminal shaft 28 have engine speed means interposed therebetween. A spur gear 152 is driven at engine speed by a shaft 154. Gear 152 engages a second spur gear 156 which has splined engagement with a shaft 158. Rotating with the shaft 158 are centrifugal weights 160 which engage a collar 162 secured to the shaft 158. Speeder shaft 26 engages a second collar 164 by means of an intermediate link 166. A compression spring 168 is disposed between the first collar 162 and the second 164. Terminal shaft 28 is responsive to the position of governor shaft 158 by means of a series of simple first-class levers and linkages.

Briefly the governor 13, as disclosed in Figure 5, operates in the following fashion. Rotation of shaft 54 by the engine will rotate centrifugal weights 160 which react against the collar 162 causing it to assume a certain longitudinal position. As the engine increases in speed, weights 160 will move outwardly due to their increased centrifugal force thus moving collar 162 and shaft 158 to the right. This action will be transmitted through the link and levers to governor terminal shaft 28 causing it to turn in a counterclockwise direction. Counterclockwise rotation of terminal shaft 28 is transmitted to the injection pump rack 38 so as to decrease the supply of fuel to the engine and reduce its speed. The reverse action will take place as an increased load reduces the speed of the engine so that terminal shaft 28 will cause the injection pump 16 to increase its output to compensate for the slower engine speed. Rotation of the speeder shaft 26 by the throttle pedal 12 will force collar 164 to move in a direction to either compress or extend the length of the spring 168. This motion is also transmitted to the terminal shaft 28 to either increase or decrease the fuel supplied as determined by the throttle position. Therefore, the position of the terminal shaft 28 is responsive to both throttle position and engine speed.

Referring to Figures 1 and 2 of the drawing, the governor control mechanism 14, which forms a principal part of this invention, is pivotally mounted on the side of the engine 10 by means of a bracket 42 which is held enmeshed by a pin 43 with a pair of lugs 44 projecting from an end plate 45 of the control mechanism 14. The control mechanism 14 comprises a cylindrical shell or housing 46 which has formed on one end portion thereof a flange 48 which is bolted to said end plate 44 for sealing off said end of the housing. The other end portion of said housing 46 has a flange 50 bolted to a bearing cap 52 which has a bearing seal 54 nested on the inside thereof through which a reciprocally mounted shaft 56 is adapted to be moved. The seal 54 is adapted to prevent leakage of fluid from the inside of the housing. The exposed end of said shaft 56 is threaded to receive an axially adjustable collar 58 which has radially projecting pins 59 for pivotally supporting the bifurcated end 40 of the lever 30. Formed in said bearing cap 52 is a right angled channel 69, one end of which opens into the interior of the housing 46 and the other end of which receives a fitting 61 to which is attached a conduit 62 connected to the manifold of the engine whereby changes in pressure in the manifold will be transmitted to the control mechanism 14 for a reason to be hereinafter described.

Mounted on the upper central portion of the housing 46 is a reservoir 64 which has a threaded opening 66 for use in filling the reservoir and which is adapted to receive a plug 67 having a vent 68 passing therethrough. A shield 69 is disposed over said plug 67 for preventing extraneous material from entering the reservoir through the vent 68. Communicating between the interior portion of the housing 46 and the interior portion of the reservoir 64 is a series of ports 70, 71, and 72 which are adapted to permit the free flow of fluid between the housing and the reservoir.

Slidably positioned within the housing 46 is a piston 74 which has a sleeve 76 of reduced outside diameter fastened on and extending from the left hand end portion thereof. Formed circumferentially about the outer surface of the piston 74 is a circumferentially formed valley or grooved portion 80 which is bounded on opposite sides by the equal diametered housing engaging land portions 82 and 84. A pair of ports 86, 88 axially spaced from each other, extend through the walls of the piston 74 to permit communication between the valley 80 and the inner chamber 89 of the piston. An elongated tubular member 90 is telescopically and slidably received within the sleeve portion 76 of the piston and has formed on the left end thereof a disc 92 which has a shoulder 94 radially extending beyond the outside diameter of the member 90. Said disc 92 seals off one end of the tubular member 90 and has a spacing welt 93 formed on the outer side thereof which is adapted to engage with the inner surface of the plate 45. A compression spring 96 is disposed in chamber 97 and is wrapped around said tubular member 90 and said sleeve 76 and abuts against said shoulder 94 on member 90 and against said land portion 82 on piston 74 for urging one end of said piston against the bearing cap 52 and for urging the spacing welt 93 on the disc 92 against the plate 45. The welt 93 prevents the disc 92 from becoming sealed by suction against the plate 45. A plurality of spacing shims 99 are positioned between the end of spring 96 and the portion 82 whereby any desired load can be preset on said spring. The tubular member 90 not only serves to support the springs but also coacts with the sleeve 76 to form a seal whereby fluid in chamber 89 is permitted to flow only through the ports 86 when they are uncovered.

Fastened within the bore of the right hand portion of the piston 74 is a bearing sleeve 98 which is adapted to slidably receive a shaft 100 therein. The left end faces of the piston 74 and bearing sleeve 98 form one side of a pressure chamber 101 which is in communicating relation with the manifold pressure of the engine through the channel 60. The fit between the shaft 100 and the sleeve 98 is such as to permit movement therebetween but will not permit the fluids in chambers 101 and 89 to become intermingled. Shaft 56 abuts against one end of the shaft 100 which in turn abuts against a cup-shaped piston 102 slidably received within the piston 74. The axial length of said piston 102 is slightly shorter than the spacing between the ports 86 and 88 so that at no time will both ports be closed off by the piston. A second compression spring 104 seated within the tubular member 90 extends within the cup-shaped piston 102 for forcing said piston 102 into engagement with the shafts 100 and 56. A spring retainer 106 having a shoulder 108 against which the spring 104 is seated is positioned within the piston 102 and has an elongated port 110 fitting within the spring 104 to prevent said spring from buckling. Said elongated port 110 also serves as a limiting abutment to prevent excessive movement of the piston 102 in one direction. In the initial position of the cup-shaped piston 102 its forward edge is adapted to be positioned so as to uncover ports 86 so as to permit free flow of hydraulic fluid from the chamber 89 into the valley portion 80 and through ports 71, 72 into the reservoir 64. The piston 102 in the initial position also uncovers ports 88 so that fluid can flow into or out of chamber 112 on the other side of piston 102.

The chambers 89 and 112 and part of the reservoir 64 are all full of hydraulic fluid of any suitable type so long as its viscosity is such as to permit free movement through ports 86, 88, 70, 71, and 72 during the various operations of the mechanism.

Operation

When the throttle is moved from the idle position toward a more open position, the speeder shaft **26** will be rotated a selected amount in the clockwise direction which will cause the terminal shaft **28** to attempt to rotate the full amount in the clockwise direction. However, the lever **40** will start to rotate and will force the shafts **56** and **100** and piston **102** to the left against the action of spring **104**. When the terminal shaft rotation force is sufficient to overcome the force of the spring **104**, the piston **102** will move to the left, forcing the surplus fluid in chamber **89** out of the ports **86** until said piston **102** covers said ports **86**. This is the condition shown in Figure 3. Since the fluid in chamber **89** cannot be compressed, further rotation of the terminal shaft will be prevented and only the small amount of rotation of the terminal shaft required to shut off ports **86** will be transmitted through the other end of lever **30**, link **32** and lever **34** to the rack **38** of the injection pump **16**. The small movement of the rack **38** will permit only a gradual increase in the amount of fuel injected into the engine with the result that the engine will pick up speed gradually. Since the amount of injected fuel will be limited, no excess will be available to cause smoke in the exhaust of the engine. When the piston **102** is moved to the left, the size of chamber **112** will be increased, which chamber will be filled by fluid flowing from the reservoir **64** through ports **72** and **88**.

As the engine picks up speed, the manifold pressure will increase which pressure is transmitted through channel **60** to the chamber **101**. When the increase in pressure is sufficient to overcome the force of the spring **96**, the piston **74** will be moved to the left until ports **86** are again uncovered. This will permit the fluid in chamber **89** to flow to the reservoir **64** so that the position shown in Figure 4 is obtained. The terminal shaft **28** will again start to rotate, simultaneously moving the rack **38** inwardly and driving the piston **102** to the left until the ports **86** are again covered. When the ports are covered, further movement of the terminal shaft is prevented and the movement of the rack **38** is arrested. The new position of the rack will permit the injection of an increased amount of fuel to the engine whereby the speed of the engine is again increased.

The above described cycle will be repeated several times so that the engine speed will be gradually increased until the desired speed is attained. Accordingly, at no time will the fuel-air mixture be permitted to become unbalanced enough to create smoke from the exhaust of the engine. Since the fuel-air mixture will be substantially in the correct ratio, at no time will the engine run rough, or with excessive noise due to improper fuel mixtures.

Although but a single embodiment of the invention has been shown and described in detail, it is obvious that many change may be made in the size, shape, details, and arrangement of the various elements of the invention within the scope of the appended claims.

What is claimed is:

1. A speed control device for an internal combustion engine comprising an engine speed responsive governor, a controllable fuel supply for said engine, an engine manifold pressure source, said governor having output means connected to said fuel supply for the regulation thereof, dash pot control means connected to said governor output means tending to restrict its movement in the fuel increasing direction and responsive to pressure from said pressure source to relieve said restriction of movement, said control means comprising a housing, a cylindrical piston axially slidable within said housing and having a port radially extending through the wall of said piston, a second piston axially slidable within said first piston and adapted to selectively seal off said port, a fluid within said first piston and communicating with said port, spring means for urging said piston in one particular direction, means for connecting the manifold pressure source with the side of said first piston opposed to said spring means, means connected with said governor for driving said second piston into a position to seal said port in said first piston and compress said fluid.

2. A speed control device for an internal combustion engine comprising an engine speed responsive governor, a controllable fuel supply for said engine, an engine manifold pressure source, said governor being connected to said fuel supply for the regulation thereof, control means connected to said governor tending to restrict its movement in a fuel increasing direction, said control means comprising a housing, a fluid reservoir communicating with the inner portion of the housing, a piston axially slidable within said housing, a radial port extending through the wall of said piston in communication with said reservoir, a second piston concentrically disposed within said first piston, separate spring means for urging said pistons in one particular direction, means for connecting the manifold of the engine with one side of said first named piston whereby manifold pressure will act against one of said spring means and means connected with said governor for driving said second piston into a position to cover said port in said first named piston and compress said fluid.

3. A speed control device for an internal combustion engine comprising an engine speed responsive governor, a controllable fuel supply for said engine, an engine manifold pressure source, said governor being connected to said fuel supply for the regulation thereof, a dash pot mechanism having means coacting with said governor to restrict its movement in a fuel increasing direction, said mechanism comprising a trapped fluid chamber and means coacting with said manifold pressure to vent said chamber to relieve said restriction.

4. A dash pot device for dampening a mechanical movement responsive to a fluid pressure comprising a housing, a first piston axially slidable within said housing, said first piston having a radial port through its wall, a second piston axially slidable within said first piston and adapted to selectively seal off said port, a fluid reservoir communicating with said port, spring means for urging said pistons in one particular direction, means for communicating a modulating fluid pressure with the side of said first piston opposed to said spring means, and said second piston having means associated therewith connected to the mechanical movement to be dampened.

5. A speed control device for an internal combustion engine comprising an engine speed responsive governor, a controllable fuel supply for said engine, means connecting said governor to said fuel supply for the regulation thereof, control means adapted to limit the increase in fuel-flow-rate inducible by said governor, said control means comprising a chamber and a piston slidably received therein, a fluid within said chamber, said piston being operatively connected to said first mentioned means and adapted to limit its movement in a fuel-flow-rate increasing direction by the compressive resistance of said fluid to the movement of said piston.

6. A speed control device for an internal combustion engine comprising an engine speed responsive governor, a controllable fuel supply for said engine, means connecting said governor to said fuel supply for the regulation thereof, control means adapted to limit the increase in fuel-flow-rate inducible by said governor, said control means comprising a chamber and a piston slidably received therein, a fluid within said chamber, said piston being operatively connected to said first mentioned means and adapted to limit its movement in a fuel-flow-rate increasing direction by the compressive resistance of said fluid to the movement of said piston, said engine comprising also a manifold pressure source and means responsive to pressure from said source adapted to vent said chamber and relieve said resistance.

7. A speed control device for an internal combustion

engine comprising an engine speed responsive governor, a controllable fuel supply for said engine, means connecting said governor to said fuel supply for the regulation thereof, a dash pot mechanism operatively connected to said governor and adapted to restrict the movement thereof in a fuel-flow-rate increasing direction, said engine also comprising a manifold pressure source, and means responsive to pressure from said source to relieve said restriction of movement.

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