United States Patent

Stolworthy

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[54] FUEL CONTROL ASSEMBLY FOR INTERNAL COMBUSTION ENGINES HAVING FUEL INJECTORS

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[51] Int. Cl.....**F02m 39/00**, F02b 77/08

[58] Field of Search .....123/139 R, 129 AA, 139 AK, 123/139 AN, 139 AT, 139 BA, 139 AV, 140 CC, 198 C, 198 D, 198 DB, 32 R, 32 AL; 417/286, 429

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[57] **ABSTRACT**

A fuel control assembly is described for injector fed internal combustion engines having a common injector control tube connected to a plurality of injector racks to normally move the racks in unison. Control rack levers are mounted on the control tube and extend radially therefrom to connect with the racks. A safety feature is provided to enable the control tube to move the remaining racks to an idle position when one of the racks become frozen to prevent the engine from overspeeding. The safety feature is incorporated in the control rack levers to release the connection between the tube and the frozen rack and enable the tube to control the remaining racks.

6 Claims, 6 Drawing Figures

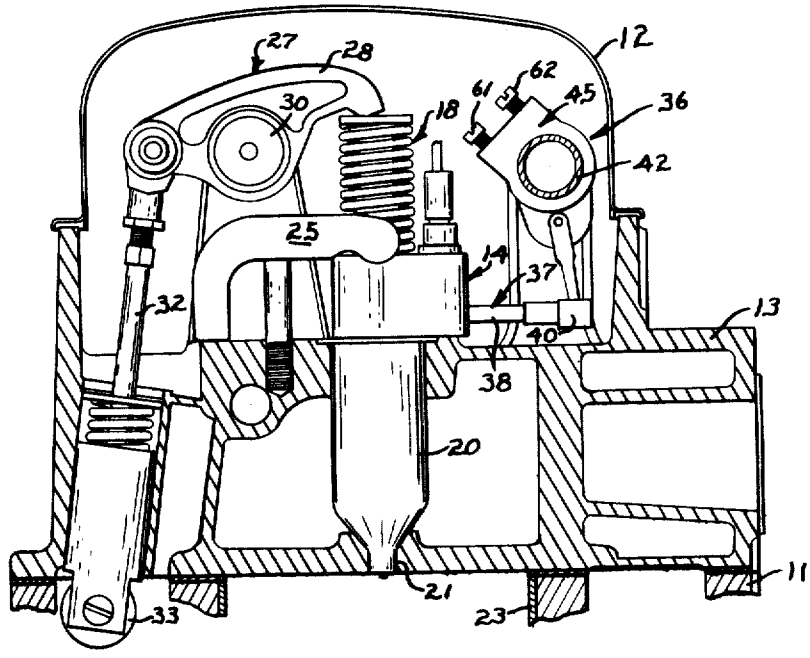


Fig. 1

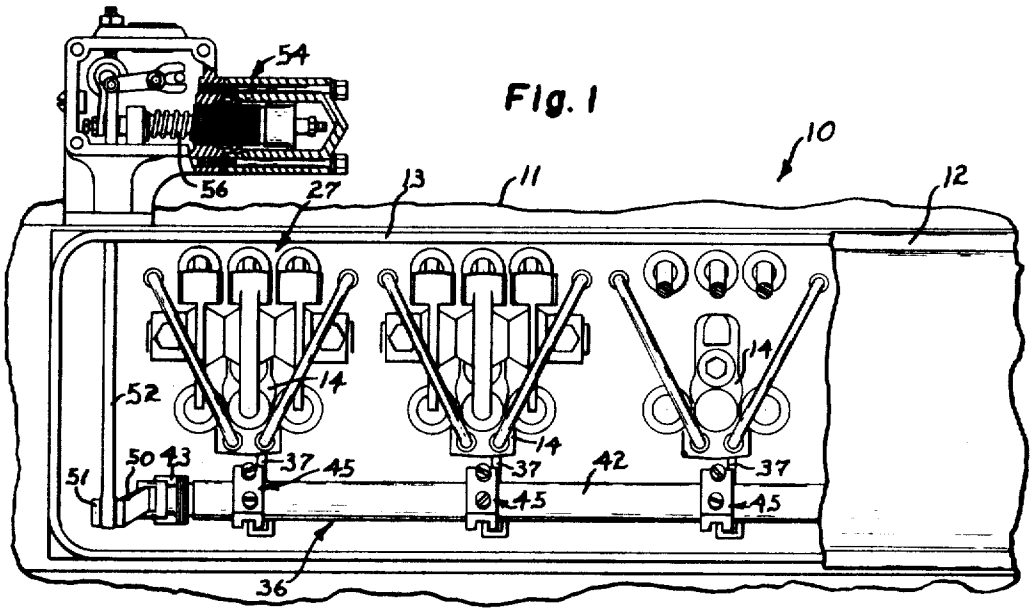
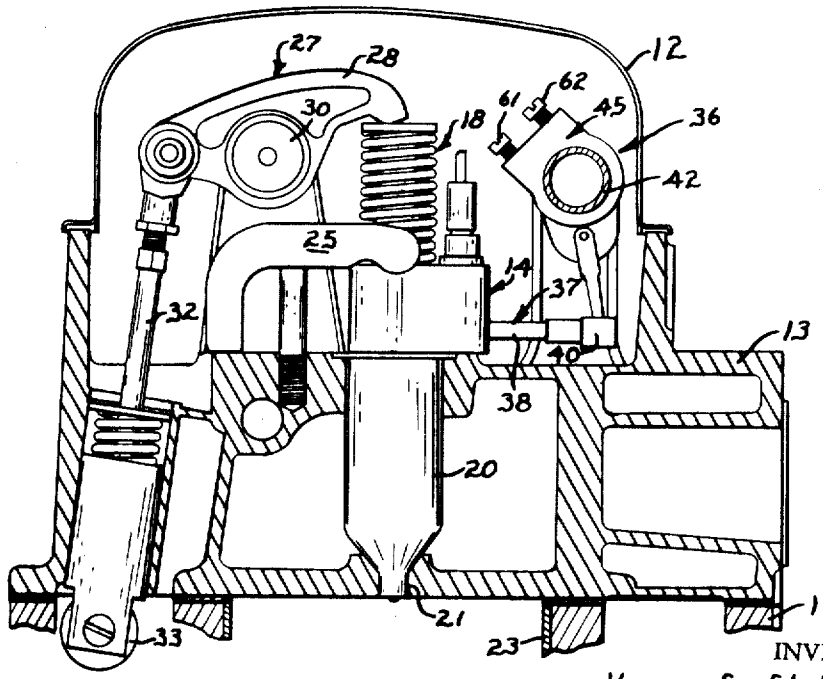


Fig. 2



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Fig. 3

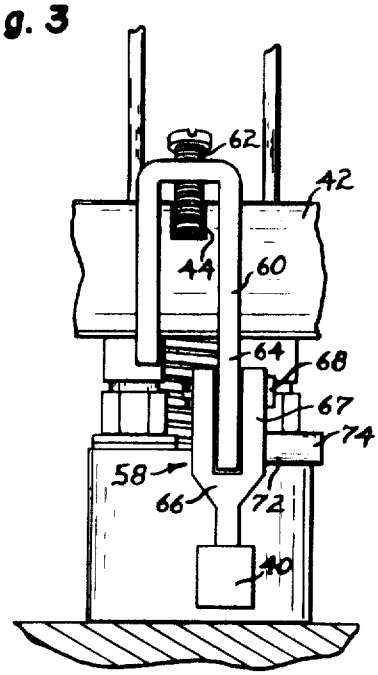


Fig. 4

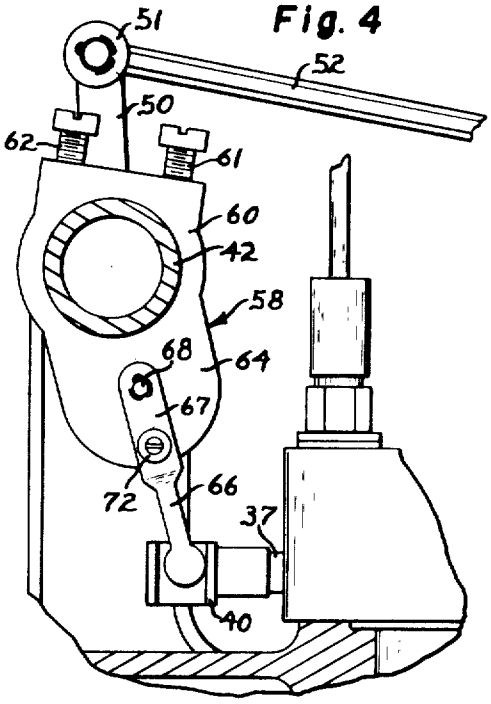


Fig. 5

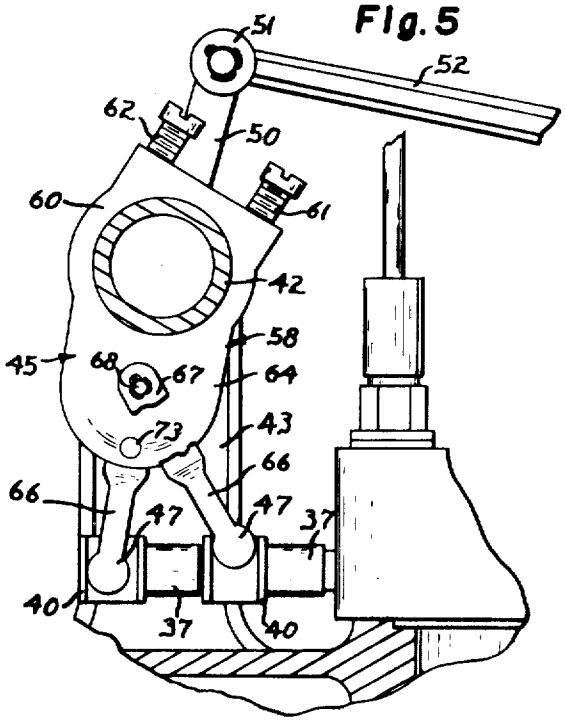
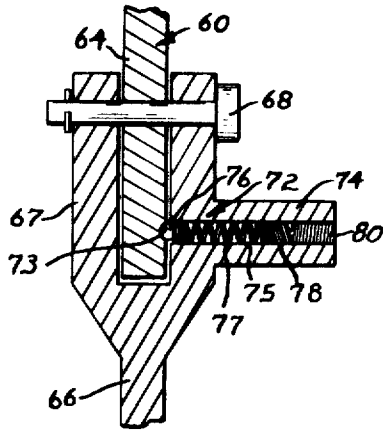


Fig. 6



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FUEL CONTROL ASSEMBLY FOR INTERNAL COMBUSTION ENGINES HAVING FUEL INJECTORS

BACKGROUND OF THE INVENTION

This invention relates to fuel control assemblies for internal combustion engines fed by fuel injectors and more particularly to safety features within the fuel control assemblies for preventing the engine from overspeeding should an injector rack become frozen.

It is not uncommon for an injector rack to become frozen, causing the engine to overspeed and destroy itself when any applied load is released.

Most fuel control systems for controlling injectors have a common injector control tube mounted alongside a bank of injectors for controlling the injectors in unison. Should one of the injector racks become frozen, the common control tube becomes immobilized, holding the other racks in the same position. If the rack is frozen in a full throttle position, then all of the injectors will feed maximum fuel to the engine. In such a case, an entire engine can be destroyed or extensively damaged due to the freezing of only one injector rack. Each year, it is estimated that over one hundred engines "runaway" because of freezing of an injector rack. Many of such engines cost several thousand dollars each.

One of the principal objects of this invention is to provide safety means associated with the fuel control system for enabling the injector control tube to be effective even though one or more of the injector racks become frozen to move the unfrozen racks to an idle position to reduce the speed of the engine.

An additional object of this invention is to provide a safety means associated with the fuel control system which may be easily inserted into the fuel control system of existing engines merely to replacing the injector control rack levers with new units incorporating the safety feature.

A further objects of this invention is to provide safety means associated with the fuel control system that is relatively easy to construct at an economical cost to place the safety feature within the availability of most diesel engine owners.

These and other objects and advantages of this invention will become apparent upon the reading of the following detailed description of a preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of this invention is illustrated in the accompanying drawings, in which:

FIG. 1 is a fragmentary plan view of a section of a diesel internal combustion engine showing a valve cover partially removed illustrating a plurality of injectors mounted in a row that are operated in unison by a common injector control tube;

FIG. 2 is a vertical cross-sectional view taken along line 2—2 in FIG. 1, more precisely illustrating the fuel injector and the fuel control system for controlling the injector;

FIG. 3 is an isolated side view of a single injector illustrating a modified injector control rack lever incorporating the safety features of the invention;

FIG. 4 is a vertical cross-sectional view taken along line 4—4 in FIG. 3, illustrating the normal position of the injector control rack lever with the injector rack moved to the full throttle position;

FIG. 5 is a view similar to FIG. 4 except showing the injector rack frozen in the full throttle position with the safety feature operable to enable the injector control tube to rotate and retract the nonfrozen injector racks to an idle position; and

FIG. 6 is a fragmentary enlarged cross-sectional view taken along line 6—6 in FIG. 4.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Now, referring in detail to the drawings, there is shown in FIG. 1 a multicylinder internal combustion engine generally designated by the numeral 10 having an in-line engine block 11 with an elongated cylinder head 13 mounted thereon. Fuel is fed into the multiple cylinders by a plurality of associated injectors 14 that are mounted in a row in the cylinder head. The injectors are covered by a valve cover 12. Each injector has an upper plunger assembly 18 (FIG. 2) that extends upwardly above the cylinder head 13 and an injector tube 20 that extends into the cylinder head 13 through an injector hole 21 to inject and spray fuel into a cylinder 23. Each injector 14 is held in the injector hole 21 by hold down clamp 25. Each injector 14 is operated by a rocker arm assembly 27 having a rocker arm 28 rotatably mounted on a rocker arm shaft 30. Each rocker arm 28 is rotated on the shaft 30 by a push rod 32. Each push rod 32 has a cam follower 33 mounted on the end thereof for riding on a timing cam (not show) to operate each injector in the appropriate sequence. At the appropriate time the rocker arm for each injector is rotated to push the plunger assembly 18 downward to push a charge of fuel into the cylinder.

The amount of fuel in each charge that is emitted into each cylinder is controlled by a fuel control system 36. The fuel control system includes injector control racks 37 that movably extend into respective injectors 14 for reciprocating movement in a direction substantially normal to that of the plunger assembly 18. Each injector control rack 37 has an injector rod 38 with a rack gear thereon that extends into the injector and a rack coupling 40 on an outer extending end.

The fuel control assembly 36 includes an injector control tube or rod 42 that extends alongside the injectors for controlling the injector racks in unison so that each injector will inject approximately the same amount of fuel into each cylinder at all throttle positions. The injector control tube 42 is rotatably supported in bearing supports 43. Grooves 44 (FIG. 3) are formed in the injector tube 42 at spaced intervals corresponding to the spacing between the injectors for receiving collared rack control levers 45 that extend radially from the control tube 42 to the rack couplings 40 for operating the control racks in unison in response to the rotation of the tube 42. Each of the rack control levers 45 have an end 47 with a ball formed thereon for connecting with a corresponding rack coupling 40.

The fuel control system 46 includes a tube control lever 50 affixed to one end of the injector control tube 42 and extending radially therefrom terminating in an end 51. A fuel rod or link 52 is connected to the end 51 for rotating the tube 42 in response to a throttle linkage which is not specifically shown. Frequently, the throttle linkage includes a limited speed mechanical governor 54 mounted in the throttle linkage system for normally preventing the engine from overspeeding. The governor 54 is designed to move the fuel rod 52 to rotate the control tube 42 in a clockwise position as shown in FIGS. 4 and 5 if the speed of the engine starts to exceed a selected value to reduce the amount of fuel emitted in the cylinder. The governor 54 has a high speed spring 56 that is preset at a determined value for retarding the movement of the fuel rod 52 in relation to the speed of the engine to prevent this engine under normal conditions from overspeeding.

One of the principal features of this invention is a safety feature 58 (FIGS. 3–6) operatively interconnected between the injector control tube 42 and the injector control racks 37 that is operable when one or more of the control racks become frozen in a fixed position to enable the injector control tube 42 to rotate and reduce the fuel injected into the other cylinders having nonfrozen injector racks. Basically, the safety feature includes a modification of the conventional control rack lever by constructing the control rack lever in two sections—a collar section 60 and an arm section 66. The collar section section 60 is mounted on the control tube 42 at the location of the grooves 44 with inside and outside collar screws 61 and 62 extending from the collar into the grooves to lock the collar section 60 on the tube and to enable the collar section 60 to be angularly adjusted with respect to the tube to align all of the control levers 45 to feed substantially the same amount of fuel into each cylinder. The collar section 60 has a blade or an extension 64 that extends radially from the injector control tube.

The arm section 66 is pivotally mounted on the blade 64. The arm section has a forked upper end that straddles the blade 64 with a pin 68 extending through the forked upper end and the blade to provide a pivot axis the is substantially parallel to the axis of the control tube 42. The other end 47 of the arm section 66 extends radially and interconnects with the rack coupling 40 as shown in FIGS. 3—5.

The safety feature 53 includes a detent mechanism 72 that rigidly interconnects the arm section 66 and the collar section 60 to prevent pivotal movement of the arm section 66 with respect to the collar section 60 when the fuel control system is operating under normal conditions to move the racks 37 inward and outward to response to the rotation of the control tube 42.

When one or more of the control racks 37 becomes frozen, the detent mechanism 72 is operated to permit the arm section 66 to pivot about the pin 68 with respect to the collar section to permit the control tube 42 to rotate even though one rack 37 is frozen as shown in FIG. 5.

The detent mechanism 72 includes an indentation 73 formed in the side of the blade 74 as shown in FIG. 5. The detent mechanism also includes a housing 74 formed on the forked upper end 67 having a bore 75 (FIG. 6) extending therethrough for receiving a detent ball 76 therein that slides along the side of the blade 64 into and out of the indentation 73. A spring 77 is mounted in the bore 75 engaging the ball 76 to provide spring tension on the ball to maintain the ball in the indentation until sufficient torque is applied on the control tube 42 to overcome the spring tension 77. A spring tension adjustment screw 78 is mounted in the bore 75 for adjusting the spring tension of the spring 77. A plug screw 80 is mounted in the end of the bore 75 for preventing the adjustable screw from rotating after it has been set.

The spring tension is set so that the collar section 60 and the arm section 66 will under normal conditions act as a unitary rigid part. It is possible to set the tension of the spring 77 at a value which enables the detent mechanism to operate to release the arm section 66 before the force on the fuel rod 52 overcomes the preset spring tension of the high speed spring 5 6 of the governor 54.

Should one of the injector control racks 37 become frozen in a fixed or immovable position, the injector control tube 42 is initially prevented from rotating. When the force on the fuel rod is sufficient to create a torque on the control tube 42 that is sufficient to overcome the spring tension on the spring 77 then the detent mechanism will release permitting the collar section 60 and the injector control tube 42 to rotate in response to the force of the fuel rod 52 and permit the arm section 66 to pivot about the pin 68 with the end 47 still residing in the rack coupling 40. As soon as the detent mechanism releases, the control tube 42 pivots the unfrozen racks to the idle throttle position reducing the amount of fuel to the cylinders to reduce the speed of the engine and thereby prevent a "run-away" engine. The detent mechanism can be defined as a torque responsive means that is responsive to the torque exerted on the tube 42 to operatively disconnect from the frozen rack when the torque on the tube exceeds a preset value.

Although this invention may appear to be extremely simple in retrospect, one can readily appreciate the substantial advance in the art that this invention represents when one considers the very simple solution that this invention provides for preventing extensive damage and maybe total loss to engines costing in the thousands of dollars. It should also be appreciated that this invention enables existing engines to be modified to include the safety feature 58 by merely removing the conventional rack control levers and substituting the rack control levers described above.

It should be understood that the above described embodiment is simply illustrative of the principles of this invention and that numerous other embodiments may be readily devised by those skilled in the art without deviating therefrom. Therefore, only the following claims are intended to define this invention.

What is claimed is:

1. In a fuel control system for a multicylinder internal combustion engine having:

a plurality of spaced fuel injectors associated with corresponding cylinders, in which each injector has an injector control rack movably extending therefrom for controlling the amount of fuel injected into a cylinder;

an injector control tube extending alongside more than one injector and rotatably mounted for rotation about an axis normal to the movement of the injector control racks;

a plurality of collared injector rack control levers mounted on the injector control tube at spaced intervals corresponding to the spacing between the fuel injectors and projecting radially from the tube connecting with associated injector control racks for normally moving the injector control racks in unison in response to the rotation of the injector control tube;

an injector control tube lever affixed to the tube and extending radially therefrom;

a fuel rod connected to the injector control tube lever for rotating the injector control tube in response to the movement of the fuel rod;

in which the improvement includes a safety means associated with each collared injector rack control lever for operatively disconnecting the corresponding injector control rack lever from a frozen injector control rack to permit the injector control tube to rotate to enable the other movable injector control racks to be responsive to the movement of the fuel rod and thereby prevent the engine from overspeeding.

2. In the fuel control system defined in claim 1 wherein the safety means has torque responsive means for enabling the injector control tube to rotate independent of a frozen injector control rack when the torque on the injector control tube exerted by the fuel rods exceeds a preselected value.

3. In the fuel control system defined in claim 2 wherein each of the collared injector rack control levers includes:

a collared section affixed to the injector control rack;

an arm section extending radially from the collared section having an end connected with an associated rack;

and wherein the safety means interconnects the arm section and the collar section in which the torque responsive means engages the arm section and the collar section to lock the arm section to the collar section when the torque exerted on the control tube is below the preselected value to translate the rotation of the control tube into movement of the control racks and to release the arm section from the collared section when an associate control rack becomes frozen and the torque on the control tube reaches the preselected value to permit the control tube to rotate and control the movement of the unfrozen injector racks in response to the movement of the fuel rod.

4. In the fuel control system defined in claim 3 wherein the torque responsive means includes a detent mechanism engaging the collared section and arm section that is spring biased to release when the torque on the control tube reaches the preselected value.

5. In the fuel control system defined in claim 4 wherein the arm section is pivotally mounted on the collar section for pivotal movement about an axis parallel with the axis of rotation of the control tube and wherein the detent mechanism engages the collar section and the arm section to prevent the arm section from pivoting about the parallel axis until the associated control rack becomes immovable and the torque on the control tube reaches the preselected value.

6. In the fuel control system defined in claim 4 wherein the fuel rod is operatively connected to a speed limiting governor having a high speed spring set at a selected preload condition, in which the detent mechanism is designed to release before the selected preload condition of the high speed spring is exceeded.

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