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INTERNAL COMBUSTION ENGINES

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Filed July 8, 1953

3 Sheets-Sheet 1

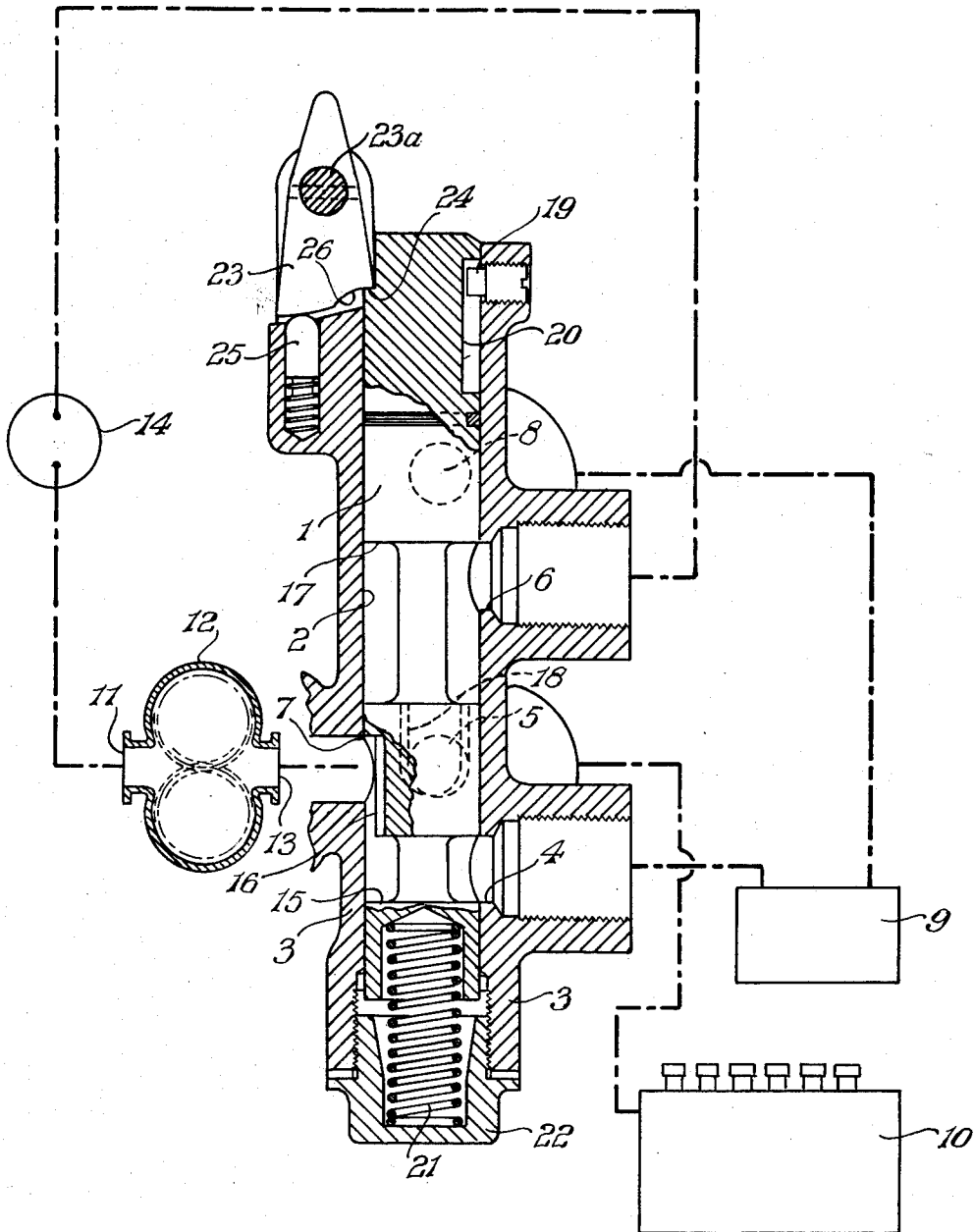


Fig. 1.

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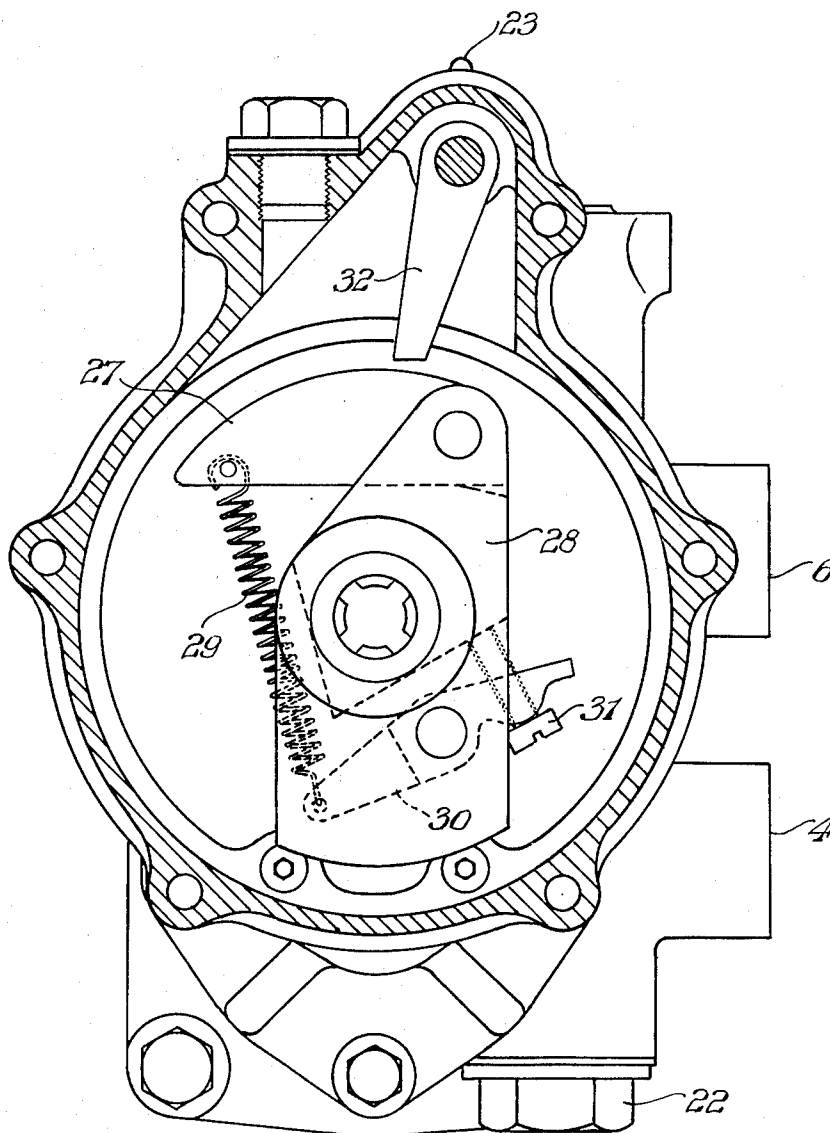


Fig. 3.

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INTERNAL COMBUSTION ENGINES

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14 Claims. (Cl. 123—139)

This invention relates to internal combustion engines of the compression-ignition type and more particularly to such engines of the kind (hereinafter referred to as "the kind described") wherein a fuel supply or booster pump, hereinafter termed "the feed pump," is arranged to pump the fuel from a fuel reservoir or like fuel supply to the fuel injection pump which in its turn supplies the fuel in measured quantity to the injectors of the engine.

The object of the present invention is to provide improved means for automatically stopping the engine in the event of an abnormal condition arising such as, for example, an increase of the engine speed beyond a predetermined limit, failure of the lubricating oil pressure, overheating of the lubricating oil or the water of the cooling system, or failure of driven machinery.

According to the invention means for automatically stopping an engine of the kind described in the event of an operating condition of the engine becoming abnormal consist of a valve device which is operable, under the control of means responsive to said condition, to reverse the delivery of the feed pump so that fuel in the injection pump or pumps is withdrawn therefrom.

Reference will now be made to the accompanying drawings which illustrate a preferred embodiment of the invention, and in which

Figs. 1 and 2 are sectional views of the valve device in its inoperative and operative conditions respectively, and shown incorporated in a fuel feeding and controlling system for an engine of the kind described, the system being illustrated diagrammatically, and

Fig. 3 is a view showing, by way of example, one form of the means for controlling the operation of the valve device shown in Figs. 1 and 2.

As shown in Figs. 1 and 2 the preferred embodiment of the invention consists of a valve device comprising a slide valve member 1 of generally cylindrical form mounted for limited axial movement within an elongated bore 2 formed in a cylindrical valve casing 3. The wall of this casing is formed with five ports 4, 5, 6, 7, and 8 which open into the bore and of which ports 4, 5, 6, and 7 are adapted to be connected, respectively, with the fuel reservoir 9, the fuel injection pump (or pumps) 10, the outlet 11 of the feed pump 12, and the inlet 13 of the feed pump, whilst the fifth port 8 provides an outlet from the bore 2 to the fuel reservoir 9 or to waste as may be desired. Except that the ports 5 and 7 are both disposed in the same radial plane the ports are all arranged in spaced relationship along the length of the bore.

The usual filter through which the fuel is passed after being discharged by the feed pump is indicated at 14. The valve casing 3 may be fixed to or formed integrally with the housing of the feed pump, or may be located remotely therefrom.

In the surface of the slide valve member 1 there are formed a circumferential channel 15 whose width is approximately equal to the diameter of the ports 4 and 5, a longitudinal channel 16 one end of which opens into the channel 15, a second circumferential channel 17

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which is of substantially greater width than the first channel 15 and which is axially spaced therefrom, and a second longitudinal channel 18 one end of which opens into the channel 17.

The disposition of the several ports and channels described above is such that when the slide valve member is in its inoperative position as shown in Fig. 1, which position it is adapted to occupy during normal operating conditions of the engine, the channels 15 and 16 register with the ports 4 and 5 respectively to place the inlet 13 of the feed pump 12 in communication with the fuel reservoir 9, the channels 17 and 18 register with the ports 6 and 5 respectively to place the outlet 11 of the feed pump in communication with the fuel injection pump 10, and the port 8 is closed off altogether. Thus in the inoperative or normal position of the slide valve member the arrangement is such that the feed pump draws fuel from the reservoir and delivers it to the fuel injection pump.

When the valve member is moved into its operative position as shown in Fig. 2, however, into which position it is adapted to be moved, as will be described later herein, when an abnormal operating condition of the engine arises, the port 4 is entirely closed off, the channel 15 registers with both of the ports 5 and 7 to place the inlet of the feed pump in communication with fuel injection pump, and the channel 17 registers with both of the ports 6 and 8 to place the outlet of the feed pump in communication with the outlet from the bore 2 to the fuel reservoir or waste. Thus in this position of the valve member the arrangement is such that the feed pump withdraws the fuel from the injection pump and delivers it back to the reservoir or to waste as may be desired, and the engine, being thus completely starved of fuel, stops immediately.

The axial movement of the valve member into its operative position is limited by a stud 19 which is fixed in the wall of the valve casing so as to engage in a groove 20 formed longitudinally in the valve member. This stud thus serves to determine the operative position of the valve member and ensures that the channels register accurately with the respective ports.

The movement of the valve member into its operative position can be effected and controlled in a number of ways one of which is illustrated by way of example, and in a preferred form, in Fig. 3. The mechanism shown in this figure is designed to bring the valve device into operation in the event of the speed of the engine increasing beyond a predetermined limit. The slide valve member, when adapted to be controlled by this mechanism in the manner about to be described, is biased towards its operative position by a coil-spring 21 which is held in compression between a cap 22 closing one end of the bore 2, and the adjacent end of the valve member. The latter is held in its inoperative position against the bias of the spring, however, by a latch 23 which is fixed to a rotatable shaft 23a and which engages a notch 24 formed in the end of the valve member remote from the spring 21. This end of the valve member extends slidably through the adjacent end of the bore which is left open for this purpose. The latch 23 is held resiliently in engagement with the valve member by a spring-loaded stud 25 which bears against the edge of the latch. When the latter is disengaged from the valve member, which operation will be subsequently described herein, the stud enters a recess 26 in the edge of the latch and holds it out of engagement with the valve member.

The mechanism shown in Fig. 3 is operated centrifugally and consists of a trip finger 27 mounted upon a rotary carrier 28 which is driven from the engine; it may, for example, be keyed to the shaft of the feed pump for rotation therewith. One end of the trip finger

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is pivotally connected to an extremity of the rotary carrier 28, whilst to its other end there is anchored a coil spring 29. The latter is held in tension between the free end of the trip finger and one end of a lever 30 which is also pivotally supported by the rotary carrier. This lever is pivoted intermediate its ends, and in order to enable the tension of the spring 29 to be varied the lever is made angularly adjustable by means of a screw 31 which is provided in the end of the lever remote from that to which the spring is anchored. The screw passes through threaded aperture in the lever 30 and bears against a part of the rotary carrier. Lying just beyond the circular path of movement to which the free end of the trip finger is constrained by the spring 29 when the engine is running at its maximum permissible speed, i. e. the speed which corresponds to the aforesaid predetermined limit is the tip of a trip arm 32 which is fixed to the shaft 23a to which the latch 23 is fixed.

When the engine is running at or below its maximum permissible speed the centrifugal force acting on the trip finger 27 is opposed by the spring 29 sufficiently to constrain the free end of the trip finger to a circular path of movement of a radius less than the distance from the axis of the rotary carrier 28 to the tip of the trip arm 32. When the speed of the engine exceeds the aforesaid predetermined limit, however, the centrifugal force overcomes the spring 29 sufficiently to cause the free end of the trip finger to strike the trip arm and thereby disengage the latch 23 from the valve member which is consequently moved by the spring 21 into its operative position.

The engine speed at which the latch is disengaged from the valve member by the trip mechanism can be predetermined by adjusting the tension of the spring 29 in the aforesaid manner so as to vary the opposition thereof to the centrifugal force acting on the trip finger.

The devices above described can be modified in a number of ways without departing from the scope of the invention. For example, the trip mechanism can be located remotely from the valve member and connected to the latch either by mechanical linkage or hydraulically.

The invention can also be carried out by means of a rotary valve member instead of the slide valve member described above.

The movement of the slide valve member into its operative position can also be effected by means of hydraulic pressure instead of the coil spring described above, or by means of a solenoid controlled, for example, by a contact switch operated by the engine tachometer. Such a solenoid could also be employed for operating the valve member to stop the engine in the event of abnormal conditions arising other than excessive engine speed. For example, the solenoid could be controlled by a switch actuated by a thermostatic or pressure-responsive device to stop the engine in the event of the temperature of the engine lubricating oil or the water of the engine cooling system exceeding a predetermined limit, or the pressure of the lubricating oil falling too low. In addition to actually moving the valve into its operative position a solenoid could equally well be employed to effect the necessary disengagement of the latch 23 from the valve member to cause its operation in the manner described earlier herein. The latch 23 could also be actuated directly by the thermostatic or pressure-responsive device.

I claim:

1. In combination with an internal combustion engine of the compression ignition type having fuel connections including therein a fuel feed pump with a suction inlet and a discharge outlet arranged to pump the fuel from a fuel supply to the fuel injection pump, of means for automatically stopping the engine in the event of an abnormal operating condition, said means comprising valve mechanism interposed in said fuel connections between said fuel feed pump and said fuel supply

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and between said fuel feed pump and said fuel injection pump, and means responsive to an abnormal operating condition of said engine and operatively connected to said valve mechanism to reverse the suction and delivery of said fuel feed pump so that said fuel in said injection pump is withdrawn therefrom.

2. In the combination set forth in claim 1 wherein said valve mechanism is arranged during normal operating conditions of said engine to maintain said inlet and said outlet of said fuel feed pump in communication with said fuel supply and said fuel injection pump respectively so as to cause fuel to be delivered to said injection pump, said responsive means being operable in the event of abnormal engine conditions to cut off said inlet of said fuel feed pump from said fuel supply and to place said inlet in communication with said fuel injection pump so as to cause said fuel to be withdrawn from said injection pump.

3. In the combination as defined in claim 1 wherein said valve mechanism comprises a casing having a valve member movably mounted therein, a first port in said casing adapted to provide an outlet from said casing to said fuel supply, second, third, fourth, and fifth ports in said casing adapted to be connected respectively with the inlet and outlet of said fuel pump, said fuel supply, and said fuel injection pump, said valve mechanism having means for normally maintaining said valve member in a first operative position wherein it closes off said first port and places said second and third ports in communication with said fourth and fifth ports respectively to cause fuel to be withdrawn from said fuel supply and delivered to said injection pump, said means responsive to an abnormal operating condition being operatively connected to said last means to render the same inoperative, and means acting upon said valve member to move the same into a second operative position wherein it closes off said fourth port and places said second and third ports in communication with said fifth and first ports respectively to cause the fuel to be withdrawn from said injection pump when said last means is rendered inoperative.

4. In the combination as defined in claim 3 wherein said valve casing is formed with an elongated bore into which said ports open, and wherein said valve member is of cylindrical form and is slidably mounted within said bore for movement in an axial direction between said first and second operative positions, said ports being arranged along the length of the bore, and the surface of the valve member being formed with a number of channels which are arranged, when said valve member is in the first operative position, to place said second and third ports in communication, with said fourth and fifth ports respectively, and when said valve member is in its second operative position, to place said second and third ports in communication with said fifth and first ports respectively.

5. In the combination as defined in claim 4 wherein said valve member is biased toward second operative position by a coil spring which is held in compression between one end of the valve member and a closure member at the adjacent end of the bore, and a movable latch member having an arm and normally held in engagement with said valve member to retain it in its first operative position.

6. In the combination as defined in claim 5 wherein said second operative position of the valve member is determined by its abutment with a stud which is secured in the wall of said valve casing and which projects there-through to engage within a groove formed longitudinally in the surface of said valve member, said stud also serving to guide the valve member in its axial movement.

7. In the combination as defined in claim 5 wherein said means responsive to said abnormal operating condition of the engine are operable, in the event of said condition becoming abnormal, to cause disengagement of the latch member from said valve member and there-

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by cause the latter to be moved into said second operative position.

8. In the combination as defined in claim 5 wherein the means responsive to said abnormal operating condition of the engine comprises a centrifugally operated mechanism driven from the engine and operable, in the event of the latter's speed exceeding a predetermined limit, to actuate said latch member and thereby cause operation of said valve member into its second operative position.

9. In the combination as defined in claim 8 wherein said centrifugally operated mechanism comprises a rotary member driven from said engine, a trip finger pivotally mounted at one end upon said rotary member so that its other end is urged radially outward by centrifugal force, spring means acting upon said finger to resist said centrifugal force whereby when the speed of the engine exceeds a predetermined limit the centrifugal force acting upon said trip finger overcomes said spring means sufficiently to cause said trip finger to strike said arm connected to said latch member to cause the latter to be disengaged from said valve member.

10. In the combination as defined in claim 8 wherein an angularly adjustable lever is pivotally supported by said rotary member, and said spring means consists of a tension spring anchored at one end to the free end of said trip finger and at the other end to said lever whereby to enable the tension of said spring to be varied for the purpose of predetermining the engine speed at which said trip finger is operated to cause disengagement of said latch member from said valve member.

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11. In the combination as defined in claim 5 wherein said means responsive to said abnormal operating condition of said engine consists of a thermostatic device, said thermostatic device being operatively connected with said latch member whereby operation of said valve member will take place in the event the temperature to which said thermostatic device is responsive exceeds a predetermined limit.

12. In the combination as defined in claim 5 wherein said means responsive to said abnormal operating condition of the engine consists of a device which is responsive to the pressure of the engine lubricating oil and which is operable to cause actuation of the latch member, and thereby operation of the valve member, in the event of said pressure falling below a predetermined limit.

13. In the combination as defined in claim 11 wherein the latch member is adapted to be actuated by a solenoid which is controlled by a switch actuated by said thermostatic device.

14. In the combination as defined in claim 4 wherein the valve member is adapted to be moved into its operative position by a solenoid, and a switch actuated by said means responsive to said abnormal operating condition of said engine for controlling said solenoid.

References Cited in the file of this patent

UNITED STATES PATENTS

2,215,756 Heinrich et al. ----- Sept. 24, 1940