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[54] PROTECTIVE DEVICE FOR ENGINE SHUTDOWN
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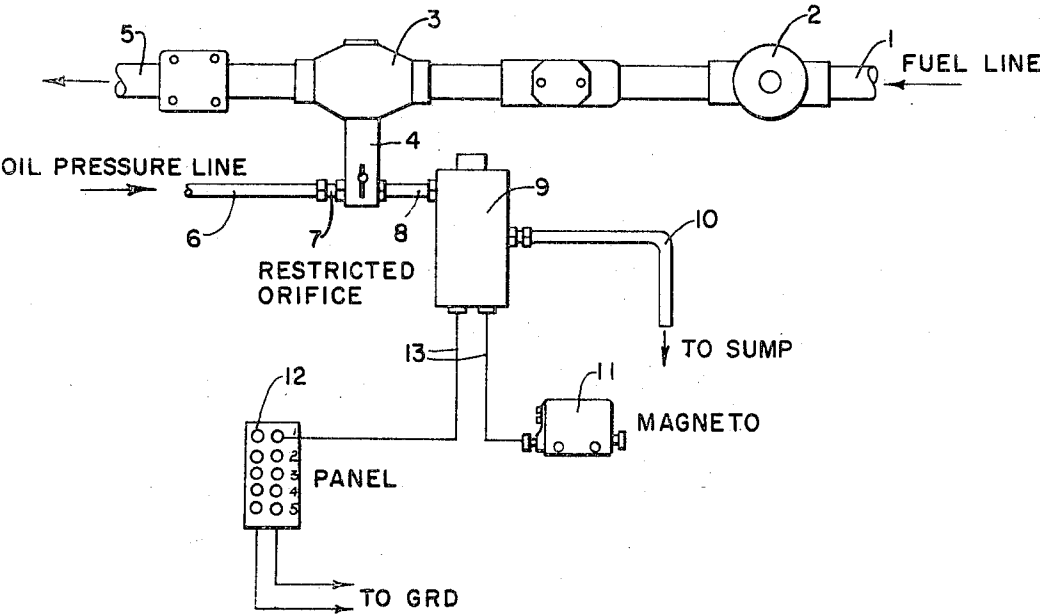
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198(D1), 198(D2), 198(D3), 198, 98, 41.15;
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References Cited			
UNITED STATES PATENTS			
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3,385,278	5/1968	Johnson et al	123/198

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ABSTRACT: A dump valve device for use in combination with a fuel shutoff for an internal combustion engine, said valve causing operation of said shutoff either in response to a decrease of the oil pressure in a lubricating system associated with the engine or in response to an electrical signal from a grounding switch or like electrical safety device.



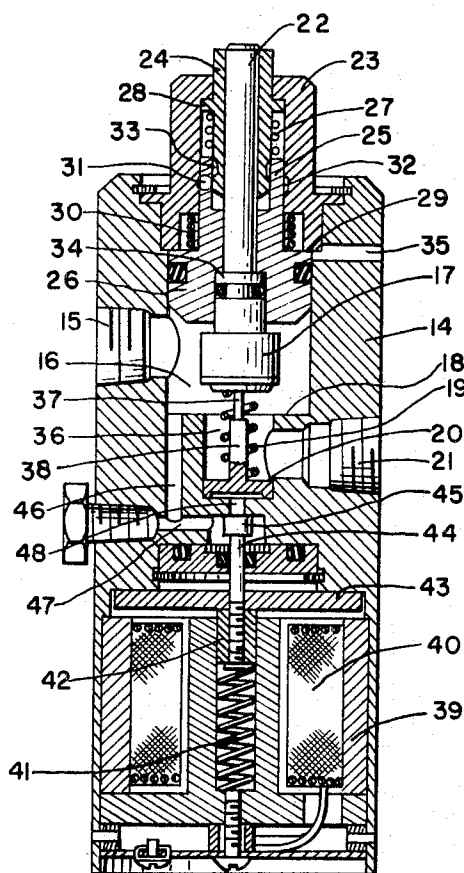
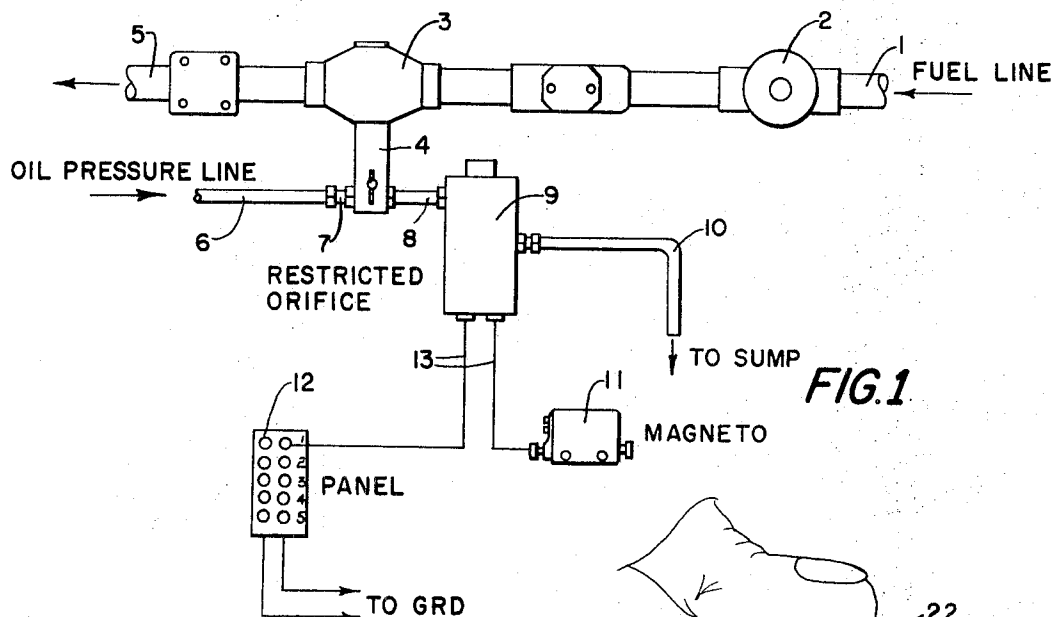
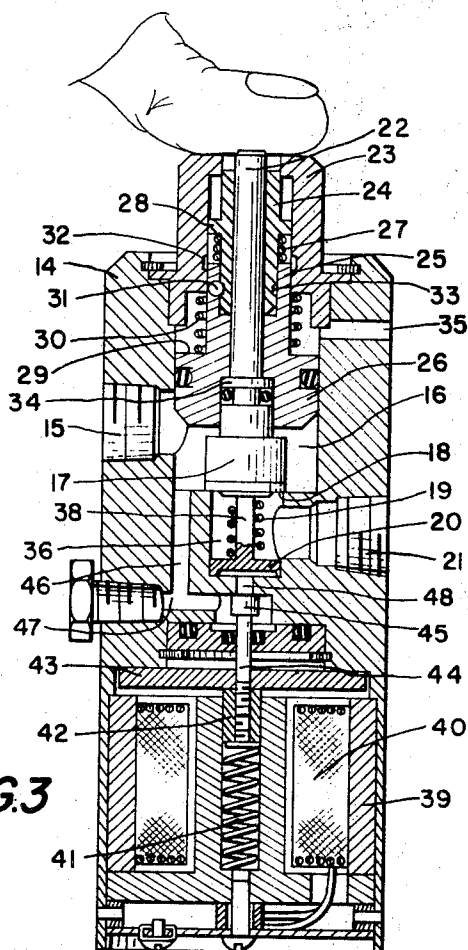


FIG. 3



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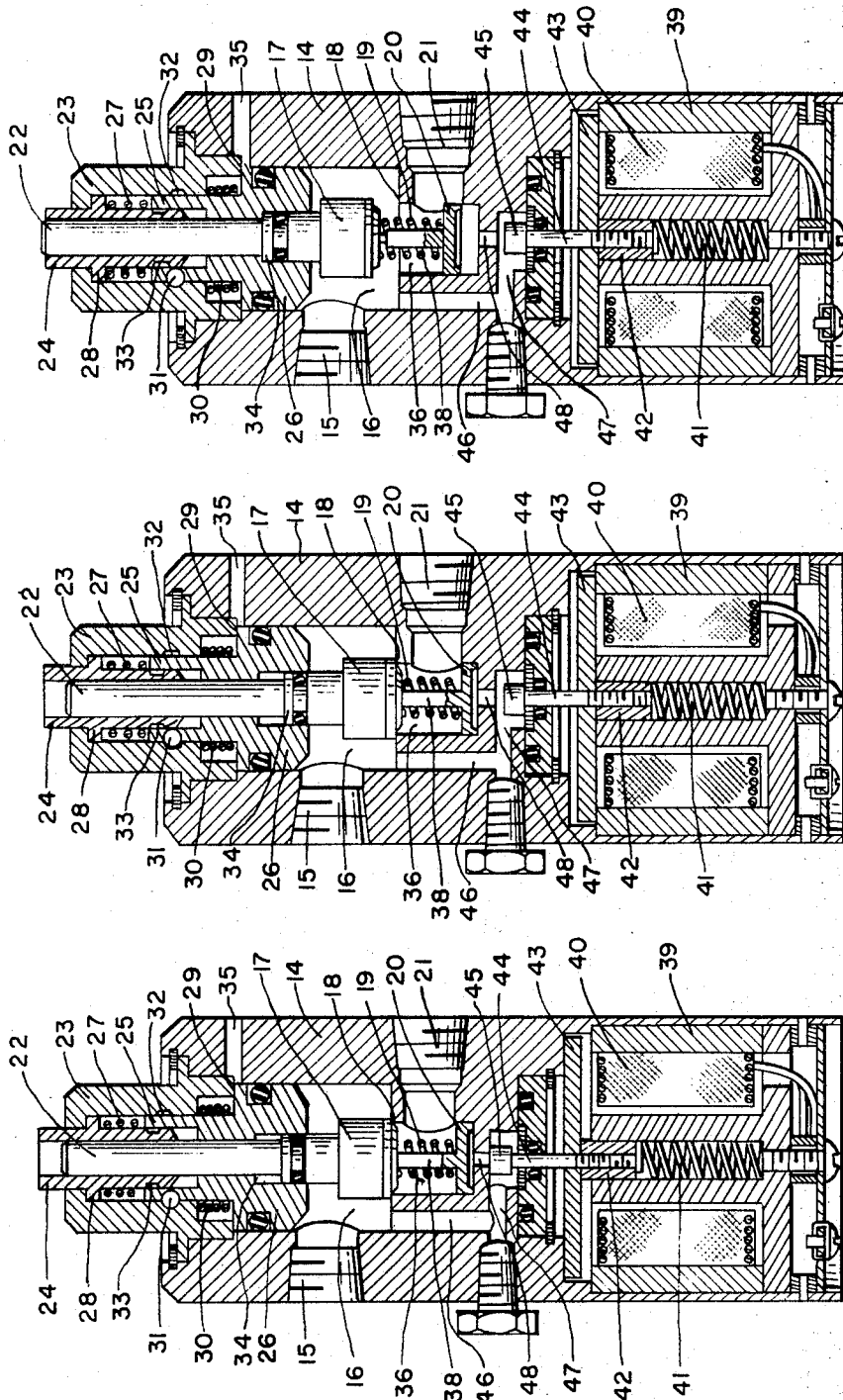


FIG. 6

FIG. 5

FIG. 4

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PROTECTIVE DEVICE FOR ENGINE SHUTDOWN

BACKGROUND OF THE INVENTION

This invention relates to protective systems for shutting down internal combination engines in response to abnormal pressure conditions existing in lubricating systems associated with such engines, or in response to electric signals from safety grounding switches or like devices used as protective equipment on the engine.

There have been developed in the past a number of pressure responsive engine fuel shutoff devices of which those disclosed in U.S. Pat. No. 3,202,143 granted Aug. 24, 1965, to Joe E. Goodwin, are representative. In these prior devices, the flow of fuel to the engine is controlled by a valve normally maintained in open position by a piston which is movable in valve opening direction by a pressure existing in the lubricating system and in the opposite valve closing direction by means such as calibrated springs. The strength of which is preselected to establish the oil pressure level at which the fuel shutoff valve closes.

U.S. Pat. No. 3,202,143 also discloses the use of such a shutoff valve, called an Oil Sentinel, in combination with a temperature responsive valve called a Heat Sentinel. A restrictive orifice is inserted in the lubricating oil pressure line on the pressure side of the Oil Sentinel, and this line continues from the Oil Sentinel to the Heat Sentinel which is normally closed. When the Heat Sentinel opens in response to excessive temperature, however, it "dumps" the lubricating oil on the downstream side of the orifice to the engine sump with the result of immediately and substantially decreasing the control pressure in the Oil Sentinel and closing the fuel shutoff valve to shut off the fuel to the engine.

Also many such engines are provided with normally open safety switches and/or associated indicators which are connected so as to ground the engine magneto or otherwise cut off the supply of ignition current to the engine whenever a malfunction occurs. It has been proposed heretofore, in U.S. Pat. No. 3,385,278 granted May 28, 1968, to Joe E. Goodwin and Ralph B. Johnson, Jr., to utilize an electric impulse resulting from the closing of such a safety grounding switch and/or the operation of such an indicator to operate a fuel shutoff valve such as the Oil Sentinel of prior U.S. Pat. No. 3,202,143. This is accomplished in U.S. Pat. No. 3,385,278 by means of a dump valve connected to the oil pressure line on the pressure side of the Oil Sentinel. When this dump valve is operated by the electrical impulse, it opens and connects the oil pressure line to an oil dump line leading to the engine sump, thereby reducing the control pressure in the Oil Sentinel and causing shutoff of the fuel supply to the engine.

SUMMARY OF THE INVENTION

The present invention resides in a dump valve which operates either in response to a decrease of lubricating oil pressure below an acceptable value, or in response to an electrical impulse or magneto grounding signal from any one or more of a number of safety grounding switches and/or indicators, so as to cause the reduction of the control pressure in the Oil Sentinel. This dump valve is normally closed and thus closes also the oil pressure line which extends to it from the downstream side of the restricted orifice associated with the Oil Sentinel or like fluid pressure-controlled valve. When the dump valve opens in response to either cause, therefore, the Oil Sentinel is caused to function in the manner described in U.S. Pat. No. 3,202,143 mentioned above and shuts off the supply of fuel to the engine. The dump valve has the dual function of providing a safety backup for the Oil Sentinel, in the case of an impermissible drop in oil pressure, and of causing operation of the Oil Sentinel in case of the actuation of an electrical safety device regardless of the lubricating oil pressure.

More specifically the dump valve device comprises a valve member controlling communication between an inlet port connected to the lubricating oil pressure line from the Oil Sen-

tinell or like fuel control valve and an outlet port connected to an oil dump line. *e.g.*, a line leading to the engine sump. This valve member can be closed manually against a spring in starting the engine and is then held closed automatically (*e.g.* by another spring) until the oil pressure builds up to a predetermined minimum value greater than the strength of the compressed spring. Thereafter, the valve member is held in closed position by the oil pressure, but whenever the pressure of the oil falls below this predetermined value, the spring opens the valve member and the dumping effect referred to above takes place to close the fuel supply valve at the Oil Sentinel.

In addition, a passage leads from the oil pressure line to a point at which the oil pressure can be exerted on the valve member in valve opening direction. This passage is controlled by a normally closed pilot valve. On receipt of an electrical impulse or magneto grounding signal, however, the pilot valve is opened so that the oil pressure acting on the valve member in the valve opening direction, even though declining, is sufficient together with the compressed spring to cause the valve member to open fully and to set the dumping effect described above into operation.

The manually actuated means for closing the valve member initially may suitably comprise an externally projecting actuating member together with resilient means normally held under tension by releasable means such as a friction device, a sliding ball lock, or the like. Preferably the actuation of this member not only moves the valve member toward closed position but also releases the resilient means which then hold the valve member against its seat long enough for the control pressure to build up to said predetermined minimum value. Thereafter the control pressure holds the valve member in closed position and also restores the resilient means to its normal compressed state and locked position.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention is illustrated in the accompanying drawings wherein:

FIG. 1 is a diagrammatic layout of part of the fuel feed system of an internal combustion engine in which the present invention has been embodied;

FIGS. 2-6 inclusive are cross-sectional views showing the preferred dump valve in successive operating positions as follows:

FIG. 2—dumping or open position, following a failure of oil pressure;

FIG. 3—cocked position with the external actuating member initially depressed by hand and the resilient means thereby unlocked to move the valve member to and hold it against its seat;

FIG. 4—armed position in which the valve member is maintained closed by the control pressure, and the resilient means has been recompressed and relocked;

FIG. 5—tripped position in which an electric impulse or signal has been received and the pilot valve has been opened;

FIG. 6—open or dumping position caused by opening of the pilot valve as a result of the electrical impulse or signal.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1, fuel, either gaseous or liquid, is supplied to the engine (not shown) through a supply line 1 and main control valve 2, a fuel supply valve 3 which is controlled by an Oil Sentinel 4, and a supply line 5 to the carburetor or injectors. It will be understood that the fuel supply valve 3 and Oil Sentinel 4, as shown, are of the type illustrated and described in prior U.S. Pat. No. 3,202,143 mentioned above, particularly in FIG. 11. As described in said prior patent, oil under the pressure existing in the lubricating system fills the line 6 leading through a restricted orifice 7 to the inlet port of the Oil Sentinel 4. From the outlet port of the Oil Sentinel, a pressurized oil line 8 leads to a dump valve 9 which is illustrated in detail in FIGS. 2-6 inclusive. When the dump valve opens, oil under pressure on the downstream side of the ori-

rice, including the Oil Sentinel 4, pipe 8 and dump valve 9. is discharged immediately through the line 10 as described hereinafter, preferably to the engine sump. This sudden reduction of pressure in the Oil Sentinel results in closing of the fuel valve 3.

As illustrated diagrammatically, the ignition system of the engine includes any suitable magneto 11. It is usual to provide for grounding such magnetos when a malfunction occurs and also to provide a visual indication of the malfunction. When a number of such safety switches and associated indicators are used, they are conventionally mounted on a so-called tattletale panel through which the ground connection is made whenever any one of the switches is closed due to a malfunction. Such a tattletale panel is shown diagrammatically at 12. It will be noted that the magneto 11 is connected to the panel 12 by wires 13 which run to and from the dump valve.

Referring now to FIG. 2, the dump valve of the present invention comprises a substantially cylindrical body 14 having an oil inlet port 15 through which oil under pressure passing through the line 6 and orifice 7 enters a chamber 16. A valve member 17, shown in open position in FIG. 2, is adapted to be moved downwardly and seated against a valve seat 18 as shown in FIG. 3, thereby compressing a spring 19 which is interposed between the valve member 17 and a piston 20 as hereinafter described. In the position shown in FIG. 2, with the valve member open, oil can pass from the chamber 16 through the outlet port 21 and the line 10 to the engine sump with the result of "dumping" the oil on the downstream side of the restricted orifice 7, causing the fuel supply valve 3 to be closed due to the action of Oil Sentinel 4.

In starting the engine, valve 17 must be moved against its seat 18 to close the chamber 16 and permit the lubricating oil pressure to build up to the desired minimum operating value. This is accomplished by means of a plunger 22 which extends upwardly from the valve member 17 and out of the cap 23 of the valve body so that it can be pressed in by hand as indicated in FIG. 3. The plunger 22 is slidable in a locking sleeve 24 which in turn telescopes within a tubular extension 25 of a piston 26 forming the upper closure of the oil chamber 16. Normally the locking sleeve projects from the cap 23 with its outer end more or less flush with the outer end of the plunger 22. The locking sleeve is urged to this position by a spring 27 interposed between the end of the tubular extension 25 and a flange 28 on the sleeve which limits its outward movement by engagement with the end wall of the valve body cap 23.

As shown in FIG. 2, the piston 26 and its extension 25 are also in their outermost position which is limited by engagement of the piston with the inner end of the valve body cap at the point 29. In this position the piston compresses a spring 30 between it and the valve cap, but the piston is held against inward movement by means of a locking ball or balls 31 disposed in holes or pockets in the tubular extension 25. Being of somewhat greater diameter than the thickness of the wall of this extension, the ball 31 is forced outwardly by the lower end of the locking sleeve 24 into engagement with a locking groove 32 in the inner surface of the valve cap 23.

In starting the engine, the projecting ends of the plunger 22 and locking sleeve 24 are first pressed inwardly by hand as indicated in FIG. 3, the plunger moving the valve member 17 against its seat 18. The inward movement of the locking sleeve 24 also brings a groove 33 in the sleeve into registry with the balls 31 which now move into groove 33 to lock the sleeve 24 and the extension 25 together, and at the same time to release the extension 25 from the valve cap 23.

The spring 30 now expands from the compressed state shown in FIG. 2 to the expanded state shown in FIG. 3, pushing the piston 26 downwardly against the shoulder 34 of the plunger 22 and holding the valve member 17 against its seat 18. As will be seen in FIG. 3, this inward movement of piston 26 withdraws the outer end of the locking sleeve 24 somewhat inside of the cap 23.

To avoid air pockets, spaces in the upper end of the valve body can be suitably vented to the atmosphere as by means of vent passages, one of which is shown at 35.

The seating of the valve member 17 on its seat 18 also results in compressing the spring 19 and in holding the piston 20 down against the bottom of a recess 36 at the bottom of oil chamber 16 already mentioned. Preferably the relative movement of the valve member 17 and the plunger 20 are guided by means such as a telescoping rod 37 on the valve member and a sleeve 38 on the piston 20.

It will be understood that spring 19 is preset to have a predetermined maximum force in the compressed position shown in FIG. 3, which is less than the predetermined minimum force exerted on valve member 17 by the control pressure of the oil. The spring 30 holds the valve 17 seated until the oil pressure in the chamber 16 builds up beyond this minimum value, at which time the oil pressure forces the piston 26 outwardly to its FIG. 1 position, again compressing this spring 30 and moving the locking sleeve 24 out to its original position (see FIG. 4). In this position, the tubular extension 24 is again locked to the valve body cap as in FIG. 1.

In the event that the control pressure applied to the differential area of the valve member 17 (i.e., the difference between the area of this valve member and its rod) and holding the valve member in closed position should decrease to a preset value, the compressed spring 19 will expand and force the valve member away from its seat 18 as shown in FIG. 1, thereby opening the oil chamber 16 to the outlet port 21 and dumping the oil on the downstream side of the orifice 7 to the sump. This causes the Oil Sentinel to close the supply valve 3.

Means are also provided for opening the valve 17, 18 in response to the closing of one of the safety switches and/or the energization of one of the associated indicators at the tattletale panel 12. To this end, the lower part of the valve body contains a magnetic casing 39 surrounding an excitation coil 40 which is connected with the magneto 11 and with the safety switches and/or associated indicators as illustrated in FIG. 1. A spring 41 is located in a recess or well in the central part of the casing 39 and interposed between the bottom of this well and a slidable plug or plunger 42, preferably of non-magnetic material. Mounted on the upper end of this plug in normally spaced relation to the magnetic casing 39 is a disc-like armature 43 which, upon energization of coil 40, is pulled downwardly against the spring 41 and into engagement with the pole pieces formed by the casing 39.

This downward motion of the armature 43 also pulls down the stem 44 of a small pilot valve 45, the valve stem 44 passing through the armature 43 and being threaded into the non-magnetic plug 42 (see FIG. 5). When the pilot valve 45 is thus opened, oil pressure is admitted through passages 46, 47 and 48 to the underside of piston 20, the area of which is substantially greater than the differential area of the upper side of the valve member 17. The upwardly acting resultant oil pressure raises the piston 20, and, through the sleeve 38 and spring 19, the valve member 17 is lifted suddenly from its seat 18 to its outermost position limited at the point 29. This brings the parts to the positions shown in FIG. 6 in which communication is established between inlet port 16 and outlet port 21 so that oil pressure on the downstream side of the orifice 7 is immediately "dumped" and the fuel valve 3 is immediately closed. Thereafter the spring 19 expands to return the piston 20 to the bottom of its recess, and the spring 41 expands to move the pilot valve 45 back to its seat and to close the passage 48 leading to the lower side of the piston 20. The parts are now in the positions shown in FIG. 2 and are ready for another starting operation as described above.

The invention thus provides improved dump valve means for use in combination with pressure-controlled valves wherever it may be desired to operate such a valve in response either to a decrease in control pressure or in response to an electrical impulse or magneto grounding signal. In either case, the control pressure at the valve to be operated will be immediately and completely "dumped" so as to effect the designed and intended operation of the pressure-controlled valve whatever they may be. It will also be obvious that the invention is applicable to either fluid-pressure controlled or pneumatic-pressure controlled valves.

We claim:

1. Protective apparatus for controlling the flow of fuel to an internal combustion engine of the type comprising a fluid-pressure-controlled fuel supply valve for said engine, a restricted inlet port and an outlet port in the valve body for subjecting the valve to the fluid control pressure existing in a pressure lubricating system, said control pressure normally maintaining said valve in open position against opposing spring means, and a connection between said outlet port and a normally closed valve which can be opened to dump the pressure fluid on the downstream side of said restricted inlet and thereby to reduce said control pressure and cause closing of the fuel supply valve by its spring means, the improvement which comprises:

dump valve means having an inlet port to which said connection leads and an outlet port leading to a sump, a valve member controlling communication between said ports and normally maintained in closed position by said control pressure transmitted thereto through said connection and acting thereon in a closing direction, resilient means opposing the closing of said valve member with a force having a predetermined maximum value less than the closing force exerted on said valve by a predetermined minimum value of said control pressure, a passage in said dump valve through which said control pressure is effective to move said valve member in an opening direction, a pilot valve normally closing said passage, and means operating in response to an engine-protective signal external to said dump valve for opening said pilot valve, said resilient means moving said valve member to open position whenever said control pressure falls below said predetermined minimum value, and said resilient means together with the resultant effective oil pressure moving said valve member to open position whenever said pilot valve is opened, to decrease said control pressure on the downstream side of said orifice and thereby to close said fuel valve regardless of the pressure existing upstream of said orifice.

2. Apparatus as defined in claim 1, including manually operable means for moving said valve member initially to closed position before said control pressure builds up to said predetermined minimum value, said manually operable means

including a member extending outwardly from the valve body for manual actuation.

3. Apparatus as defined in claim 2, including a piston movable in one direction by said control pressure, resilient means opposing and tensioned by the piston movement, releasable locking means for holding said piston against the force exerted by said tensioned resilient means, said locking means being released by said manual actuation and said piston moving resiliently in the opposite direction to engage and hold said valve member against its seat until said control pressure reaches said predetermined minimum value.

4. Apparatus as defined in claim 3, said releasable locking means comprising a tubular member connected with and movable axially with said piston in said valve body, a locking sleeve movable telescopically within said tubular member, a locking ball disposed in an opening in the wall of said tubular member and having a diameter greater than the thickness of said wall, a locking groove in the inner surface of said valve body and a locking groove in the outer surface of said locking sleeve, said ball being forced outwardly into engagement with said first-named groove by said locking sleeve to lock said tubular member and valve body together and being forced inwardly into engagement with said second-named groove by said valve body to lock said tubular member and locking sleeve together.

5. Apparatus as defined in claim 1, said valve body containing electromagnetic means for energization on receipt of an external engine-protective electric signal, a magnetic armature displaced by energization of said coil, and means connecting said armature with said pilot valve for opening the pilot valve on receipt of said signal.

6. Apparatus as defined in claim 1, including a piston capable of axial movement in valve-opening direction with and relative to said valve member, said resilient means being interposed between said piston and valve member, and said passage admitting said control pressure to said piston in valve-opening direction.

7. Apparatus as defined in claim 6, said piston having a greater area over which control pressure is effective than the differential area of said valve member to which said control pressure is applied.

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