

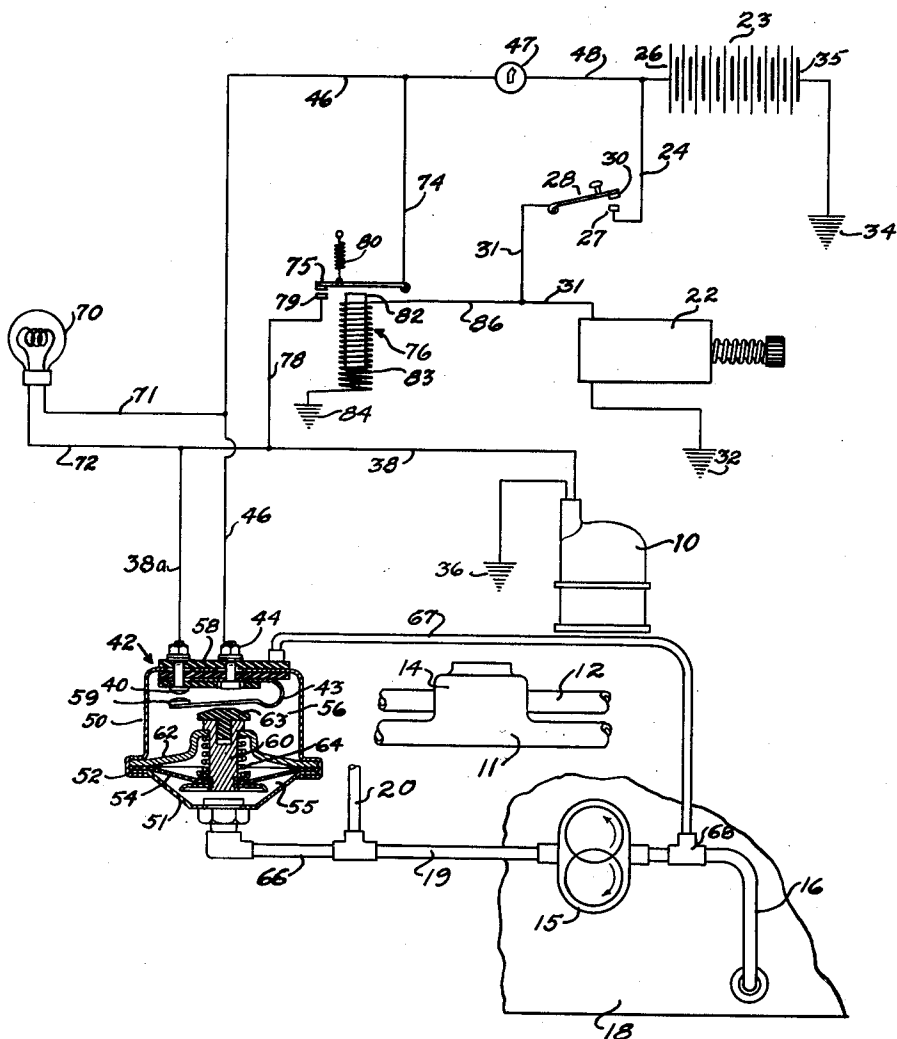
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AUTOMATIC SAFETY CONTROL AND INDICATOR FOR ENGINES

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AUTOMATIC SAFETY CONTROL AND
INDICATOR FOR ENGINES

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This invention relates to improvements in control systems for internal combustion engines, and has particular reference to an improved control system operable automatically to discontinue engine operation in the event of an abnormal functional condition in the engine organization, as failure of normal oil flow in the engine lubrication system. In this respect the invention herein disclosed is similar to my prior patent filed jointly with Kenneth Lannert, No. 2,370,249, and patented February 27, 1945. In this particular patent, as well as in the present application, the control system is for an internal combustion engine, and comprises a fuel system including an electrically driven fuel pump powered by two separate parallel electric circuits from the battery to the pump. One of the circuits includes a control means actuated by the starter motor switch, and the other circuit is controlled by a lubricant pressure operated switch. In the above patent, both said switches are placed in series with the ordinary ignition switch for the ignition system of the engine. In my prior application with A. N. Szwargulski, Ser. No. 719,184, filed Dec. 30, 1946, now Patent No. 2,497,029, dated February 7, 1950, I have shown the above system broadly with some modification of the pressure-operated switch and incorporating a signal or indicating lamp. The present application is directed to a similar combination wherein the signal or warning indicator lamp is so connected to the system as to perform a similar function to that performed in my prior patent with Szwargulski, but the connection is in a novel manner, whereby to eliminate the necessity of a double-throw pressure-operated switch. With the present circuit disclosed in the instant application, a simple single-throw, single-pole pressure-operated switch is used, yet the function performed by the single or indicating lamp or device is substantially the same.

The principal object of the invention is to provide an improved automatic control system suitable in particular for use with automotive engines having a pressure lubrication system, wherein the control system is operative in response to abnormally low pressure or pressure failure in the lubrication system, to cause cessation of fuel delivery with consequent stopping of the engine, and to effect a warning indication of the existence of such abnormal condition of the lubrication system.

Another object of the invention is to provide an oil pressure indicator which does not require a special switch or switch point in addition to the

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oil pressure control provided in the fuel pump circuit as disclosed, for instance, in copending applications, Serial No. 715,558, filed December 11, 1946, now Patent No. 2,537,354, dated January 9, 1951, and Serial No. 719,184, filed December 30, 1946, now Patent No. 2,497,029, both in the names of Korte and Szwargulski.

A further object is to provide a control system of the character and for the purpose indicated, which includes in the energizing circuit of the electric motor driven fuel supply pump, a warning indicator device having an electrical resistance effective when said device is operative, to reduce the current flow through the fuel pump motor to a value insufficient for pump motor operation, and a single pole switch operable in response to normal lubricant flow pressures in the engine lubrication system, to by-pass the indicator device and cause the pump motor to operate the switch in response to abnormally low pressure or pressure failure in the lubrication system, then operating to render the indicator device operative to cause cessation of pump operation and to provide a warning indication of the abnormal condition of the lubrication system.

A further object is to provide a warning indicator which will not only indicate the operation of the oil pump for the engine, but which will also indicate whether or not the fuel pump is operating after the ignition switch is turned to the "on" position.

Further objects and advantages of the present invention will appear readily from the following description of a presently preferred embodiment thereof, as such is illustrated in the accompanying drawing.

The single figure of the drawing illustrates the presently preferred electric circuit arrangement of the control system, shown in application to an electric motor operated fuel supply pump and the pressure lubrication system of an automotive engine. The engine appears in fragmentary part only, including the engine starter and its operating circuit.

As hereinbefore indicated, the present control arrangement is particularly suitable for use with automotive engines, but without limitation thereto. Referring to the drawing, 10 is an electric motor driven, engine fuel supply pump which may be of known construction, the pump being suitably located with respect to the usual automotive vehicle supported fuel tank (not shown) for supplying fuel through a feed line, to the engine fuel mixing device or carburetor (not shown) delivering fuel mixture to the engine cylinders through

the engine intake manifold shown in part at 11. A portion 12 of the exhaust manifold is here shown in heat supplying relation to the so-called "hot spot" portion 14 of the intake manifold.

Included in the portion of the engine pressure lubrication system illustrated, is an engine driven oil pump 15 indicated as being of gear type, having its intake connected by a suction conduit 16, to the engine crankcase oil pan shown in part at 18. Oil under pressure delivery from the pump 15, is conducted through pipes 19 and 20 to the engine bearings and other operating parts (not shown) requiring lubrication.

Engine cranking may be accomplished in the conventional manner, as by a starting or cranking motor 22 operated from the battery 23 of the automotive vehicle. The starting motor circuit comprises a lead 24 extending from the negative terminal 26 of the battery, to one contact 27 of a starter switch 28, the cooperating contact 30 of the latter being connected by lead 31 to the starter motor 22. Motor 22 is grounded at 32 which completes the circuit to the ground connection 34 of the positive battery terminal 35. Switch 28 may be of a conventional manual or foot-operated type, as desired.

Describing now the presently improved control system in operative association with the fuel supply pump 10 and the engine pressure lubrication system, one terminal of the supply pump motor is grounded at 36, while the other terminal thereof is connected by a lead or conductor 38 to a fixed contact 40 of a single pole, pressure operated switch device indicated generally at 42. The movable contact member 43 of the pressure switch, connected to a post 44, is connected to the battery by a wire 46 leading from post 44 to the vehicle ignition switch 47, and a wire 48 between the ignition switch and battery terminal 26.

Pressure switch 42 includes casing members 50 and 51 in assembly connection at 52, and a yieldable or flexible diaphragm device 54 dividing the casing interior into a pressure chamber 55 and a switch chamber 56. Suitably secured to the end wall of casing member 50, is an insulator assembly 58 supporting contact 40, post 44, and movable contact member 43 of the switch, the latter being of spring character and arranged in the chamber 56 such that in its free or untensioned condition, the contact element 59 thereof will be spaced from, and hence out of engagement with the fixed contact 40, as this appears in the figure.

Carried by diaphragm 54 is a plunger 60 which extends into switch chamber 56, and is guided in its movement by a rigid member 62, the latter serving also as a diaphragm backing to limit the pressure displacement of the diaphragm. At the free end of the plunger is a head element or switch tappet 63 of insulating material, engageable with switch member 43 upon pressure displacement of the diaphragm 54, to move the member to switch-closed position wherein the contacts 40 and 59 are engaged. A suitable compression spring 64 encircling the plunger between the rigid member 62 and the diaphragm, serves to bias the diaphragm and plunger device to initial position as shown in the drawing, wherein the switch is open.

Pressure chamber 55 is in communication with the pressure flow side of the engine lubrication system, as through a conduit 66 connected to the oil pressure feed pipe 20. Moreover, switch chamber 56 preferably is vented in any suitable manner, as by a vent pipe 67 which in the present example, leads to connection at 68 with the oil

pump suction pipe 16 (see application, Serial No. 715,558, now Patent No. 2,537,354, mentioned above).

It will be clear from the above explanation and description that a system has been described which comprises two parallel electric circuits connecting the battery and fuel pump, one of which is controlled by the actuation of the starter motor switch and the other of which is controlled by the closing of a fluid pressure operated switch responsive to oil pressure, or the like. The present improvement over what has been described in my prior patents above-mentioned resides in the arrangement to operate the following indicator or warning device.

Arranged in shunt-circuit to the pressure switch, is an indicator lamp 70 connected by a lead 71 to circuit conductor 46, and by a lead 72 to conductor 38^a. Any other type of indicator utilizing a comparable resistance may be substituted for the lamp. The indicator lamp is located in full view of the automotive vehicle operator, as upon the vehicle dashboard.

Completing the present control circuit arrangement is an auxiliary energizing circuit for the engine fuel supply pump 10, including a lead 74 from conductor 46 to the movable contact 75 of a relay switch 76, and a lead 78 between the fixed contact 79 of the relay and the pump motor conductor 38. Contact member 75 is biased to open position, as by a suitable spring 80, and is closed on contact 79 responsive to energization of the relay electromagnet 82. The winding 83 of the latter is grounded at 84, and is connected to the starting motor lead 31 by lead 86, so as to place the electromagnet under control of the starter switch 28.

Turning to the operation of the control system, the several switches normally will be in open circuit condition as shown in the drawing, when the engine is out of operation. Now upon closure of the ignition switch 47, indicator lamp 70 will be energized, thereby giving visual indication of the "on" condition of the ignition switch. The lamp energizing circuit then obtaining, extends from battery 23, through the ignition switch, conductors 46 and 71, lamp 70, conductors 72 and 38 to the motor of fuel pump 10, and thence through ground to the battery. The lamp and pump motor thus are in series, but pump operation is here precluded by the current-limiting effect of the lamp. To this end, the lamp is selected to have a filament resistance factor such that in the lighted condition of the lamp, the current return through the pump motor to the battery will be at a value well below the current amperage required for pump motor starting. In one example, the pump motor when connected across the vehicle battery 23 affording, say, a potential of 6 volts, requires a starting current of approximately 2.5 amperes and the lamp draws a current of between .25 and .5 amperes. Consequently, the voltage drop due to the resistance of the lamp will be such as to preclude starting of the pump, the latter then serving merely to complete the lamp return circuit to ground and the battery.

With the ignition switch closed, starting of the engine is effected by closure of the starting switch 28, which thereby completes the energizing circuit to the cranking motor 22. Closure of the starter switch also causes switch-closure of the relay 76, as is obvious from the circuit arrangement, thereby establishing the heretofore described auxiliary circuit which affords direct connection of the fuel pump to the battery through

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the closed ignition switch, and at the same time, a direct short-circuit of the indicator lamp 70 to render the latter inoperative. The fuel pump therefore, starts and operates in the cranking period, to assure fuel supply at the engine carburetor. It may be pointed out here that while the illustrated relay-controlled, auxiliary pump operating circuit is presently preferred, an extra contact on the starting switch may be employed, if desired. This feature is disclosed in my Patent No. 2,370,249.

When the engine fires and starts under its own power, the starter switch normally is released to open position, which results in deenergization of relay 76 and consequent open-circuiting of the auxiliary pump energizing circuit. However, as this occurs, the pressure switch 42 is closed at its contacts 40 and 59 in response to pressure actuation of the diaphragm plunger assembly by the lubricant pressure then established by the engine-driven oil pump 15 in the engine lubrication system. Closure of switch 42 completes the main energizing circuit of the fuel pump, as from the battery 23 through the ignition switch 47, conductor 46 to post 44 of the pressure switch, switch member 43, contacts 59 and 40 in engagement, conductor 38^a—38 to the motor of fuel pump 10, and thence to the battery through motor ground 36. Consequently, operation of the fuel pump as initiated in the cranking period, will continue throughout engine operation, providing the pressure switch remains closed. The switch 42 in establishing the pump circuit as described, short-circuits the indicator lamp 70, so that the latter is inoperative during normal operation of the engine.

The pressure switch 42 is adapted and regulated in part through the diaphragm loading spring 64, for operation to maintain the circuit contacts thereof in closed condition, so long as the oil pressure effective on the diaphragm is within the normal range of oil pressure obtaining in the engine lubrication system consequent to engine operation between idling and maximum speeds. If for any reason during engine operation, the pressure in the lubrication system should fall below the normal minimum pressure, spring 64 will act to displace the diaphragm in the direction to retract the plunger 60 from its switch-closing position. The spring switch member 43 thereupon will move to disengage the contacts 40 and 59, thus opening the direct energizing circuit to the fuel supply pump 10, and at the same time removing the short-circuit about the indicator lamp 70. The lamp 70 then affords a visual warning to the vehicle operator, of an abnormally low pressure of pressure failure in the engine lubrication system, and in so operating, reduces the current through the fuel supply pump motor to a value insufficient for continued pump operation. Consequently, the fuel pump stops, and following the resultant cessation of fuel delivery to the engine, the engine will cease operation.

Thus the presently improved control system affords in the event of pressure failure in the engine lubrication system, both a visual warning indication to the vehicle operator, of such condition, and an automatic shut-down of the engine. The lamp affords a simply and conveniently available warning indication of any failure in normal operation of the engine pressure lubrication system, and coincidentally when the lamp resistance is in the fuel-pump circuit it results in a reduction of current through the fuel supply pump motor such as to render the pump inoperative.

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Likewise, it can be readily understood that the lamp affords a simple indicator of fuel pump operation. However, it will be appreciated that any suitable indicator device having a resistance characteristic similar to that of the lamp, may be employed in the present system. For example, a bell or buzzer device may be substituted for the lamp 70, or if desired, a lamp and bell or buzzer may be used in combination, to afford both sound and visual warning. The insertion of the usual generator and cut out in the electrical system will not adversely affect the above operation.

It is to be pointed out here that the relatively simple yet highly effective warning indicator and fuel supply pump control system as provided by the present invention, importantly facilitates the use of a simple and inexpensive pressure switch having but a single movable contact cooperable with a single fixed contact, and wherein the pressure-closure of the switch contacts may be closely regulated through selection of the diaphragm loading spring to afford a predetermined desired biasing influence on the diaphragm.

Having now described the invention with respect to a presently preferred embodiment thereof as illustrated by the drawing, it will be appreciated and understood that modifications of the system may be made without departing from the spirit and full intended scope of the invention as defined by the appended claims.

I claim:

1. In combination with an internal combustion engine having a pressure lubrication system, an electric motor operated fuel pump for the engine, an energizing circuit for the pump motor including a main switch, indicator means of resistance character in said circuit, said indicator means being effective upon closure of said main switch prior to engine starting for indicating circuit closure therethrough to said pump, the resistance of said means being predetermined in relation to the normal current characteristics of said energizing circuit such as to determine the current through the pump motor at a value less than that required for pump operation, a second switch connected in parallel with said indicator means, and a pressure actuator for said second switch connected to said lubrication system for closing said second switch in response to the development of normal lubricant pressure in said lubricating system consequent to running operation of the engine, to form a short circuit around said indicator resistance and establish operating energization of the pump motor, said switch actuator in response to abnormal decrease of pressure in said lubricating system cutting out said short circuit and thereby causing cessation of pump operation, said indicator means then serving to indicate failure of normal pressure in said lubricating system.
2. In a power plant, an engine, a lubricating pump connected to be driven from said engine, an electrical system for said engine, including a battery, starter motor, and control switches, a fuel supply system for said engine, including an electrically driven fuel pump, two parallel electric circuits connecting said battery and said electric fuel pump, control means in one circuit to energize said fuel pump responsive to starter motor operation, and control means in the other circuit to energize said fuel pump responsive to operation of said lubricating pump, the combination with said other circuit, of means comprising a resistance circuit in shunt with said second control means and including an indicator device, said resistance circuit having resistance sufficient to

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produce a voltage drop therethrough to said fuel pump below pump motor operating requirements.

3. In a power plant, an engine, a lubricating pump connected to be driven from said engine, an electrical system for said engine, including a battery, starter motor, and control switches, a fuel supply for said engine, including an electrically driven fuel pump, two parallel electric circuits connecting said battery and said electric fuel pump, control means in one circuit to energize said fuel pump responsible to starter motor operation, and control means in the other circuit to energize said fuel pump responsive to operation of said lubricating pump, the combination with said other circuit of means comprising an indicator circuit connected in parallel relation with said second control means, said indicator circuit having an electrical resistance sufficient to produce a voltage drop therethrough to said fuel pump below pump motor operating requirements.

4. In a power plant, an engine, a lubricating pump connected to be driven from said engine, an electrical system for said engine, including a battery, starter motor, and control switches, a fuel supply system for said engine, including electri-

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cally driven fuel pump, two parallel electric circuits connecting said battery and said electric fuel pump, control means in one circuit to energize said fuel pump responsive to starter motor operation, and control means in the other circuit to energize said fuel pump responsive to operation of said lubricating pump, the combination with said other circuit of a means including an indicator circuit connected to said other circuit to be short-circuited by operation of said second control means to close said other circuit, said indicator circuit including an electrical resistance sufficient to produce a voltage drop therethrough to said fuel pump below pump motor operating requirements when said second control means is inoperative.

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REFERENCES CITED

20 The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,370,249	Korte	Feb. 27, 1945