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ENGINE SHUT-DOWN SYSTEM

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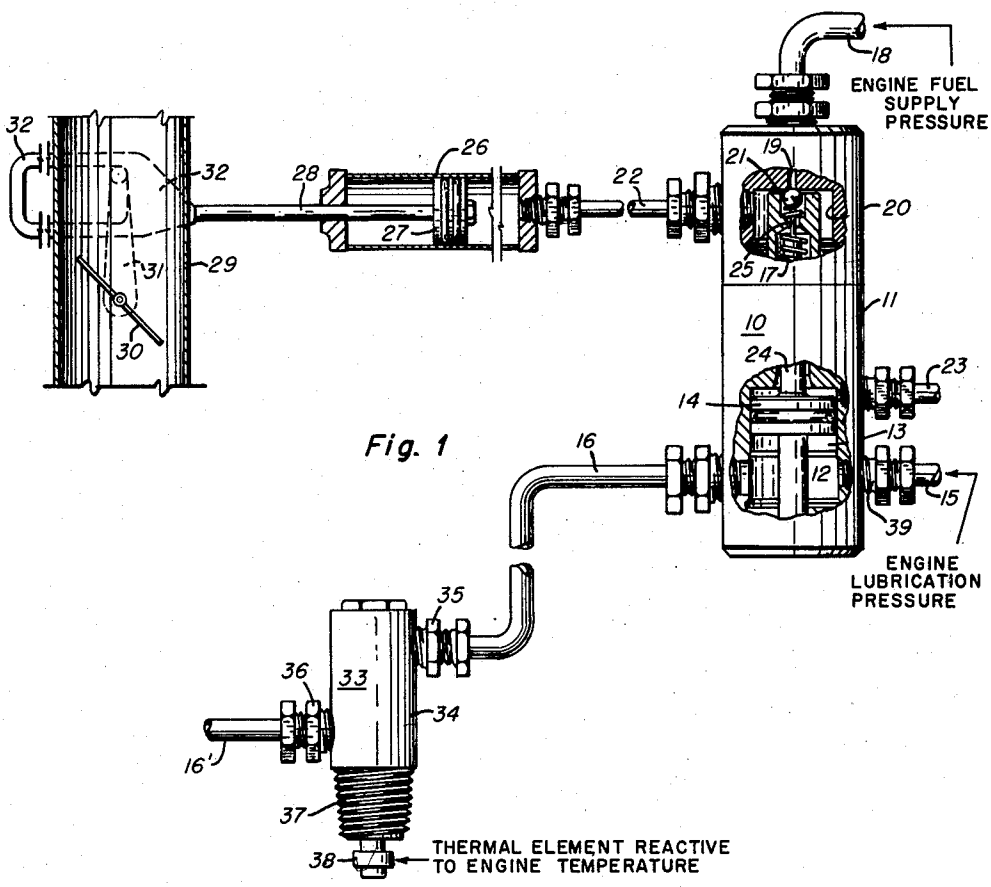


Fig. 1

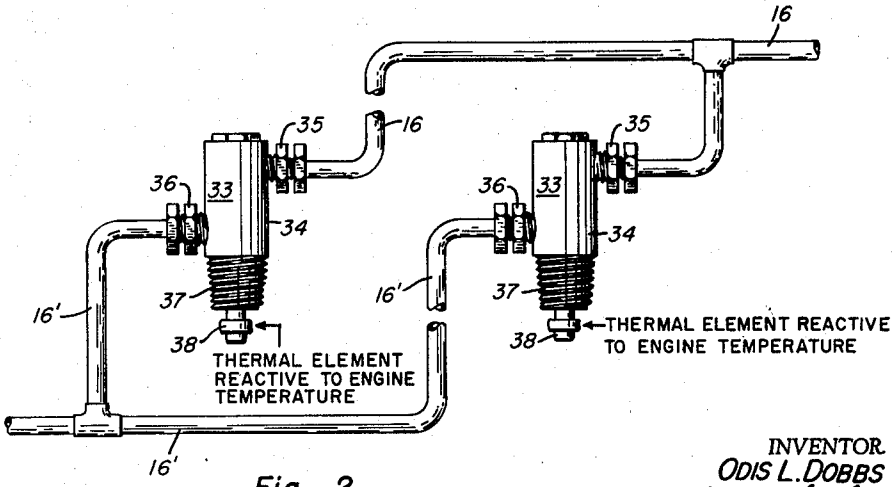


Fig. 2

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ENGINE SHUT-DOWN SYSTEM

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This invention relates to means effective to arrest the operation of internal combustion engines, and analogous equipment, in automatic reaction to potentially-damaging rise of temperature and drop of lubricant-circulating pressure, either or both, significant to proper functioning of an associated engine, and has an object to provide novel and improved such means reliable in diverse specific adaptations to interrupt the operation of an engine subject to adverse variations of working temperature and lubricant-circulating pressure at predetermined values in the range of such variations.

A further object of the invention is to provide a novel and improved engine shut-down system automatically responsive to adverse variations of working temperature and lubricant-circulating pressure of an associated engine that is amenable to functional correlation with and actuation of any preferred one of various known agencies applicable to interrupt engine operation.

A further object of the invention is to provide a novel and improved engine shut-down system automatically responsive to adverse variations of working temperature and lubricant-circulating pressure of an associated engine that is effective in correlation with a single preferred one of various known agencies applicable to interrupt engine operation to correspondingly and independently actuate such agency at a predetermined value of temperature rise and at a predetermined value of pressure drop.

A further object of the invention is to provide a novel and improved engine shut-down system automatically responsive to adverse variations of working temperature and lubricant-circulating pressure of an associated engine that is effective in correlation with a single preferred one of various known agencies applicable to interrupt engine operation to correspondingly and independently actuate such agency at a predetermined value of temperature rise sensed at any one of a plurality of stations and at a predetermined value of pressure drop.

A further object of the invention is to provide a novel and improved organization and operative correlation of elements and components constituting a system automatically effective to interrupt operation of an associated engine in reaction to adverse variations manifest in the working temperature and lubricant-circulating pressure of the engine, either or both.

A further object of the invention is to provide a novel and improved engine shut-down system that is expedient and economical of production in adaptations suited for association with engines of diverse type, size, and particularity, that is simple and practical of application to use coaction with an engine, and that is positive and efficient in attainment of the ends for which designed.

With the foregoing and other objects in view, my invention consists in the construction, arrangement, and operative combination of elements as hereinafter set forth, pointed out in the appended claims, and illustrated by the accompanying drawing, in which—

FIGURE 1 is a schematic representation of a typical engine shut-down system organized in accordance with and to give effect to the principles of the invention, certain components featuring the system being broken away or shown in section to expose otherwise concealed structural arrangements, fluid flow lines utilized in the system being but fragmentarily applied to connection with the system and interrupted in length to conserve space, and conventional facilities comprised in or served

by the system being shown but generally and only to such extent as will suffice for an understanding of the invention as hereinafter described.

FIGURE 2 is a fragmentary, schematic view, on a relatively-reduced scale, of a multi-station adaptation of the system according to FIGURE 1 within the contemplation of the invention, fluid flow lines featuring the adaptation being broken away and interrupted in length to indicate, with conservation of space, their selective adjustability in connection to and between the variously-positionable stations which they serve.

Internal combustion engines, diesel-type or other, whereto the improved system of the invention is applicable conventionally incorporate functionally-integrated means for the circulation of lubricant under pressure, separate functionally-integrated means for pressure-supply of engine fuels, whether liquid, air, or both, means for limiting working temperatures of the engine with respect to an appropriate maximum, throttle valve means actuable to regulate fuel feed to the engine, and ignition means suited to the particular type of engine. While failure or malfunction of the means for pressure-supply of engine fuels is seldom productive of damage to the engine and normally results but in an interruption of engine operation, inadequacy of lubricant circulation evidenced by a drop in the value of the circulating pressure and overheating of the engine, however caused, will occasion, independently or concurrently, serious impairment of the ultimately-stalled engine unless promptly detected with opportunity to stop the engine before critical damage ensues. The merit and practical advantage of means for halting operation of an internal combustion engine an automatic reaction to inadequate lubricant-circulating pressure and overheating of the engine, either or both, being manifest, especially where the engine is installed to operate for extended time periods without an attendant at an isolated site, the instant invention is directed to the provision of a simple and reliable system capable of immediately detecting excess engine temperature and deficient lubricant pressure and automatically reflecting either or both of the same through the conventional engine controls in a manner to stop the engine.

In any and every practical adaptation of the system according to the present invention, an essential is the provision of a pressure-reactive valve unit functionally equivalent to that designated generally by the numeral 10 in FIGURE 1. The pressure-reactive valve unit may be of any preferred structural particularity suited to accomplish its functions of inhibiting flow through a line subject to the fuel-supply pressure of the engine when the lubricant-circulating pressure is properly adequate and of accommodating flow previously inhibited when the lubricant-circulating pressure becomes inadequate to sustain effective lubrication of the engine. Representative of functionally-equivalent organizations, the pressure-reactive valve unit 10 of FIGURE 1 is the same as that shown and described in my copending application for Letters Patent of the United States entitled Pressure-Reactive Valve which, save for its functional capabilities, is in and of itself no part of the present invention. As shown, the unit 10 is contrived as a separable, multi-section, cylindrical housing 11 formed adjacent one end with an interior chamber 12 in full communication with one end of a coaxial cylinder 13 reciprocably housing a piston 14. Suitably associated by means of an input line 15 and a return line 16 with the lubricant-circulating arrangements of the engine, the chamber 12 is conditioned to maintain a full charge of lubricant at the pressure of its engine-induced circulation effective therein to urge the piston 14 away from the chamber against the bias of an expansive spring 17. A line 18 subject

to the engine fuel-supply pressure is connected to deliver through a passage 19 to a well 20 interiorly adjacent the end of the housing 11 remote from the chamber 12 past a ball valve 21 lightly spring-biased to yieldably close said passage in opposition to the pressure of input through the line 18, a line 22 communicates with and leads outwardly from the well 20 subject to the pressure charge within the latter, and a return line 23 serving the end of the cylinder 13 at the side of the piston 14 remote from the chamber 12 supplements the input line 18 for completion of the circuit wherethrough the pressure of engine fuel supply, whether liquid or air, is applied to and made subject to flow regulation by the valve unit 10. The piston 14 carries a stem 24 having a terminal finger 25 arranged to positively hold the ball valve 21 in closing relation with the passage 19 against the input of pressure through the line 18 when the piston 14 is elevated within the cylinder 13 away from the chamber 12, and to free said ball valve to the influence of its biasing spring, alone, when the piston is shifted by means of the spring 17 toward said chamber, whereby, as is manifest, pressure of lubricant circulation obtaining within the chamber 12 with a force sufficient to overcome the resistance of the spring 17 urges and holds the piston 14 away from the chamber with consequent application of the piston stem finger 25 to the ball valve 21 in a manner to close the passage 19 and inhibit input from the line 18 to the well 20, while, alternatively, a pressure of lubricant circulation obtaining within the chamber 12 at a value inadequate to overcome the bias of the spring 17 permits the latter to move the piston 14 toward the chamber with consequent retraction of the finger 25 away from the ball valve 21 and release of the latter to the input of pressure through the line 18 opposed but by the yieldable bias applied to the ball valve. Thus, the pressure-reactive valve unit primary to organization and operation of the improved system of the present invention whether that illustrated and above described or any functional equivalent thereof, is effective at adequate pressures of lubricant circulation to hold closed a separate, entirely independent, circuit subject to engine-induced flow of pressurized fluid and to reflect inadequate pressures of lubricant circulation as accommodation of pressurized fluid flow through the associated separate circuit subject to but an initial check as the latter flow acquires a minimal pressure value. The moderate bias of the ball valve 21 is provided to facilitate starting of an engine from a condition wherein both lubricant-circulating pressure and fuel-supply pressure are lacking and serves in an obvious manner to delay input of fuel-supply pressure to the well 20 until the rapidly-evolved lubricant-circulating pressure has become operatively manifest within the chamber 12.

In accordance with and to give effect to the principles of the invention, the line 22 leading from communication with the well 20 for transmission of fluid pressure input thereto past the ball valve 21, or any equivalent line for transmission of fluid pressure in consequence of a drop affecting the lubricant-circulating pressure, connects with a suitable actuator responsive to application of fluid pressure, such as, for example, the cylinder 28 conventionally housing a piston 27 and piston stem 28 for extension of said stem outwardly through one end of the cylinder in reaction to input of fluid pressure from the said line 22 at the other end of the cylinder, which actuator, of whatever expedient structural particularity, converts the fluid pressure input thereto into mechanical action, or motion, applicable through any appropriate means and connections to operate agencies effective to halt engine performance. The actuator responsive to fluid pressure applied through the line 22 may be coupled to and for operation of a control switch in the circuit powering igniter elements of the engine, when such circuit and elements are, as is common, functionally critical to engine performance, in a manner and by means hitherto known to and utilized by those skilled in the pertinent art and effective to interrupt power supply to the igniter elements and thereby shut down the engine in automatic reaction to a fluid pressure impulse delivered through the line 22. Alternatively, and again in a manner and by means well known in the art, the actuator typified by the cylinder 26 may be linked to and for adjustment of a throttle valve controlling the supply of fuel, liquid or vapor, to the engine in such a way as to close the valve and thereby shut down the engine in consequence of fluid pressure delivery by the line 22, whereby, as indicated in FIGURE 1, to adapt the system of the invention for realization of its purposes in association with engines, especially those of Diesel type, devoid of circuit-powered igniter elements. Thus, at the left of FIGURE 1, the numeral 29 designates the air intake of an engine, Diesel or other, wherein a conventional butterfly valve 30 is rockable through the agency of an arm 31 about its axis for customary regulation of air input to the ingine, to which available engine control the influence of the actuator is applied through a lost-motion linkage 32 intercoupling the ends of the piston stem 28 and arm 31 for conjoint reflection of fluid pressure input to the cylinder 26 as a rocking of the valve 30 to obstructing relation with the intake 29 and consequent engine-stopping interruption of air feed to the engine.

Organized as illustrated and thus far described, the improved system of the invention typified by the pressure-reactive valve 10 is effective to automatically shut down an associated engine when, for any reason, the lubricant-circulating pressure of the engine is inadequate to hold closed the passage to the line 22 from the independent supply of fluid pressure manifest in and through the line 18, since appropriate connection of the return line 16 in and to complete a lubricant-circulating circuit suffices to at all times reflect interiorly of the chamber 12 and against the piston 14 the lubricant-circulating pressure of the engine whereto the system is responsive.

The utility of the system is advantageously enlarged through adaptations conditioning it to effect shut-down of the associated engine in response to excess heats of engine operation in addition to, and without impairing, its capability in reaction to inadequate pressure of lubricant circulation, as above elaborated. Temperature-responsive, or thermostatic, valves automatically effective to control fluid flow through a line in reaction to variations of imposed temperature are readily and extensively available in considerable diversity of structural particularity, specific applicability, and actuating temperature values. One typical such thermostatic valve suited for use in and to extend the utility of the system of the invention is represented generally at 33 in the views of the drawing and is illustrated in a conventional structural organization facilitating its operative inclusion in the system that is characterized by a rigid barrel 34 housing valve components normally closing a passage therethrough between flow line connections 35 and 36, a threaded terminal 37 coactable with a threaded seat disposed on or in association with the engine to mount the barrel with the end of the terminal 37 exposed to overheating effects upon the engine, and a thermal element 38 interchangeably projecting from the barrel terminal 37 in position to sense the temperatures to which it is exposed when the barrel is mounted in its seat and to open the passage controlled by the valve components within the barrel when the temperature to which it is subject attains and exceeds that value at which the element 38 is designed to react. Organization and mode of operation of the typical thermostatic valve appropriate to effectuate the concept of the present invention being long known and well understood, outline depiction and the foregoing functional description thereof should suffice to explain its application and use in connection with the system as hereinafter set forth without occasion for elaboration of structural detail.

Practical adaptation of the improved system of the invention to shut down an associated engine in reaction

to overheating as well as in response to inadequate pressure of lubricant circulation is exemplified by FIGURE 1. A thermostatic valve 33 having a thermal element 38 responsive to open a passage through the valve components and between the fittings 35 and 36 at and above the maximum temperature appropriate for engine operation is applied by means of its threaded terminal 37 to sense the operating temperature of the engine where overheating becomes evident, the return line 16 from the pressure-reactive valve unit 10 of the system hereinbefore described is connected to serve the valve 33 through the input fitting 35 thereof, and a return line extension 16' is connected by way of the output fitting 36 to complete a closed circuit for engine lubricant circulation in series through the chamber 12 of the unit 10 and the valve-controlled passage through the component 33. At acceptable operating temperatures of the engine, the passage through the thermostatic valve 33 is closed to inhibit flow through the circuit by way of the lines 16 and 16' and the pressure of lubricant circulation applies within the chamber 12 for reaction through the unit 10 and associated actuator as previously described. In addition, overheating of the engine sensed by and sufficient to activate the thermal element 38 opens a passage through the valve 33 between the lines 16 and 16' accompanied by outflow of pressurized lubricant from the chamber 12 by way of the so-opened return circuit to the engine, and the consequent reduction of the pressure within the chamber acts with the same effect as a drop in the pressure of lubricant input thereto to operate the unit 10 and associated actuator for arrest of engine operation. That heat-induced opening of the flow passage through the valve 33 will positively occasion a reduction of pressure within the chamber 12 sufficient to actuate the unit 10 when input pressure of the lubricant is unimpaired may be assured by arranging that capacity for outflow from the chamber through the line 16 shall much exceed the rate of input to the chamber from the line 15, as through appropriate size-proportion of the inlet to and outlet from the chamber or provision of a flow-reducing connector 39 wherethrough the line 15 is constrained to serve the chamber. Obviously, during or upon re-establishment of normal engine operating conditions the actuating agencies featuring the improved system automatically assume and maintain the correlations significant to their potential as standby safeguards.

The adaptation according to FIGURE 2 indicates the amenability of the improved system to accommodate a plurality of temperature-sensing stations in functional association with a single pressure-reactive valve unit 10 effective to shut down an engine as hereinabove explained in response to overheating of the engine evidenced at any one of the stations. In an installation where overheating deriving from engine operation may develop, and be detectable, at any one of several unrelated places, it is practical and entirely feasible to locate a thermoplastic valve 33 at each such place in exposure, as above set forth, of its thermal element 38 to the temperature there to be sensed and to interconnect all of the so-located valves 33 alike in parallel between a return line 16 and a return line extension 16' common thereto, whereby, as clearly appears from FIGURE 2, each of the several valves 33 is qualified to open a passage for flow through the circuit of the lines 16 and 16', with consequent actuation of the valve unit 10, in response to a temperature affecting and sufficient to activate its thermal element 38.

Since changes, variations and modifications in the form, construction, and arrangement of the elements shown and described may be had without departing from the spirit of my invention, I wish to be understood as being limited solely by the scope of the appended claims, rather than by any details of the illustrative showing and foregoing description.

I claim as my invention:

1. The combination with an internal combustion engine having pressure feed of fuel, pressure circulation of lubricant, and a control selectively actuable to halt engine operation, of a pressure-responsive actuator linked to and for operation of the engine control, a line subject to the fuel feed pressure serving said actuator, and means reactive to the pressure of lubricant circulation controlling flow through said line with inhibition of such flow when the pressure of lubricant circulation is adequate and accommodation of such flow when the pressure of lubricant circulation is inadequate, whereby automatically to shut down the associated engine in reflection of impairment in the lubrication thereof.

2. The combination with an internal combustion engine having pressure feed of fuel, pressure circulation of lubricant, and a control selectively actuable to halt engine operation, of a pressure-responsive actuator linked to and for operation of the engine control, a line subject to the fuel feed pressure serving said actuator, means reactive to the pressure of lubricant circulation controlling flow through said line with inhibition of such flow when the pressure of lubricant circulation is adequate and accommodation of such flow when the pressure of lubricant circulation is inadequate, and supplementary means responsive to operating temperatures of the engine effective to evidence excess such temperatures as a decrease of the pressure of lubricant circulation manifest at and for corresponding activation of said first means, whereby automatically to shut down the associated engine in reflection of overheating of the engine as well as impairment in the lubrication thereof.

3. The combination with an internal combustion engine having pressure feed of fuel, pressure circulation of lubricant, and a control selectively actuable to halt engine operation, of a pressure-responsive actuator linked to and for operation of the engine control, a line subject to the fuel feed pressure serving said actuator, a valve component in said line yieldably opposing supply of pressure to said actuator, and means subject to the pressure of lubricant circulation coactable with said valve component to hold closed against flow the line serving the actuator when the pressure of lubricant circulation is adequate and to release said valve component for yielding to imposed pressure with consequent pressure supply to the actuator when the pressure of lubricant circulation is inadequate, whereby automatically to shut down the associated engine in reflection of impairment in the lubrication thereof.

4. The combination with an internal combustion engine having pressure feed of fuel, pressure circulation of lubricant, and a control selectively actuable to halt engine operation, of a pressure-responsive actuator linked to and for operation of the engine control, a line subject to the fuel feed pressure serving said actuator, a valve component in said line yieldably opposing supply of pressure to said actuator, means subject to the pressure of lubricant circulation coactable with said valve component to hold closed against flow the line serving the actuator when the pressure of lubricant circulation is adequate and to release said valve component for yielding reaction to imposed pressure with consequent pressure supply to the actuator when the pressure of lubricant supply is inadequate, and supplementary means responsive to operating temperatures of the engine effective to evidence excess such temperatures as a decrease of the pressure of lubricant circulation manifest at and for corresponding activation of said first means, whereby automatically to shut down the associated engine in reflection of overheating of the engine as well as impairment in the lubrication thereof.

5. A system effective, in association with an internal combustion engine having pressure feed of fuel, pressure circulation of lubricant, and a control selectively actuable to halt engine operation, automatically to shut down the engine upon impairment of lubricant circulation, comprising a pressure-responsive actuator linked to and for op-

eration of the engine control, a line subject to the fuel feed pressure serving said actuator, and a valve subject to the pressure of lubricant circulation adapted to close said line against flow therethrough when the pressure of lubricant circulation is adequate and to open said line for pressure supply of fluid to the actuator when the pressure of lubricant circulation is inadequate.

6. A system effective, in association with an internal combustion engine having pressure feed of fuel, pressure circulation of lubricant, and a control selectively actuable to halt engine operation, automatically to shut down the engine upon overheating and impairment of lubricant circulation, comprising a pressure-responsive actuator linked to and for operation of the engine control, a line subject to the fuel feed pressure serving said actuator, a valve subject to the pressure of lubricant circulation adapted to close said line against flow therethrough when the pressure of lubricant circulation is adequate and to open said line for pressure supply of fluid to the actuator when the pressure of lubricant circulation is inadequate, and means responsive to operating temperatures of the engine adapted to evidence excess such temperatures as a decrease of the pressure of lubricant manifest at and for corresponding activation of said valve.

7. A system effective, in association with an internal combustion engine having pressure feed of fuel, pressure circulation of lubricant, and a control selectively actuable to halt engine operation, automatically to shut down the engine upon impairment of lubricant circulation, comprising a pressure-responsive actuator linked to and for operation of the engine control, a line subject to the fuel feed pressure serving said actuator, a valve component in said line yieldably opposing supply of pressure to said actuator, and means reciprocably subject to and yieldably biased against the pressure of lubricant circulation coactable with said valve component to hold close against flow the line serving the actuator at higher, normally-adequate values of lubricant circulating pressure and to release said valve component for yielding reaction to imposed pressure with consequent pressure supply to the actuator at lower, normally-inadequate values of lubricant circulating pressure.

8. A system effective, in association with an internal combustion engine having pressure feed of fuel, pressure circulation of lubricant, and a control selectively actuable to halt engine operation, automatically to shut down the engine upon overheating and impairment of lubricant circulation, comprising a pressure-responsive actuator linked to and for operation of the engine control, a line subject to the fuel feed pressure serving said actuator, a valve component in said line yieldably opposing supply of pressure to said actuator, means reciprocably subject to and yieldably biased against the pressure of lubricant circulation coactable with said value component to hold closed against flow the line serving the actuator at higher, normally-adequate values of lubricant circulating pressure and to release said valve component for yielding reaction to improved pressure with consequent pressure supply to the actuator at lower, normally-inadequate values of lubricant circulating pressure, means responsive to operating temperatures of the engine adapted to open a normally-closed fluid flow passage at excess such temperatures, and a line connecting said passage with the lubricant circulating pressure supply at said first means, whereby opening of the flow passage effects a decrease of lubricant circulating pressure at and consequent activation of said first means.

9. A system effective, in association with an internal combustion engine having pressure feed of fuel, pressure circulation of lubricant, and a control selectively actuable to halt engine operation, automatically to shut down the engine upon overheating and impairment of lubrication circulation, comprising a pressure-responsive actuator linked to and for operation of the engine control, a line subject to the fuel pressure serving said actuator, a valve component in said line yieldably opposing supply of pressure to said actuator, a flow circuit subject to the pressure of lubricant circulation, means reciprocably reactive to and yieldably biased against the pressure manifest in said circuit coactable with said valve component to hold closed against flow the line serving the actuator at higher, normally-adquate values of lubricant circulating pressure and to release said valve component for yielding reaction to imposed pressure with consequent pressure supply to the actuator at lower, normally-inadequate values of lubricant circulating pressure, and means responsive to operating temperatures of the engine normally obstructing flow in said circuit beyond said first means adapted to open the circuit to flow at excess engine temperatures, whereby to reflect abnormal engine temperatures as a decrease of lubricant circulating pressure at an effective to activate said first means.

10. The organization according to claim 9, wherein the means responsive to operating temperatures of the engine is comprised as a plurality of like thermostatic valves independently associated with the engine in parallel, individual connection with said circuit beyond the coaction of said first means therewith, whereby actuation of any one of said valves occasions pressure decrease in the circuit manifest at and for activation of said first means.

11. The organization according to claim 9, wherein said first means coacts with said circuit at a station having an input and outlet accommodating pressure circulation of lubricant therethrough, and said inlet is of flow capacity reduced relative to that of the outlet, whereby opening of the circuit to flow beyond said first means occasions decrease of pressure at the station in consequence of outflow therefrom in excess of input thereto.

References Cited in the file of this patent

UNITED STATES PATENTS

1,740,259	Morrison	Dec. 17, 1929
2,112,664	Dube	Mar. 29, 1938
2,714,883	Mitzger	Aug. 9, 1955