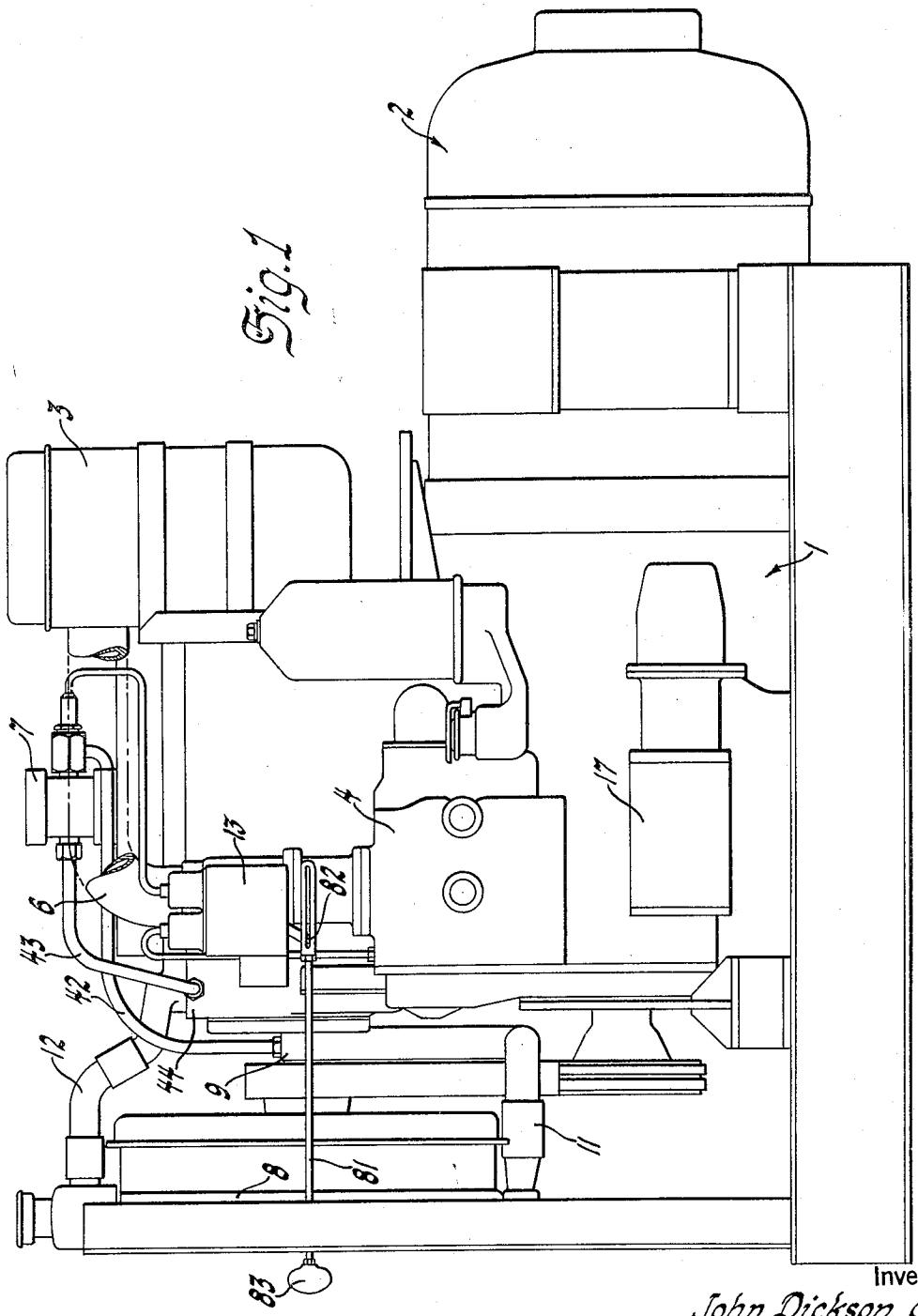
Jan. 17, 1956 J. DICKSON ET AL 2,731,001

ENGINE SAFETY SHUT-DOWN DEVICE

Filed Dec. 26, 1952 3 Sheets-Sheet 1

Fig. 1



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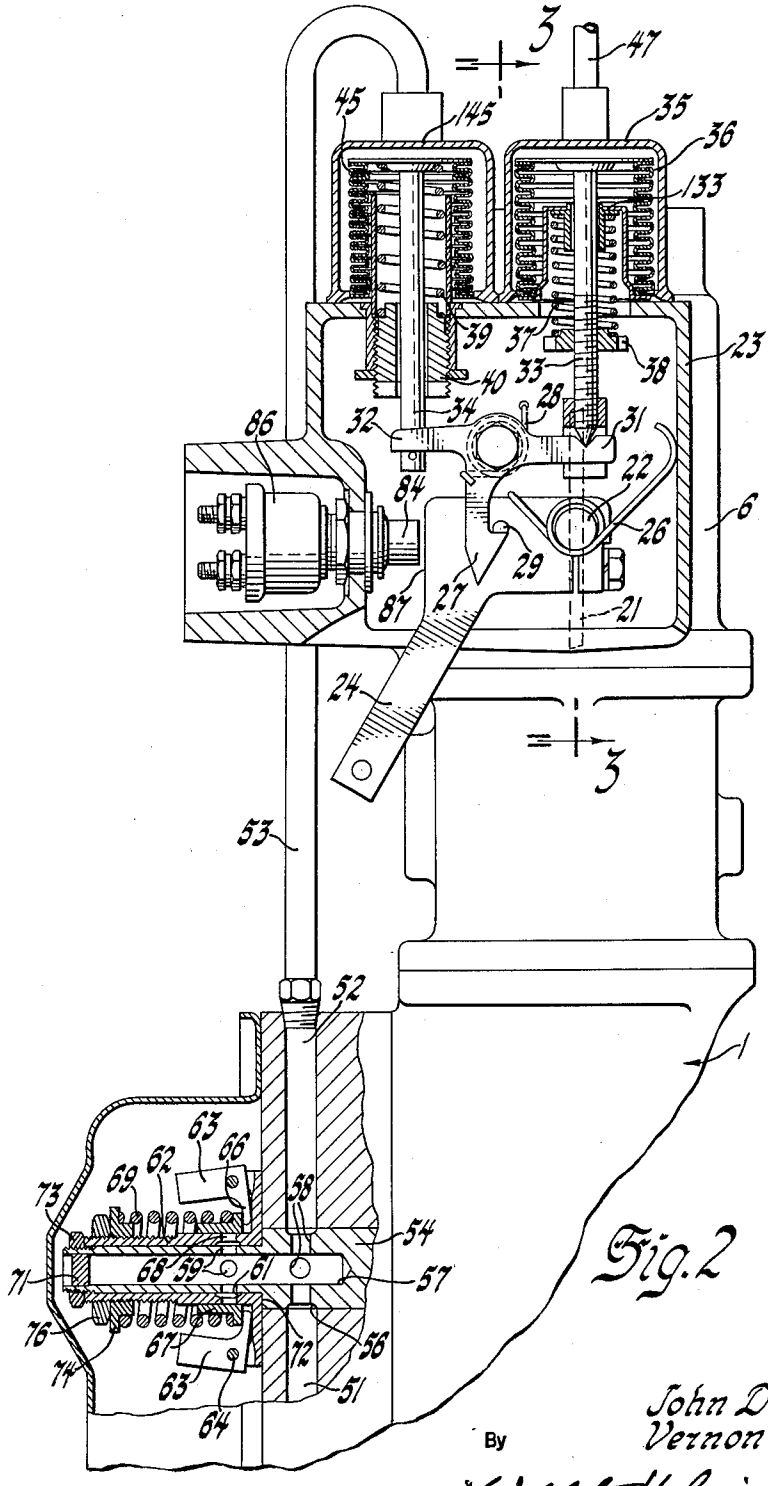

Fig. 2

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Filed Dec. 26, 1952 3 Sheets-Sheet 3

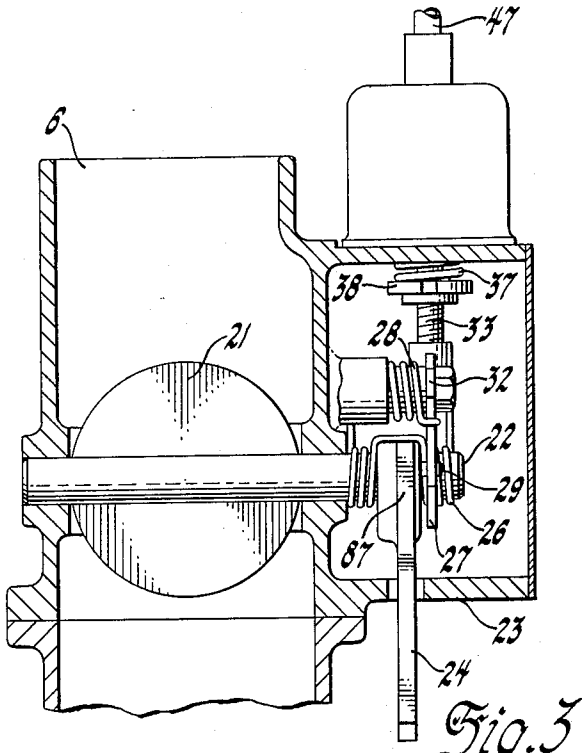

Fig. 3

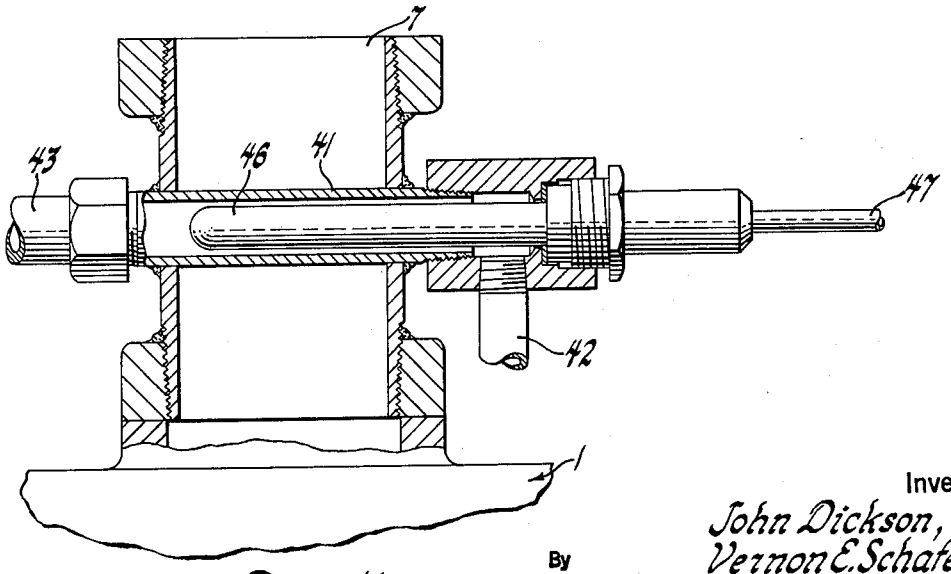

Fig. 4

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United States Patent Office 2,731,001 Patented Jan. 17, 1956

2,731,001

ENGINE SAFETY SHUT-DOWN DEVICE

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Application December 26, 1952, Serial No. 328,116

6 Claims. (Cl. 123—41.15)

This invention relates to safety shut-down devices for protecting internal combustion and other types of engines against continued operation in the event of a failure of their cooling or lubrication systems, as well as against excessive engine speed developing for any reason in operation.

While the invention is shown and described as applied to an internal combustion engine mounted for stationary use and driving an electrical generator, such is to be taken only for purposes of illustration since the invention is considered equally applicable to vehicular engines of various types.

One of the principal objects of the present invention is to provide a safety shut-down or protective device for such engines operative to choke off the engine combustion supporting air and having its engine temperature responsive means in heat conductive relation with coolant which is in turn subject to rapid heating by the engine exhaust gases, whereby a quick response to failure of the coolant circulating means is had.

Another object of the invention is to provide the oil pressure responsive means of the protective device with a pressure release operable in response to excessive engine speed, whereby such excessive engine speed creates a condition in the protective device simulating a failure of the engine oil pressure.

A further object is to provide such a protective device with manual re-setting means operatively associated with an engine starter control whereby actuation of the engine starter may be effected by manipulation of a single re-setting lever.

The means by which these and other objects of the invention are obtained will be more readily apparent from the following description, having reference to the drawings, wherein:

Figure 1 is a a view in side elevation of an internal combustion engine and generator unit incorporating our protective device.

Figure 2 is an enlarged fragmentary view similar to Figure 1 with parts broken away and in section to show the construction of the protective device.

Figure 3 is a sectional view taken substantially on line 3—3 of Figure 2.

Figure 4 is an enlarged fragmentary view similar to Figure 1 with parts broken away and in section to show the mounting arrangement of the engine coolant temperature responsive element of the protective device.

Referring now in detail to the drawings and first particularly to Figure 1, the numeral 1 indicates generally an internal combustion engine drivably connected to an output generator 2. Air for supporting engine combustion is taken in through an air filter 3 which is connected to the engine blower 4 by a duct 6. The engine exhaust gas outlet duct is shown at 7. An engine coolant radiator is shown at 8 to and from which coolant is circulated through the engine by a suitable pump whose housing is indicated at 9. Connecting the engine water outlet to the radiator is a pipe 12 and at 11 is shown a return

pipe from the radiator to the pump. The numeral 13 indicates generally the engine protective device. In the particular engine shown it will be appreciated that the blower, coolant pump and oil pressure pump are each driven by the engine, however, either of these may be separately operated units within the scope of the invention.

At 17 is indicated an engine starter, the control for which is operatively associated with the engine protective device now to be described.

As best shown in Figure 2 the flow of combustion supporting air through the air inlet duct 6 is controlled by a valve 21 which may be of the butterfly type having a shaft 22 extending into a housing 23 mounted adjacent the duct 6. Fixed on the shaft 22 is a member controlling this valve in the form of a lever 24. Yieldable biasing means shown in the form of a torsion spring 26 wrapped around the shaft 22 and having its opposite ends engaging the housing 23 and the lever 24 serves to move the valve from its open position shown to a closed position within the duct 6. Rotatably mounted within the housing 23 is a latch 27 which is yieldably biased in the counterclockwise direction as viewed in Figure 2 by a second torsion spring 28 for engagement with a keeper portion such as the pin 29 carried by the lever 24. The latch has a pair of oppositely extending arms 31 and 32, and having one-way driving connections with these arms for independently effecting opposite or clockwise rotation of the latch against the force of the second spring 28 are a pair of links 33 and 34, respectively. The link 33 has its upper end suitably anchored and sealed to the movable upper end of a bellows element 36 whose lower end is sealed to the open end of a cup-shaped container 35 fixedly mounted on the housing 23. Yieldable biasing means, shown in the form of a coil spring 37 compressed between an adjustable retainer washer 38 threadedly engaging the link 33 and a stationary guide member 133, tends to prevent the bellows from contracting and moving the link 33 downwardly in driving relation with its associated latch arm 31. Similarly, the link 34 has its upper end anchored and sealed to the movable upper end of a second bellows element 45 whose lower end is sealed to the open end of an adjacent cup-shaped container 145 which is likewise fixedly mounted on the housing 23. Yieldable biasing means in the form of a coil spring 39 compressed between the movable upper end of this bellows element and an adjustable retainer nut 40 threadably mounted in the housing 23 tends to expand the bellows element 45 and move the link 34 upwardly in driving relation with its associated latch arm 32.

The interior of the container surrounding the bellows element 36 is filled with a fluid under sub-atmospheric pressure having a high rate of thermal expansion and is connected by a tube 47 also containing such fluid whose opposite end terminates in a bulb 46 which as best shown in Figure 4 is located in a coolant conduit 41 extending through the exhaust gas duct 7. The conduit 41 is connected at its opposite ends by a pipe 43 leading from the water outlet end 44 of the engine cylinder head and by a pipe 42 leading to the inlet side of the coolant pump housing 9. Since coolant is circulated at all times through the conduit 41 during engine operation the bulb is prevented from being overheated by the exhaust gases flowing over the external surface of the conduit 41. In the event, however, that a failure of the coolant circulation system occurs, the coolant within the conduit 41 becomes rapidly overheated and in turn raises the temperature of the thermally expansive fluid in the bulb 46 with the result that the consequent increase in pressure of the fluid within the container 35 forces the bellows 36 to contract in opposition to the spring 37 and actuate the arm 31 of the latch 27 by means of the link 33 to ro-

tate the latch clockwise and disengage the valve control lever 24.

The container 145 is supplied with engine oil through a passageway from the pressure side of the engine lubricating system. This passageway includes the pipe 16 (Figure 1), connecting passages 51 and 52 (Figure 2) in the blower housing, and an external pipe 53 leading from the latter passage to the bellows 45. An engine driven shaft 54 which may be a driving or driven shaft associated with the engine blower or any other engine driven accessory is provided with an external groove 56 by which the oil in the passage 51 is transferred to the passage 52. During normal operation of the engine lubricating system the oil within the pipe 53 is at sufficient pressure to maintain the bellows 45 contracted with the result that its latch actuating link 34 is prevented from being moved upwardly by its spring 39 to rotate the latch to its disengaged position. However, upon a failure of the engine oil pump to maintain its predetermined pressure in the pipe 53 the bellows 45 expands under the biasing force of the spring 39 which raises the link 34 and actuates the latch to its released position.

As shown in Figure 2, the shaft 54 is provided with an axial passage 57 which is in communication with the groove 56 through one or more radial ports 58. Spaced longitudinally of the shaft 54 from the ports 58 are additional transverse ports 59 which connect the internal passage 57 with an annular groove 61 formed in the bore of a sleeve 62 which is fixed to rotate with the shaft 54 and has one or more centrifugal weights 63 pivoted thereto at 64. Arms 66 on these weights are arranged to shift the slide valve 67 mounted on the sleeve. The slide valve 67 normally forms a closure for one or more transverse ports 68 extending through the wall of the sleeve from its annular groove 61, and biasing means in the form of a compression spring 69 is shown which tends to maintain the slide valve in closed position with respect to the ports 68 in opposition to the thrust imposed on this slide valve by the outward swinging of the weights during engine operation. The internal passage 57 is shown closed by a plug 71, and the sleeve 62 is located longitudinally of the shaft between a shoulder 72 on the latter and a retaining nut 73 threadedly engaging the end of the shaft. At the opposite end of the compression spring 69 from the slide valve 67 is a retainer washer 74. A nut 76 threaded on the sleeve periphery forms an adjustable abutment for the retainer washer 74. This nut 76 maintains the compression spring under sufficient compression to prevent the weight from shifting the slide valve a sufficient distance to uncover the pressure escape ports 68 when the engine is operating within its normal speed range. Under excessive engine speed conditions, however, the compression spring sufficiently collapses under the force applied by these weights to effect uncovering of the escape ports 68 with the result that the oil pressure in the passage 52, pipe 53 and bellows 45 is relieved, and the latch 27 is disengaged from the valve controlled lever 24, irrespective of the fact that the engine oil pressure lubricating system may be functioning properly.

Upon the latch 27 being disengaged from the lever 24, either by reason of the contraction of the bellows 36 in response to failure of the coolant system or by reason of the expansion of the bellows 45 in response to reduced oil pressure supplied to it from the engine lubricating system, the torsion spring 26 rotates this lever 24, shaft 22 and air valve 21 in their counterclockwise direction to stop the flow of air to the engine blower. The engine will automatically then come to a stop, and before it may be restarted the lever 24 must be returned to its initial position shown and held in such position until the engine oil pressure within the pipe 53 and the coolant temperature in the conduit 41 return to normal. Because of the fact that the coolant conduit 41 is in direct heat conductive relation with the engine exhaust gases, and since the oil pressure in the pipe 53 is normally sensitive to the engine oil pump delivered pressure, the latch actuating links 33 and 34 will promptly return to their normal position shown after the engine commences firing and the latch 27 will automatically re-engage the lever pin 29 to maintain the air valve 21 open.

Referring to Figure 1, there is shown a lever actuating rod 81 having at one end a lost-motion connection indicated at 82 with the lever 24 and provided at its opposite end a handle portion 83 which is accessible for manual operation at one end of the engine. In order that this same operating handle and control rod 81 may be employed to control the engine starter 17 the latter is provided with a controller indicated at 84 (Figure 2) in the form of a button for the starter switch 86. The lever 24 is provided with a surface 87 which is directly opposite the button 84 and spaced slightly therefrom when the lever is in its normal position corresponding to the open position of the air valve 21. Upon movement of the lever 24 in the re-setting direction (clockwise, as in Figure 2) to a position slightly beyond the full open position of the valve 21 this surface 87 on the lever engages and moves the starter switch button 84 inwardly to its starter operating position. After the engine commences firing, the handle 83 may be allowed to return a sufficient distance to effect its disengagement with the starter button, and after it is determined that the latch 27 is engaged the handle may then be fully released, completing the engine start.

While the invention has been described and shown with reference to a particular engine installation it will be understood that this was done for purposes of illustration only, and that various changes and modifications may be made therein without departing from the scope of the invention which is defined as follows.

We claim:

1. In an internal combustion engine having an engine combustion air supply duct, an engine exhaust gas delivery duct, an engine oil pressure lubricating system and an engine coolant distribution system, a valve in said air supply duct normally stopping the flow of air therethrough but movable to an open position permitting such flow, a member movable with said valve, a latch engageable with said member to hold said member in its valve open position and movable into and out of latchable relation with said member, latch actuating means operative to move said latch out of latchable relation with said member, biasing means yieldably opposing said latch actuating means, said latch actuating means including a pressure responsive means and a temperature responsive means, oil passage means for conducting oil to said pressure responsive means from the engine oil pressure lubrication system, said passage means having a pressure relieving opening, a closure for said opening, yieldable means biasing said closure to its closed position, and means operable in response to excess engine speed for opening said closure, said temperature responsive means including a body of thermally-expansive fluid, a second member confining said body, a third member through which coolant passes during normal operation of said coolant distribution system, said second member being in direct heat conducting relation with the coolant in said third member, one of said second and third members being in direct heat conducting relation with the engine exhaust gases in said exhaust gas duct.

2. The combination with an internal combustion engine having a combustion air supply inlet, an exhaust gas outlet, an oil pressure lubricating system, a coolant circulating system and an engine starter controller having a normally inoperative position but movable therefrom to a starter operating position, of a protective device for automatically stopping the engine upon the occurrence of insufficient lubricating oil pressure, interruption of the coolant circulation or excessive engine speed, said device including a valve controlling the air supply inlet, a member connected to the valve and movable therewith in opposite directions from a position cor-

responding to the open position of said valve, biasing means urging said member in one direction to effect closing of said valve, said member having a portion arranged to engage and move said starter controller upon movement of said member in the other direction from its valve open position, a latch operative to releasably engage and hold said member in its valve open position, yieldable means biasing said latch to its member engageable position, latch releasing means including respective thermally responsive and pressure responsive members each having a one-way actuating connection with the latch, biasing means yieldably opposing latch actuating movements of said responsive members, a passage for conducting engine oil under pressure from the engine lubricating system to said pressure responsive member, means for relieving oil pressure in said passage including an oil escape port in said passage ahead of said pressure responsive member, a closure for said port, means biasing said closure to its port closing position and an engine speed responsive governor operatively connected to said closure for moving said closure to its port open position upon the occurrence of excessive engine speed, a conduit through which coolant passes during normal operation of said coolant circulating system, said conduit being in direct heat conducting relation with the exhaust gases in said exhaust outlet, said thermally responsive member having an operating element in substantially direct heat conductive relation with the conduit.

3. In a protective device for an engine having a coolant circulation system, a valve closable to choke off engine combustion supporting air, a conduit through which coolant passes during normal operation of said coolant circulation system, said conduit having its exterior surfaces in direct heat conductive relation with the engine exhaust gases, a thermostat directly sensitive to the temperature of the coolant in said conduit, and a member rendered operable by said thermostat upon a predetermined increase in said temperature to close said valve.

4. In an engine protective device, an operable and closable valve controlling the supply of combustion supporting air to the engine, a member resiliently biasing said valve to its closed position cutting off the supply of combustion supporting air, means releasably engageable with said valve when in its open position to hold said valve open against the biasing force of said first member, a member resiliently opposing the release of said valve by said means, an engine coolant circulating system including a conduit externally heated by the engine exhaust gases and through which coolant is normally passed during engine operation, and means containing a body of thermally expansive fluid including a bulb submerged in the coolant within said conduit and a bellows expandible by said fluid to releasably operate said first named means.

5. In a device for protecting an engine having a pressure lubricating system and a coolant circulating system against continued operation after failure of either of said systems, a normally closed valve operable in its closed position to choke off the delivery of combustion supporting air to the engine, valve engageable means for releasably holding the valve open during normal engine operation, a conduit through which coolant is normally conducted by the engine coolant circulating system, said conduit being externally exposed to the engine exhaust gases, thermally responsive means submerged in the coolant within said conduit and operative to release said valve engageable means from the valve upon the occurrence of a predetermined temperature rise in the coolant within said conduit, a resilient member operative to release said valve engageable means from the valve upon a predetermined decrease in engine lubricating pressure, and engine lubricating pressure responsive means including a member normally restraining said resilient member from operating to release said valve engageable means.

6. In a protective device for an engine having a coolant distribution system including a conduit through which coolant passes during normal operation of said system, a thermostat, a valve controlling the delivery of combustion supporting air to the engine and a member operable by said thermostat in response to a predetermined increase in engine coolant temperature to move said valve in a closing direction, said thermostat and the coolant in said conduit being in direct series heat conducting relation with each other, one of said thermostat and said conduit being in direct heat conducting relation with the engine exhaust gases.

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