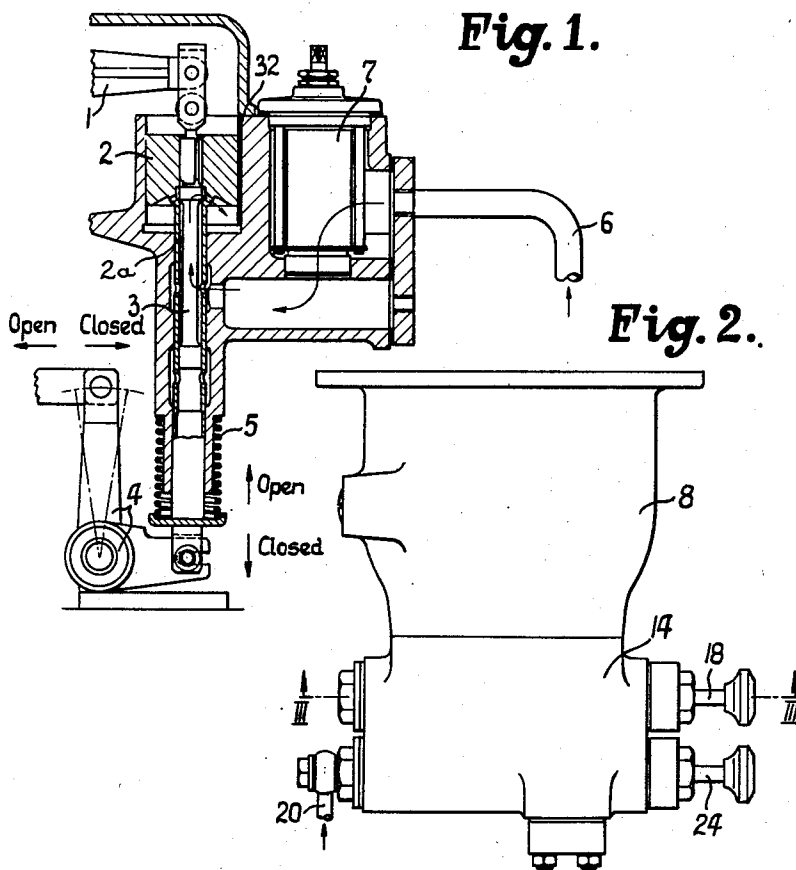
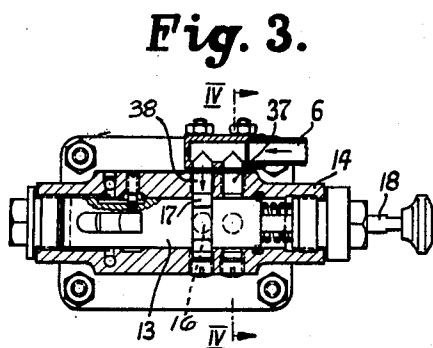
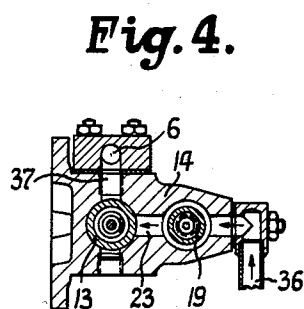


M. HOFER

AUTOMATIC CUT-OFF DEVICE

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MAX HOFER

ATTORNEYS

June 24, 1958

M. HOFER

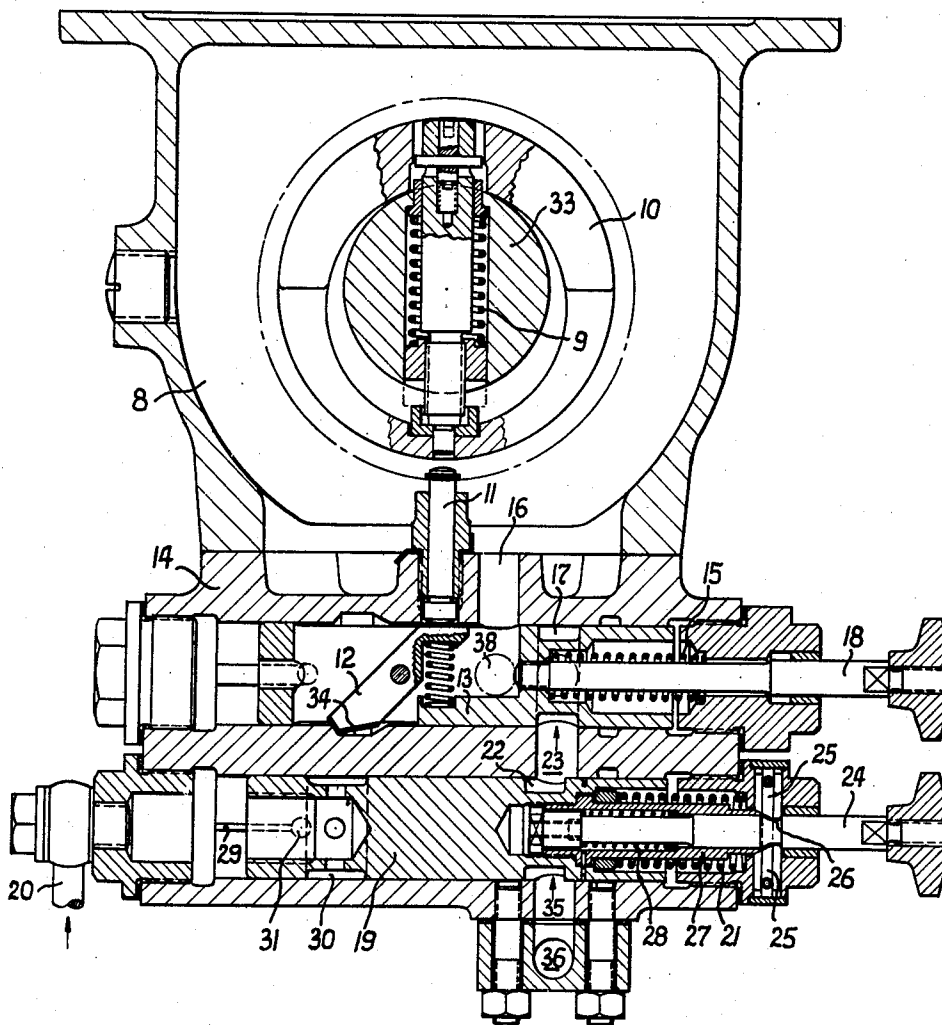
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Fig. 5.



INVENTOR
MAX HOFER

BY *Marchal, Biebel, French & Bugg*

ATTORNEYS

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AUTOMATIC CUT-OFF DEVICE

Max Hofer, Augsburg, Germany, assignor to Maschinenfabrik Augsburg-Nürnberg A. G., Augsburg, Germany, a corporation of Germany

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8 Claims. (Cl. 123—97)

This invention relates to automatic cut-off devices and more particularly to such devices for automatically stopping internal combustion engines upon the occurrence of excessive speed or deficient lubricating oil pressure.

In the operation of internal combustion engines it may be desired to incorporate in the engine controls a device or devices for automatically stopping the engine in cases of unsafe conditions of operation. Particularly it may be desired to have such a cut-off device for stopping the engine in the event that the engine turns up an excessive number of R. P. M. and/or in the event that the lubricating oil pressure falls below safely operating levels. Since such unsafe operating conditions usually result from some abnormal condition or breakdown, it may be desired to have such cut-off devices completely automatic and yet of such simplified and foolproof construction as to be readily operable by the usual unskilled personnel without special training.

Furthermore, with a cut-off for stopping the engine when an excessive number of R. P. M. is developed, the stopping action may advantageously be sudden or substantially instantaneous; whereas, with a device for stopping the engine in the event of lowered oil pressure, the cut-off may advantageously operate more slowly to give time, for example, for the operator to recognize the difficulty in oil pressure and have an opportunity to correct it without actually bringing the engine to a complete stop.

According to this invention, such an automatic cut-off device is provided to operate on, for example, a fuel control throttle through a hydraulic servomotor so that, upon the engine exceeding a predetermined number of R. P. M. and/or the lubricating oil pressure dropping below a predetermined level, the flow of hydraulic fluid to the servomotor is automatically interrupted causing the servomotor to close the fuel throttle and cut off further supply fuel to the engine. Furthermore, the device according to this invention provides for a sudden or substantially instantaneous closing of the throttle upon an excessively high number of R. P. M. and a more gradual closing of the throttle upon dropping of the lubricating oil pressure below the predetermined level.

It is, accordingly, a principal object of this invention to provide a cut-off device of the character described for interrupting, through a servomotor, fuel feed to an internal combustion engine upon dropping of the lubricating oil pressure therein and/or upon the occurrence of an excessive number of R. P. M.

A further object of this invention is to provide in a cut-off device of the character described a governing member responsive to the engine speed for stopping the engine through a hydraulic servomotor when a predetermined number of R. P. M. is reached.

Another object of this invention is to provide in a cut-off device of the character described automatic means responsive to the lubricating oil pressure in the engine for stopping the engine through a hydraulic servomotor when a predetermined low lubricating oil pressure is reached.

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Still another object of this invention is to provide a combined automatic cut-off device of the character described having independently acting speed-responsive and oil-pressure-responsive devices for automatically cutting off fuel feed to the engine through a hydraulically actuated servomotor control when either an excessive speed condition or a deficient oil pressure condition obtains during the engine operation.

Still another object of this invention is to provide in such an automatic cut-off device means for resetting the device after actuation thereof.

A still further object of this invention is to provide in such an automatic cut-off device a substantially instantaneous speed-responsive member for effecting sudden or substantially instantaneous actuation of a feed control servomotor.

Still another object of this invention is to provide in such an automatic cut-off device an oil-pressure-responsive member effective for gradually actuating a fuel control servomotor.

A still further object of this invention is to provide an automatic cut-off device of the character described of simple and economic construction and dependable automatic operation yet without electrical or mechanical complexity as would require greater skill or training than normally obtains with operators of the engine to which it is applied.

Other objects and advantages will be apparent from the following description, the attached drawings and the appended claims.

In the drawing,

Fig. 1 is a vertical section through a fuel control servomotor of an engine embodying this invention;

Fig. 2 is a plan view of the speed-responsive and oil-pressure-responsive cut-off means;

Fig. 3 is a section along the lines III—III of Fig. 2;

Fig. 4 is a section along the lines IV—IV of Fig. 3; and

Fig. 5 is a vertical section through the device of Fig. 2. Referring to the drawings, in which like reference numerals denote like parts throughout the several views, Fig. 1 indicates a hydraulically actuated fuel control servomotor for controlling fuel feed to an internal combustion engine having the invention applied thereto. The servomotor comprises a power piston 2 connected through a lever 1 to an engine speed regulator (not shown) and to a slide valve 3 which controls the admission of hydraulic fluid to operate the piston 2. The hollow piston shaft 2a surrounds the slide valve 3 and is connected through a linkage 4 to the regulating rods or fuel feed throttle for the engine. A spring 5 urges piston 2 and slide valve 3 downwardly in the drawing against the action of hydraulic fluid supplied beneath piston 2 from conduit 6 through an oil filter 7, as indicated by the arrows in Fig. 1.

Thus, hydraulic fluid under pressure working against the bottom of piston 2 tends to raise the piston against the action of spring 5 and to move the fuel feed throttle into "open" position through the linkage 4; whereas a stoppage or decrease in pressure of the hydraulic fluid supplied beneath piston 2 allows the spring 5 to force the piston downwardly in Fig. 1 and move the feed fuel throttle to "closed" position through the linkage 4.

In the operation of the automatic cut-off device, however, the rapidity or suddenness with which piston 2 and the linkage 4 is moved to "closed" position depends on, among other things, the rapidity with which the hydraulic fluid can be discharged from beneath piston 2. Accordingly, for rapid operation of the cut-off device, as in the case where the engine is attaining an excessively high speed, a large discharge area for the hydraulic pressure beneath piston 2 is preferred. For more gradual opera-

tion of the device in the event of falling lubricating oil pressure, however, a smaller discharge area for the hydraulic fluid from beneath piston 2 is satisfactory.

In the illustrated embodiment of this invention, both the speed-responsive and oil-pressure-responsive devices are combined as indicated in Fig. 2 and interposed between the servomotor and the source of hydraulic pressure therefor to interrupt or control the flow of hydraulic fluid through conduit 6 to the servomotor. As indicated in more detail in Fig. 5, the speed-responsive cut-off comprises a speed-responsive governor 8 and piston 13, while the oil-pressure-responsive cut-off comprises the piston 19, both pistons being mounted in series in the line of flow of hydraulic fluid toward the servomotor through conduit 6.

Referring in detail to Fig. 5, the automatic excessive speed cut-off includes a quick acting speed-responsive device 8 and a control piston 13 mounted in a housing 14. The speed-responsive member comprises an eccentric ring 10 mounted around a shaft 33 which revolves with the engine crankshaft (not shown). Eccentric ring 10 is maintained concentrically about the axis of shaft 33 under the action of a spring 9. During rotation of shaft 33, centrifugal force tends to urge the heavy side of eccentric ring 10 radially outwardly from shaft 33 against the action of spring 9. Thus, the out-of-balance weight of eccentric ring 10 is correlated with the strength of counteracting spring 9 so that, upon attaining a predetermined number of R. P. M., eccentric ring 10 will be thrown radially outwardly from the axis of shaft 33 sufficiently to engage pin 11 and, by means of pin 11, to release pawl 12 pivoted in control piston 13.

Thus, during normal operation of the engine at speeds less than the predetermined number of R. P. M. above which pawl 12 will be disengaged as above noted, pawl 12 engages stop 34 in housing 14 and holds piston 13 toward the right in Fig. 5 in such position that hydraulic fluid for actuating piston 2 of the servomotor has free passage from the supply of fluid under pressure (not shown) into housing 14 at 36 through passages 35 and 23, around piston 13 via a circumferential valve groove 17 therein, and out of housing 14 via passage 37 which communicates directly to conduit 6 leading the hydraulic fluid to the servomotor. That is, as long as pawl 12 remains engaged against stop 34 in housing 14 maintaining the piston 13 to the right in the drawing as shown in Fig. 5, hydraulic fluid has free passage through piston 13 and conduit 6 to the servomotor to maintain piston 2 thereof in raised position and the fuel throttle "open." When, on the other hand, shaft 33 exceeds the predetermined number of R. P. M., the out-of-balance weight of eccentric ring 10 will overcome the force of spring 9, move radially outward from the axis of 33, strike pin 11 and disengage pawl 12 from stop 34. Upon such disengagement of pawl 12, piston 13 is forced to the left in the drawing by the action of spring 15 thereby moving the valve groove 17 out of alignment with passages 23 and 37 and interrupting the flow of hydraulic fluid therethrough to conduit 6 and the servomotor.

In addition, in the furthest left position of piston 13, as indicated in Fig. 3, the valve groove 17 moves into alignment with passage 16, communicating with conduit 6, and a passage indicated at 38 leading to the hydraulic fluid reservoir. Thus, in the furthest left position of the piston 13, not only is the passage of further hydraulic fluid into conduit 6 interrupted, but the free back flow of hydraulic fluid out of conduit 6 through passages 16 and 38 is assured, thereby almost instantaneously relieving substantially all the pressure beneath piston 2 in the servomotor and permitting spring 5 to move piston 2 rapidly downwardly to close the fuel throttle almost instantaneously. Thus, in the case where the engine may exceed the predetermined number of revolutions for which the speed responsive member 8 is set, disengagement of pawl 12 and movement of piston 13 to the left in the drawing not only cuts off further admission of hydraulic fluid to the

piston 2 of the servomotor but also provides for rapid and substantially instantaneous discharge of hydraulic fluid from under piston 2 to effect virtually immediate closing of the fuel throttle linkage 4 by the spring 5 of the servomotor.

In order to reset the speed-responsive cut-off device for continued operation, a pull knob arrangement 18 is provided on piston 13 whereby the piston can be manually moved to the right against the action of spring 15 until pawl 12 once again engages stop 34 and maintains the piston 13 in the right-hand position until the eccentric ring 10 again dislodges the pawl 12 through pin 11. In this right-hand position, as above noted, the hydraulic fluid for the servomotor has free access to conduit 6 thereof through passages 23, 37 and valve groove 17.

Illustrative of the oil-pressure-responsive cut-off device of this embodiment, a control piston 19 is also mounted in housing 14 for free lateral movement therein. A sampling line 20 supplies against the left end of piston 19 oil pressure taken from the engine bearing lubrication system. During normal operation of the engine, this oil pressure acts against the left end of piston 19 urging it to the right in housing 14 against the action of spring 21. The strength of spring 21 is correlated with the predetermined minimum oil pressure desired so that, when less than this predetermined pressure is delivered against piston 19 through the sampling line 20, spring 21 will shift piston 19 to the left sufficiently to interrupt the flow of hydraulic fluid through passages 36, 35 and 23, thereby cutting off further supply of hydraulic pressure under piston 2 of the servomotor.

Since a sudden or instantaneous cut-off of the engine fuel feed may not be desired with a drop in lubricating oil pressure, it is not necessary with the actuation of the oil-pressure-responsive device to have the rapid discharge of hydraulic fluid from beneath the servomotor piston 2 as was described in connection with the speed-responsive cut-off piston 13. Accordingly, a bleed-off groove 32, of substantially less capacity than conduit 6, is provided adjacent piston 2 in the servomotor so that, with the closing by piston 19 (i. e., moving to the left in Fig. 5) of the passages 36, 35, 23, and 37 to conduit 6, the hydraulic fluid under piston 2 is gradually bled off through groove 32 as spring 5 gradually forces piston 2 and slide valve 3 downwardly in Fig. 1 to close the fuel throttle linkage 4 gradually.

In order to set the oil-pressure-responsive piston 19 to operative position, a pull knob and shaft 24 is mounted in piston 19. The piston is manually moved to the right in the drawing sufficiently for the two arresting pins 25 to snap into appropriate notches 26 on the pull knob shaft 24. In this position, the valve groove 22 in piston 19 is at least partially aligned with passages 35, 23, etc., to provide passage of hydraulic fluid from 36 through the control device to conduit 6 leading to servomotor. As the engine runs and lubricating oil pressure builds up the sampling line 20, piston 19 is moved still further to the right under the effect of increasing oil pressure acting against spring 21 until such time as the arresting pins 25 are pressed radially outwardly out of engagement with the notches 26 by the action of shell 27 mounted in piston 19 around shaft 24.

Upon release of the arresting pins 25, pull knob shaft 24 (but not piston 19) is forced to the left within piston 19 by the action of spring 28 so that the notches 26 are to the left of and out of engagement with arresting pins 25. Thus, piston 19 is free to move throughout its extent of lateral displacement under the counteracting forces of the lubricating oil pressure admitted into housing 14 by the sampling line 20 and the action of spring 21.

Housing 14 also includes a discharge groove 29 through which oil may be constantly bled off to achieve freer movement of piston 19 in response to the opposed forces of the oil pressure admitted at 20 and the spring 21. To

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the extent that the force of spring 21, correlated with the minimum oil pressure desired, overbalances the oil pressure delivered to piston 19, piston 19 is moved to the left, with accumulated oil being bled off over the groove 30, through the passage 31.

It will thus be noted that an automatic cut-off device is developed according to this invention providing for a sudden or virtually instantaneous cut-off of engine fuel feed when an excessive speed occurs and, also, a more gradual reduction in fuel feed upon the dropping of lubricating oil pressure below a predetermined value. The device, after operation, may be manually set or reset quite simply, and does not require a skilled operator as with electrical and other automatic cut-off devices yet is positive, automatic and dependable of operation whenever the engine is running. Also, although the speed-responsive and oil-pressure-responsive cut-off members are described as being sequentially mounted and operated in the hydraulic fluid supply line to the servomotor, the two devices act independently of each other to the extent that each will function to stop the engine upon the happening of the particular abnormal operating condition for which it is designed. As will be understood, either device singly could be incorporated separately in an engine embodying this invention notwithstanding that, when arranged in sequential or interdependent manner as illustrated, the operation of either device precludes or affects operation of the other.

While the forms of apparatus hereing described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In an automatic cutoff device of the character described for stopping an internal combustion engine at a predetermined number of R. P. M. and a predetermined minimum lubricating oil pressure which comprises in combination a hydraulically actuated servomotor for controlling fuel feed to said engine in accordance with the supply of hydraulic fluid to said servomotor, means responsive to the speed of said engine for interrupting said supply of said hydraulic fluid to said servomotor at said predetermined number of R. P. M., discharge means for rapidly withdrawing from said servomotor upon the operation of said speed responsive means hydraulic fluid supplied to said servomotor effecting rapid interruption of fuel feed to said engine, oil pressure responsive means for interrupting said supply of hydraulic fluid to said servomotor at said predetermined lubricating oil pressure, and means for bleeding off from said servomotor hydraulic fluid supplied thereto, said means for bleeding off having substantially less capacity than said means for withdrawing hydraulic fluid effecting more gradual operation of said servomotor in response to said oil pressure responsive means than in response to said speed responsive means.

2. In a self-actuating cutoff device for automatically stopping an internal combustion engine having a hydraulically actuated servomotor control for the fuel feed thereof, the combination which comprises a spring loaded slide valve for interrupting flow of hydraulic fluid to said servomotor, releasable locking means for maintaining said slide valve in open position against said spring loading, means responsive to the speed of said engine for automatically releasing said releasable locking means at a predetermined number of R. P. M., rapid discharge means for suddenly withdrawing said hydraulic fluid from said servomotor in the closed position of said slide valve, piston valve means responsive to the lubricating oil pressure in said engine for interrupting said supply of hydraulic fluid to said servomotor and said slide valve at a predetermined lubricating oil pressure, and bleed-off means for relieving the hydraulic

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pressure in said servomotor in the closed position of said piston valve.

3. In a self-actuating cutoff device for automatically stopping an internal combustion engine having a hydraulically actuated servomotor control for the fuel feed thereof, the combination which comprises a spring loaded slide valve for interrupting flow of hydraulic fluid to said servomotor, releasable locking means for maintaining said slide valve in open position against said spring loading, means responsive to the speed of said engine for automatically releasing said releasable locking means at a predetermined number of R. P. M., rapid discharge means for suddenly withdrawing said hydraulic fluid from said servomotor in the closed position of said slide valve, piston valve means responsive to the lubricating oil pressure in said engine for interrupting said supply of hydraulic fluid to said servomotor at a predetermined lubricating oil pressure, and bleed-off means for relieving the hydraulic pressure in said servomotor in the closed position of said piston valve, said bleed-off means having substantially less capacity than said rapid discharge means.

4. In a self-actuating cutoff device for automatically stopping an internal combustion engine having a hydraulically actuated servomotor control for the fuel feed thereof, the combination which comprises piston valve means responsive to the lubricating oil pressure in said engine for interrupting said supply of hydraulic fluid to said servomotor at a predetermined lubricating oil pressure, spring means urging said piston valve against said oil pressure, bleed-off means for relieving the hydraulic pressure in said servomotor in the closed position of said piston valve, releasable locking means for holding said piston valve into open position before operating oil pressure is reached during start-up of said engine, and means for automatically releasing said locking means when said operating oil pressure is reached in said engine.

5. In an automatic cutoff device of the character described for stopping an internal combustion engine at a predetermined number of R. P. M. and a predetermined minimum lubricating oil pressure which comprises in combination a hydraulically actuated servomotor for controlling fuel feed to said engine in accordance with the supply of hydraulic fluid to said servomotor, means for interrupting said fuel feed when the supply of said hydraulic fluid to said servomotor is interrupted, means responsive to the speed of said engine for interrupting said supply of said hydraulic fluid to said servomotor at said predetermined number of R. P. M., discharge means for rapidly withdrawing from said servomotor upon the operation of said speed responsive means hydraulic fluid supplied to said servomotor, oil pressure responsive means for interrupting said supply of hydraulic fluid to said servomotor at said predetermined lubricating oil pressure, means for bleeding off from said servomotor hydraulic fluid supplied thereto, said means for bleeding off having substantially less capacity than said means for withdrawing hydraulic fluid effecting more gradual operation of said servomotor in response to said oil pressure responsive means than in response to said speed responsive means, and resetting means for releasably maintaining said speed responsive and oil pressure responsive means in open operating position.

6. In an internal combustion engine having a hydraulically actuated servomotor for continuously regulating and controlling fuel feed to the said engine, an automatic cutoff device for stopping said engine at a predetermined number of R. P. M. and a predetermined minimum lubricating oil pressure which comprises in combination means for supplying hydraulic fluid to said servomotor for the continued operation thereof to control said fuel feed to said engine, means responsive to the speed of said engine and interposed in said hydraulic fluid supply means for interrupting supply of hydraulic fluid to said servomotor at said predetermined number of R. P. M., discharge means for rapidly withdrawing hydraulic fluid from said

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servomotor upon operation of said speed responsive means effecting substantially immediate action by said servomotor to interrupt fuel feed to said engine, and oil pressure responsive means interposed in said hydraulic fluid supply means for interrupting said supply of hydraulic fluid to said servomotor at said predetermined minimum lubricating oil pressure effecting gradual operation of said servomotor to reduce fuel feed to said engine.

7. A safety cutoff device of the character described for an internal combustion engine having a hydraulically actuated servomotor for automatically regulating fuel feed to said engine comprising in combination means for supplying hydraulic fluid to said servomotor, first cutoff means interposed in said hydraulic fluid supply means and responsive to the speed of said engine for interrupting supply of hydraulic fluid to said servomotor at a predetermined maximum engine speed and independently of the normal automatic operation of said servomotor, rapid discharge means for rapidly withdrawing from said servomotor upon operation of said first cutoff means hydraulic fluid supplied thereto effecting substantially immediate actuation thereof to interrupt fuel feed to said engine, second cutoff means interposed in said hydraulic fluid supply means and responsive to lubricating oil pressure in said engine for interrupting supply of hydraulic fluid to said servomotor at a predetermined minimum lubricating oil pressure and independently of the normal automatic operation of said servomotor, and slow discharge means for bleeding off upon operation of said second cutoff means fluid supplied to said servomotor at a rate substantially less than said rapid discharge means effecting gradual operation of said servomotor to reduce fuel feed to said engine.

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8. In an internal combustion engine having a hydraulically actuated servomotor for automatically and continuously regulating fuel feed to said engine during normal operation thereof, a safety cutoff device independent of said automatic regulation by said servomotor which comprises in combination cutoff means for interrupting further supply of hydraulic fluid to said servomotor effecting interruption of said automatic regulation of said fuel feed by said servomotor, means responsive to the lubricating oil pressure in said engine effecting operation of said cutoff device at a predetermined minimum lubricating oil pressure, releasable means for maintaining said cutoff means in inoperative position prior to starting said engine, and bleed-off means for gradually withdrawing from said servomotor hydraulic fluid supplied thereto prior to operation of said cutoff means effecting gradual operation of said servomotor to reduce fuel feed to said engine after lubricating oil pressure thereof falls below said predetermined minimum pressure.

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