

[54] THREE POSITION SOLENOID IDLE STOP

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[22] Filed: May 24, 1972

[21] Appl. No.: 256,376

[52] U.S. Cl. 74/860, 60/6, 74/526,
251/285, 335/259, 335/267

[51] Int. Cl. B60k 21/00, H02k 33/00, B60k 33/00

[58] Field of Search 310/14; 335/258,
335/259, 267, 268; 251/285; 91/167 R; 60/6;
74/526, 860

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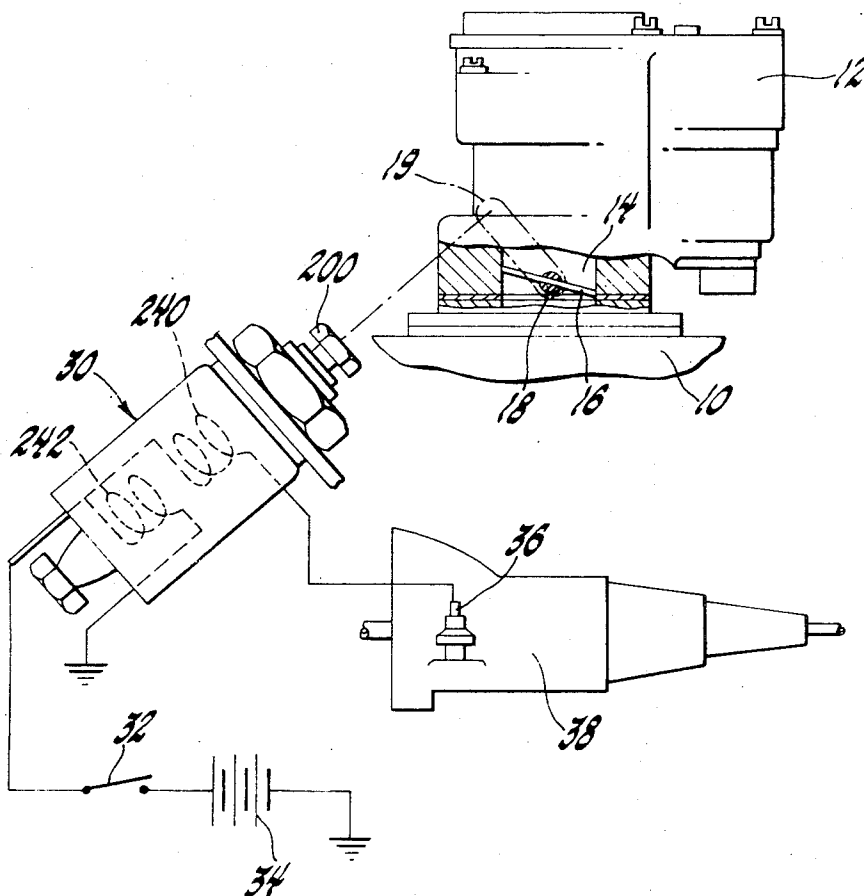
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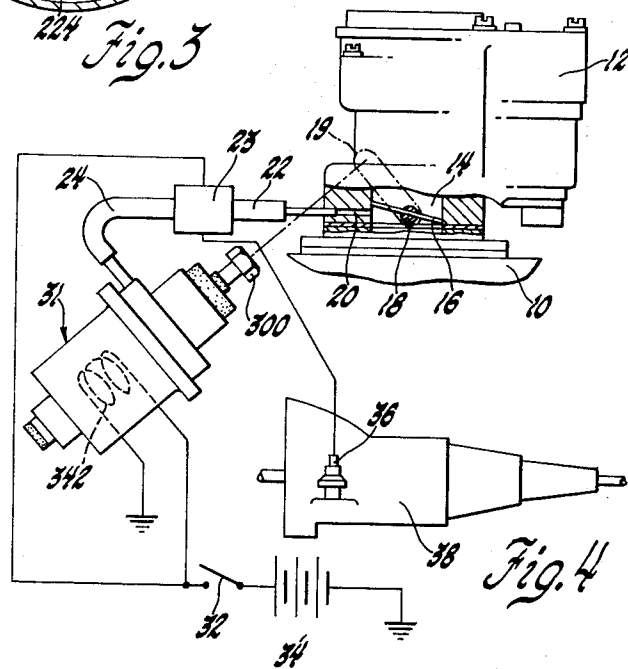
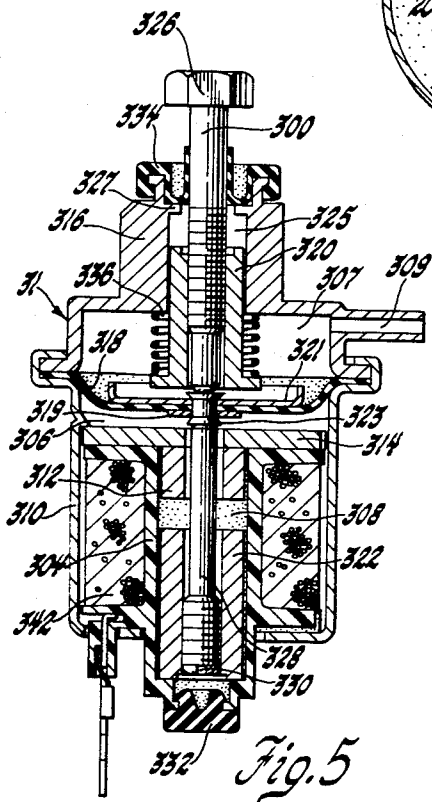
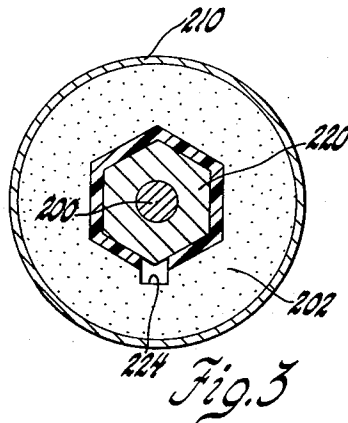
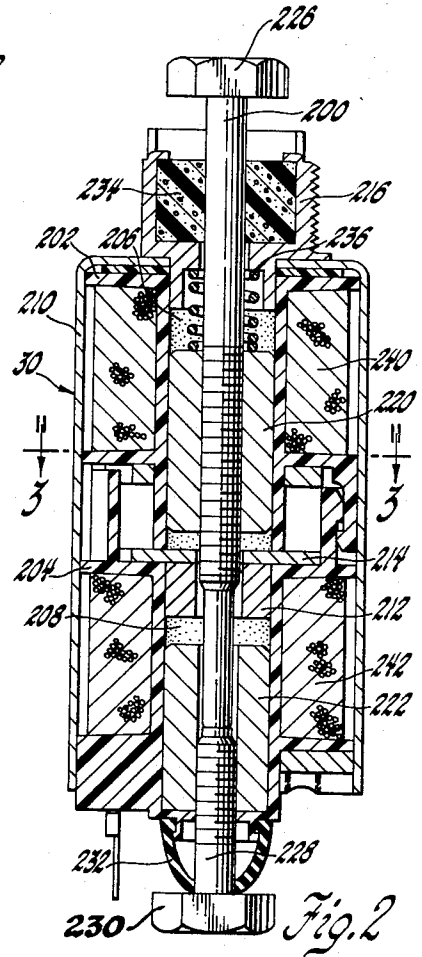
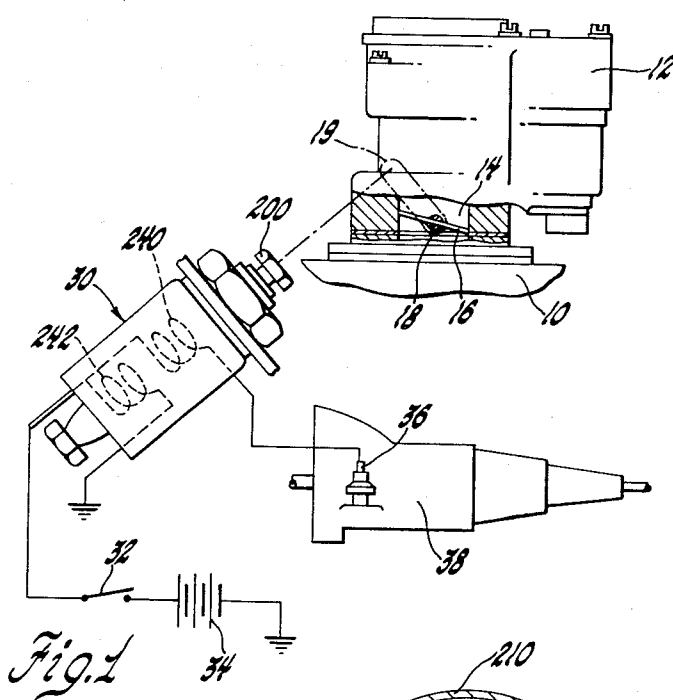
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ABSTRACT

A three position solenoid or vacuum actuated throttle stop device having independent adjustment of two positions, allowing independent adjustment of the third position and comprising first and second axially aligned actuators, each of which carries a bolt-shaped axially aligned extension which is axially adjustable with respect to its actuator. The second extension is the throttle stop which is normally biased by a spring against the first extension and into a first position which allows the throttle idle position to be set independently by external means. A first signal causes the first actuator to move the throttle stop against the spring into a second independently adjustable position; and a second signal causes the second actuator to move the throttle stop out of engagement with the first extension into a third independently adjustable position.

4 Claims, 5 Drawing Figures





THREE POSITION SOLENOID IDLE STOP

SUMMARY OF THE INVENTION

It is known that the emission of undesirable engine exhaust gas constituents from an internal combustion engine can be decreased by an increase in idle air flow to improve combustion under high speed closed throttle decelerating conditions. It is also known that a decrease in closed throttle air flow will prevent the after-run or dieseling exhibited by some internal combustion engines after the engine ignition system is shut off.

Both of these objectives can be accomplished by a three position idle stop device which controls the limit of throttle closure under different conditions. This device allows substantially full closure of the throttle when the engine ignition system is deenergized to prevent dieseling. Upon energization of the engine ignition system, the device prevents closure of the throttle beyond "curb idle" position for normal engine operation. When the transmission used with the engine is in its highest gear, the device prevents the throttle from closing past a "fast idle" position. Such a device is shown in my application for U.S. Pat., Ser. No. 170,772 filed Aug. 11, 1971.

To be most useful, the device should allow adjustment of each of the three idle stop positions; moreover, it is best if each of the three throttle stop positions can be adjusted independently, without affecting either of the other two. The device of Ser. No. 170,772 cited as an example allows adjustment of the three idle stop positions, but not independent adjustment. In that device, adjustment of the intermediate idle stop position also changes the fast idle stop position.

This invention, therefore, comprises a three-position idle stop device which provides substantially full closure of the throttle when the engine ignition system is deenergized, less full closure of the throttle when the engine ignition system is energized and still less full closure of the throttle when the transmission is in its highest gear; and further provides a device allowing independent adjustment for substantially full closure and having independent adjustment of the other two positions.

A more complete description of the invention is set forth in the drawings and the following description of preferred embodiments.

SUMMARY OF THE DRAWINGS

FIG. 1 shows one embodiment of the invention having two solenoid actuators;

FIG. 2 is an enlarged axial sectional view of the double solenoid actuated unit, showing the details of its construction;

FIG. 3 is a view along line 3—3 of FIG. 2;

FIG. 4 shows another embodiment of this invention having solenoid and vacuum actuators; and

FIG. 5 is an enlarged axial sectional view of the solenoid and vacuum actuated unit shown in FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, the engine 10 is illustrated as having a carburetor 12 providing an induction passage 14. Induction passage 14 contains a throttle 16 rotatably disposed on a shaft 18 and controlled by a throttle lever 19. Actuator 30 is fixed to the engine 10 or carburetor 12 in such a way that the throttle stop 200 is en-

gageable with the throttle lever 19 to prevent closure of the throttle 16 past a position which is determined by the position of the throttle stop 200.

Referring to FIG. 2, actuator 30 includes a pair of spools 202 and 204 which form a housing defining central passages 206 and 208. Spools 202 and 204 are disposed within a case 210. One end of passage 208 is defined by spool 204 and the other end by stop member 212, which is braced against disk 214. One end of passage 206 is defined by disk 214, and the other end by stop member 216, which is fixed to spool 202 and case 210.

A reciprocating member in the form of a magnetically responsive plunger 220 is disposed within passage 204 and is reciprocable axially within that passage. An armature in the form of another magnetically responsive plunger 222 is disposed within passage 208 and is likewise axially reciprocable. As is shown in FIG. 3, passage 206 and plunger 220 are essentially hexagonal in cross-section to prevent rotation. Likewise, plunger 222 and passage 208 are also hexagonal in cross-section. FIG. 3 also shows groove 224 which runs past both plungers 220 and 222. This groove allows air movement past the plungers which helps prevent any pressure buildup within passages 206 or 208 which would interfere with the free axial movement of the plungers.

Throttle stop 200 is a bolt-shaped non-magnetically responsive brass extension which is threaded in an axially extending hole in plunger 220. It extends past the end of plunger 220 in one direction through holes in disk 214 and stop member 212 and into an axially extending hole in plunger 222, to which it is not attached. It extends past the other end of plunger 220 through a hole in the stop member 216 and out of the actuator 30, where it ends in a head 226 which is engageable with throttle lever 19 and is formed to receive a wrench so that throttle stop 200 can be axially adjusted by rotation within the plunger 220. Non-magnetically responsive bolt-shaped extension 228 is threaded into the aforementioned hole in plunger 222. One end of extension 228 extends out of the control 30 and ends in a head 230 formed to receive a wrench so that extension 228 can be axially adjusted within the plunger 222; the other end is engageable with the one end of throttle stop 200 within plunger 222. A flexible boot 232 surrounding a portion of extension 228 outside actuator 30 prevents dirt and other contaminants from entering passage 208. Likewise, a foam urethane filter 234, disposed within stop member 216 and surrounding throttle stop 200, prevents dirt and other contaminants from entering passage 206.

A spring 236, shown here between stop member 216 and plunger 220, biases throttle stop 200 away from stop member 216 into engagement with extension 228 and thus forces plunger 222 against the closed end of spool 204. The spring 236 need not be disposed within the actuator 30, but could, for example, be disposed on the carburetor 12 in such a way that its biases throttle lever 19 toward the stop 200.

A pair of solenoid coils 240 and 242 are wound around spools 202 and 204 respectively. As shown in FIG. 1, one end of each of coils 240 and 242 is connected through the engine ignition switch 32 to battery 34. The other end of coil 242 is connected to ground, and the other end of coil 240 is connected through the transmission switch 36 on transmission 38 to ground.

The transmission switch 36 is a well-known switch used on automobiles that is normally open, but closes to ground whenever the transmission 38 is in its highest gear.

In operation, assuming the vehicle on which the device is mounted to be at rest, the transmission switch 36 and the ignition switch 32 will be open; and thus neither coil 240 nor coil 242 is energized. Throttle stop 200 is engaged with extension 228 and biased in a direction away from the throttle lever 19 as far as allowed by the engagement of plunger 222 with the closed end of spool 204. This allows the throttle lever 19 to turn the throttle 16 to its closed position. If spring 236 is included within actuator 30 as shown, a separate spring, not shown, is required to act on throttle lever 19 to move throttle 16 to its closed position. If, as stated earlier, spring 236 acts directly on throttle lever 19, no other spring would be necessary. In that case, plunger 222 would not necessarily be pushed against the end of spool 204. However, in either case, the closed throttle position is defined by an adjustable stop, not shown, such as the normal carburetor idle adjustment screw, which stops throttle lever 19 in the desired position. With the throttle in the closed position, the amount of air-fuel mixture reaching the engine 10 is insufficient to allow engine run-on or dieseling.

When the ignition switch 32 is closed, coil 242 is energized by the battery 34. The magnetically responsive plunger 222 is pulled by magnetic forces against the stop member 212. Extension 228, which is engaged with throttle stop 200, moves with plunger 222 and pushes throttle stop 200 against spring 236 and toward the throttle lever 19 into its intermediate position. The throttle 16 is now prevented from closing beyond an intermediate or "curb idle" position, in which enough fuel-air mixture is admitted to engine 10 to allow engine idling. The intermediate position of throttle stop 200 is adjustable by turning the head 230 on the end of extension 228. The hexagonal plunger 222 cannot turn so throttle stop 200 moves axially through the plunger 222.

With the ignition switch 32 closed and the transmission 38 shifted into its highest gear, thus closing the transmission switch 36 to ground, the battery 34 energizes coil 240. Magnetically responsive plunger 220 is pulled by magnetic forces against stop member 216, thus moving throttle stop 200 out of engagement with extension 228 toward the throttle lever 19 into the "fast idle" position. The throttle 16 is now prevented from closing past its "fast idle" position, and a greater amount of air-fuel mixture is allowed to enter the engine to reduce undesirable emissions under closed throttle decelerating conditions. The "fast idle" position of stop 200 can be adjusted by turning the head 226 on the end of stop 200.

Particular attention to the method of adjusting the three idle positions shows why the adjustments are independent of each other. The "fast idle" position of throttle stop 200 is adjusted only by changing the axial position of the throttle stop 200 with respect to plunger 220. This can only be done by turning the throttle stop 200 within plunger 220. Likewise, the intermediate position of throttle stop 200 can be adjusted only by changing the axial position of extension 228 with respect to plunger 222, which itself can only be accomplished by turning extension 228 within plunger 222. Finally, the substantially closed position of the throttle

16 is adjusted within carburetor, which adjustment does not affect nor is affected by any movement of throttle stop 200 within plunger 220 or extension 228 within plunger 222.

FIG. 4 shows another embodiment of the invention. The engine 10, carburetor 12, induction passage 14, throttle 16, shaft 18 and throttle lever 19 are as described in FIG. 1. However, here a vacuum port 20 opens from induction passage 14 below throttle 16. Port 20 is connected through a conduit 22, an electrically operated valve 23 and a conduit 24 to the actuator 31. The electrically-operated valve 23 is electrically connected in series with the battery 34, the ignition switch 32 and transmission switch 36. Throttle stop 300 projecting from actuator 31 is engageable with the throttle lever 19 in the same way as is throttle stop 200 projecting from actuator 30 in FIG. 1.

Actuator 31 is similar to control 30 in structure and operation, but it uses a vacuum actuator rather than a second solenoid actuator to move throttle stop 300 to its "fast idle" position. This is particularly useful when greater force is required than can economically be supplied by a solenoid.

Referring to FIG. 5, a spool 304 and a stop member 312 are held rigidly within the case 310 by the disc 314. A solenoid coil 342 is wound around spool 304 and connected in series with the battery 34 and ignition switch 32. Spool 304 and stop member 312 define a central passage 308, within which is disposed a reciprocable armature in the form of a magnetically responsive plunger 322. In cross-section, plunger 322 and passage 308 are essentially hexagonal. A non-magnetically responsive bolt-shaped extension 328 is threaded in a hole that extends axially through plunger 322. One end of extension 328 bears a screwdriver slot 330 accessible from outside the control 31 so that extension 328 can be axially adjusted with respect to plunger 322. The other end of extension 328 extends through holes in the stop member 312 and disk 314 past disk 314.

Beyond disk 314, the end of the case 310 is crimped over endpiece 316. Held between the case 310 and the endpiece 316 is a circular flexible diaphragm 318 which divides the space enclosed by the case 310, disk 314 and endpiece 316 into two cavities 306 and 307. The diaphragm 318 carries washer 319 on one side and washer 321 on the other, which are fastened to the diaphragm 318 by the rivet 323. Port 309 opens cavity 307 to the conduit 24.

Part of cavity 307 is a hollow hexagonal core 325 in the endpiece 316, in which a reciprocating member in the form of a plunger 320, hexagonal in cross-section, is free to move axially. Movement of plunger 320 in the direction of the throttle lever is limited by the inner lip 327 of endpiece 316. Throttle stop 300, a bolt-shaped extension threaded through an axially extending hole in plunger 320, is engageable at one end with rivet 323 and extends in the opposite direction through a flexible sealing boot 334 out of actuator 31, where it ends in a head 326 which is formed to receive a wrench and allow adjustment of throttle stop 300 axially with respect to plunger 320. Boot 334 seals cavity 307 from outside air when vacuum is applied to the cavity and, in addition, keeps out dirt and other contaminants. At the other end of actuator 31, flexible plug 332 keeps dirt and other contaminants out of passage 308.

A spring 336 biases the plunger 320 away from the throttle lever 19. In this manner, the spring 336 biases

the throttle stop 300 into engagement with the rivet 323, the rivet 323 into engagement with extension 328 and the plunger 322 against the end of spool 304. As in the case of actuator 30, the spring 336 could act on throttle lever 19 to bias it toward the throttle stop 300 and would thus be outside of actuator 31.

Actuator 31 operates in a manner similar to that of actuator 30 in the fully closed and "curb idle" positions. With ignition switch 32 and transmission switch 36 open and electrically operated valve 23 closed, throttle stop 300 is fully biased in a direction away from the throttle lever 19. Closure of the ignition switch 32 energizes coil 342 which causes magnetically responsive plunger 322 to move against stop 312. Extension 328 thus moves throttle stop 300 into its "curb idle" position, which can be adjusted by turning extension 328 with a screwdriver or similar tool.

When the transmission 38 is in its highest gear, the transmission switch 36 closes and, if ignition switch 32 is closed, allows the battery 34 to open the electrically operated valve 23. Cavity 307 of control 31 is now open through the port 309, conduit 24, valve 23, conduit 22 and port 20 to the reduced air pressure or "vacuum" existing below the throttle 16. The reduced air pressure within the cavity 307 allows the air at atmospheric pressure within cavity 306 to push the diaphragm 318, rivet 323, plunger 320 and throttle stop 300 toward the throttle lever 19 until the plunger 320 is stopped by the inner lip 327 of endpiece 316. The throttle stop 300 is now in its "fast idle" position which can be adjusted by turning the head 326 of stop member 300 with a wrench or similar tool.

Thus this invention provides a "fast idle" carburetor throttle setting for high gear closed throttle deceleration, a "curb idle" carburetor setting for normal engine operation at idle speeds and a closed throttle setting to prevent dieseling when the ignition is shut off. The specific structure of the invention provides a control unit with adjusting screws or bolts for the fast idle and curb idle throttle positions to go with the normal carburetor idle adjustment screw for the closed throttle position so that any of the three throttle positions can be adjusted without affecting either of the other two.

The description of preferred embodiments of the invention is not to be considered as limiting the invention, as various modifications may be made within the scope of the invention.

I claim:

1. A three position actuator comprising: a member reciprocable along a selected axis; means biasing said reciprocable member against movement in one direction along the axis; a first extension secured to the reciprocable member, said first extension being axially adjustable with respect to the reciprocable member; an armature reciprocable along the axis; a second extension secured to the armature, said second extension being non-magnetically responsive, axially adjustable with respect to the armature and disposed so as to be capable of pushing and being pushed by the first extension; a coil energizable to cause movement of the armature in the one direction, whereby said armature moves

the first extension, reciprocable member and second extension in the one direction; first stop means for limiting movement of the armature in the one direction; actuating means to cause further movement of the reciprocable member in the one direction whereby said reciprocable member moves the first extension in the one direction; and second stop means for limiting movement of the reciprocable member in the one direction.

2. In combination with an internal combustion engine having an ignition system, an induction passage for air flow to the engine, a throttle in said induction passage for controlling air flow therethrough, said throttle having fast idle, intermediate idle and off positions, a throttle lever connected to said throttle for controlling the position thereof, and an associated transmission with an input connected to said engine and an output connected to a load and with variable ratio drive means driving said output from said input, said variable ratio drive means providing high and low drive ratios wherein said low drive ratio reduces the speed of the output from the speed of the input to a greater extent than said high drive ratio, a throttle position control unit comprising: a hollow elongated housing; a member reciprocably disposed within said housing; a stop member carried by the reciprocable member, said stop member being adjustable with respect to the reciprocable member and engageable with the throttle lever for controlling the idle position of the throttle; an armature reciprocably disposed within the housing; an extension carried by the armature, said extension being axially adjustable with respect to the armature, non-magnetically responsive and disposed so as to be capable of pushing and being pushed by the stop member; a coil adjacent the armature; switch means energizing said coil when the engine ignition system is operating to cause movement of the armature, extension, reciprocable member and stop member toward the throttle lever to prevent closure of the throttle past the intermediate idle position; first stop means for limiting movement of the armature towards the throttle; actuating means operable when said high drive ratio is operative to cause movement of the reciprocable member and stop member toward the throttle lever to thereby prevent closure of the throttle beyond the fast idle position; second stop means for limiting movement of the reciprocable member towards the throttle; and a spring which is effective upon deactivation of the actuating means to move the stop member and reciprocable member in a throttle closing direction to permit closure of the throttle to its intermediate position and which is effective upon deenergization of the coil to move the stop member, reciprocable member, extension and armature in a throttle closing direction to permit closure of the throttle to its off position.

3. The combination of claim 2 in which the actuating means includes a solenoid.

4. The combination of claim 2 in which the actuating means includes an expansible chamber motor.

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