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THROTTLE VALVE CONTROL MECHANISM

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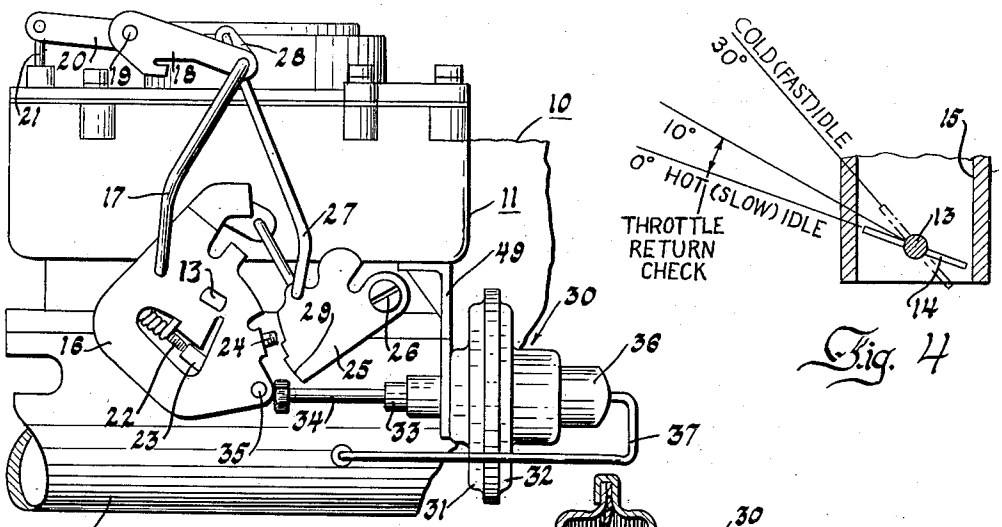


Fig. 1

Fig. 4

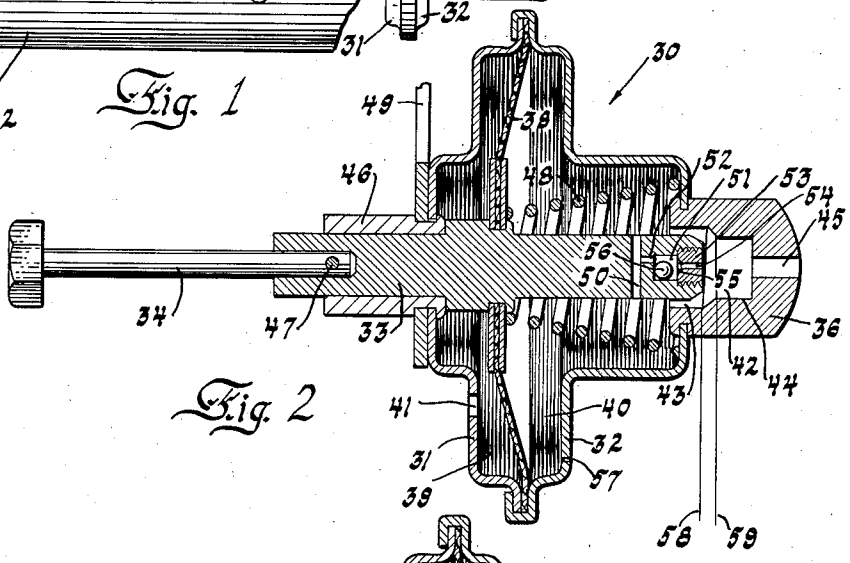


Fig. 2

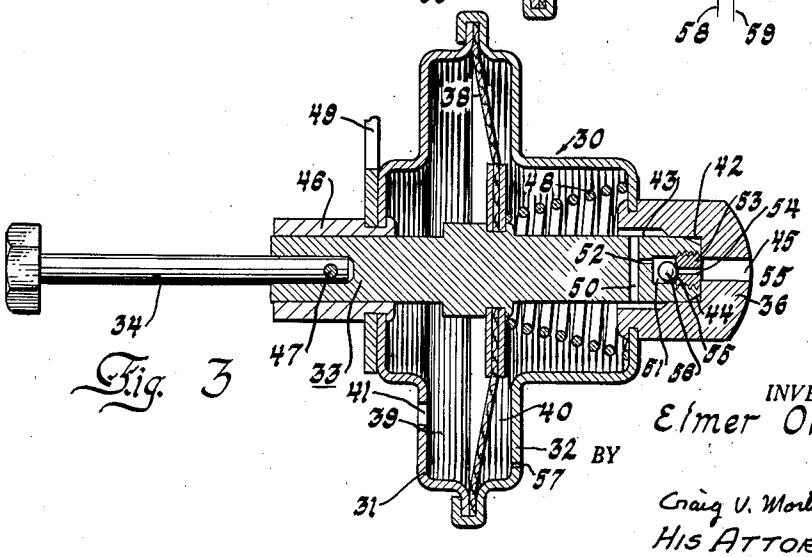


Fig. 3

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THROTTLE VALVE CONTROL MECHANISM

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This invention pertains to the control and operation of internal combustion engines, and particularly to throttle valve control mechanism including throttle valve cracking means and anti-stall means.

The necessity of anti-stall devices for the engines of motor vehicles, especially vehicles having automatic transmissions, has been recognized heretofore. Moreover, the desirability of automatically supplying a greater than normal idle supply of combustible mixture to the engine during cranking and starting is also readily apparent. The present invention relates to a throttle cracking device and return check. Accordingly, among my objects are the provision of means for automatically opening a throttle valve to an optimum cranking and starting position when the engine is not running; the further provision of means for retarding the closing movement of a throttle valve between predetermined positions; the further provision of a unitary device for cracking a throttle valve and controlling the final closing rate of the throttle valve to prevent engine stalling; and the still further provision of an improved dashpot for use with the aforesaid device.

The aforementioned and other objects are accomplished in the present invention by incorporating a spring biased, pressure differential responsive flexible diaphragm for positioning a movable throttle stop. Specifically, the device includes a two-part housing having disposed therein a diaphragm which divides the housing into two chambers. The diaphragm is connected to a reciprocable rod that extends through one wall of the housing and is connected to the movable throttle stop. One chamber is subjected to atmospheric pressure at all times through a vent, and the other chamber is subjected to manifold vacuum through a check valve and bleed arrangement constituting a dashpot, as modified by a small orifice in the housing wall establishing communication between the vacuum chamber and atmosphere.

The flexible diaphragm is spring urged to extend the movable throttle stop when the pressure differential acting on the diaphragm in opposition to said spring is less than a predetermined value. Thus, when the engine is inoperative, the device will extend the movable throttle stop so as to open the throttle valve to an optimum engine cranking and starting position. Upon starting of the engine and an increase in manifold vacuum, the movable stop is retracted to an inoperative position. However, upon engine deceleration as caused by releasing the accelerator, the throttle stop device will act to check the movement of the throttle valve to the fully closed position. The device permits substantially unretarded rapid movement of the throttle valve upon rapid deceleration to a predetermined open position, since the vacuum chamber of the housing is subjected to manifold vacuum through an open check valve arrangement during initial movement of the throttle valve towards the closed position. However, at a predetermined position of the diaphragm, the check valve closes and the rate of diaphragm movement is retarded and controlled by what, in effect, constitutes a restricted bypass opening. The final closing rate of the throttle valve is controlled as a function of the vehicle engine design to preclude engine stalling, which might otherwise occur if the throttle valve moves rapidly to a closed position. As soon as the manifold vacuum communicated to the vacuum chamber overcomes the spring, the throttle stop is moved to an inoperative position. However, as soon as manifold vacuum decreases, as will occur when the throttle valve is manually opened, the spring will automatically reposition the throttle stop for return checking action.

The dashpot construction utilized for checking the return movement of the throttle valve is formed as an integral part of the diaphragm rod. One end of the diaphragm rod is formed with a cross passage having communication with an axial recess through a small opening. The axial recess is closed by a fitting having an opening and a ball seat. A ball type check valve is confined within the axial recess of the diaphragm rod. This end of the diaphragm rod has a precision diameter and is arranged to be slidably received in a complementary precision diameter bore of a fitting which is connected by a conduit with the engine intake manifold. In order to control the return checking action, the wall of the housing which encloses the vacuum chamber has a calibrated opening therethrough so as to modify the effect of the dashpot action.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred embodiment of the present invention is clearly shown.

In the drawing:

Fig. 1 is a fragmentary view, in elevation, of an engine equipped with the device of this invention.

Fig. 2 is a sectional view of the preferred form of the combined throttle cracking and return check device in the fully extended position.

Fig. 3 is a view similar to Fig. 2 with the device in the fully retracted position.

Fig. 4 is a diagrammatic view indicating the operation of the throttle return check and throttle cracking device.

With particular reference to Fig. 1, an internal combustion engine is indicated by the numeral 10. In a conventional manner, the engine includes a carburetor **11** which is flange connected to the engine intake manifold **12**. The carburetor **11** may be of the type disclosed in copending application, Serial No. 264,136, filed December 29, 1951, in the name of Elmer Olson, et al., and assigned to the assignee of this invention. However, this type of carburetor is only by way of example since the device of this invention can be used with any carbureting device.

The carburetor may include primary and secondary throttle passages and valves, the primary throttle valve, or valves, being mounted on an oscillatable shaft **13**, as indicated in Figs. 1 and 4, the valve being of the butterfly type, as indicated in numeral **14**. As seen in Fig. 4, the throttle valve **14** is arranged for pivotal movement within a primary throttle passage **15**.

The throttle shaft **13** is rigidly connected to a throttle lever **16**. The lever **16** is connected by a link **17** to a lever **18**, the lever **18** being attached to a shaft **19**. A lever **20** is also rigidly connected to the shaft **19** at one end, the other end of the lever **20** being operatively connected with a rod **21** of an accelerator pump. The accelerator pump is of conventional design and, hence, includes a strong spring, not shown, which urges the rod **21** upwardly and constitutes the return spring for the lever **16** and the throttle valve, or valves, **14**. Thus, during normal engine operation, when the operator removes

his foot from the accelerator, the accelerator pump spring and the accelerator pedal linkage spring will return the lever 16 and the throttle valve 14 to the hot idle, or substantially fully closed, position.

The hot idle position of the throttle valve 14 is determined by engagement of a hot idle adjustment screw 22 with a lug 23. The throttle lever 16 also carries a cold idle adjustment screw 24 arranged to abut the stepped surface of choke positioned cam 25. The choke cam 25 is pivotally mounted at 26 and is positioned by a link 27, which is operatively connected to a link 28 that is connected with the automatic choke valve shaft. The automatic choke may operate in the conventional manner so that when the engine is cold, the choke valve will be yieldingly urged towards a closed position by a thermostatic spring so as to effect counterclockwise pivotal movement of the cam 25, as viewed in Fig. 1. When the engine is cold, the screw 24 will engage step 29 of the choke cam 25 so as to position the throttle lever 16 and the valve 14 at the fast idle position indicated in Fig. 4.

The carburetor mechanism hereinbefore described is of the conventional type, as presently used on some motor vehicles. By virtue of the stepped surface of the cam 25, it is readily apparent that when the engine is turned off after reaching normal engine operating temperature, the choke valve will position the cam 25 so that the idle stop for the throttle valve is constituted by lug 23 and screw 22 rather than by screw 24 and the cam 25. As the temperature of the engine decreases, the thermostatic spring will tend to move the choke valve towards a closed position, but due to the step periphery of the choke cam, the screw 24 will abut the first step and prevent further movement of the choke valve. Thus, it is conventional practice when starting a cold engine to depress the accelerator, thereby releasing the choke cam 25 so that the choke valve may be moved to the closed position by the thermostatic spring and, furthermore, permit the choke valve to position the cam 25 for fast idle. Thus, when the accelerator pedal is released, the throttle valve 14 is retained in the fast idle position, as indicated in Fig. 4, which accelerator depression is sometimes referred to as throttle cracking.

The combined throttle cracker and return check of this invention is indicated generally by the numeral 30 in Fig. 1. The device includes a housing having two parts 31 and 32 from which a rod 33 extends. The rod 33 is connected to a movable throttle stop 34 arranged to engage the throttle lever 16. The manual throttle linkage, not shown, is connected to a pin 35 of the throttle lever 16.

Movement of the throttle stop 34 to the left, as viewed in Fig. 1, will impart clockwise movement to the throttle lever 16 and shaft 13 so as to open the throttle valve 14. Conversely, movement of the throttle stop 34 to the right under certain conditions will retard and control the rate of throttle valve closing movement under the urge of the throttle return spring of the accelerator pedal linkage. Housing part 32 has attached thereto a fitting 36, which is connected by a conduit 37 to the intake manifold 12. Thus, the conduit 37 is at all times subjected to manifold vacuum, or the pressure existent in the engine intake passageway posterior to the throttle valve 14.

With particular reference to Figs. 2 and 3, a diaphragm 38 is clamped between the two housing parts 31 and 32, the diaphragm dividing the housing into chambers 39 and 40. Chamber 39 is always maintained at atmospheric pressure by reason of a large vent hole 41 in housing part 31. Chamber 40 communicates with a bore 42 in the fitting 36 having steps 43, 44 and 45. The diaphragm 38 is connected to the rod 33, which extends through housing wall 31 and is slidably supported by a sleeve 46. The rod 33 is connected to the stop 34 by means of a pin 47. A spring 48 is interposed between the inner surface of wall 32 and the flexible diaphragm 38, which spring acts in opposition to the throttle return spring also acting on the carburetor. Moreover, the spring 48 is stronger than the throttle return spring mechanism of the carburetor so that when the engine is inoperative, the device 30 will position the movable throttle stop 34 in the position depicted in Figs. 1 and 2. The device 30 may be suitably connected to the carburetor 11 by a bracket 49.

The inner end of the rod 33 is formed with a cross passage 50, which communicates with an axial recess 51 through an opening 52. A fitting 53 having an opening 54 therein is threadedly retained in the axial recess 51. The fitting 53 is formed with a ball seat 55, and a ball type check valve 56 is confined between the fitting 53 and the inner end of the recess 51. In addition, the housing wall 32 is formed with a calibrated bleed orifice 57, which interconnects the chamber 40 with the atmosphere.

As stated hereinbefore, when the engine is inoperative, the spring 48 will extend the movable throttle stop 34 to the positions depicted in Figs. 1 and 2. When the throttle stop 34 is in this position, the throttle lever 16 will be moved in a clockwise direction so as to position the throttle valve 14 at an optimum engine cranking and starting angle. Furthermore, by imparting clockwise movement to the throttle lever 16, the device permits the automatic choke to position the fast idle cam 25 through the link 27.

Upon firing of the engine, manifold vacuum will be communicated to the fitting 36 through the conduit 37. Thus, the chamber 40 will tend to become evacuated, complete evacuation, of course, being impossible by reason of the calibrated bleed orifice 57. However, the pressure differential created on opposite sides of the diaphragm 38 upon engine starting is sufficient to overcome the force of spring 48 whereby the diaphragm 38 will move to the right, as viewed in Fig. 2. The diameter of the inner end of rod 33 is precision ground, as is the inner diameter of step 44 in the bore 42 of the fitting 36. Initial movement of the diaphragm 38 and the rod 33 between lines 58 and 59 in Fig. 2 will be substantially unretarded inasmuch as the ball 56 will not engage its seat 55 and manifold vacuum is readily communicated to the chamber 40. Between the lines 58 and 59 of Fig. 2, the movable throttle stop 34 is retracted from the cold idle position of Fig. 4 to the 10° position of the throttle valve. However, as soon as the precision diameter portion of the rod 33 enters the step 44, the return checking action will ensue due to the dashpot effect. That is, when the end of rod 33 is disposed within the step 44 of the bore 42, as depicted in Fig. 3, the ball 56 will engage its seat 55 due to the suction effect, whereby continued movement of the diaphragm 38 and the rod 33 to the right between the line 59 of Fig. 2 and the position depicted in Fig. 3 will be retarded. Thus, the final closing movement of the throttle valve between 10° and slow idle is checked or retarded. The rate of movement of the diaphragm is controlled by the amount of air, which is evacuated between the precision diameter end of the rod 33 and the step 44 of the bore 42 less that amount of air drawn into the chamber 40 through the calibrated orifice 57.

After the return movement of the throttle valve 14 has been checked, any subsequent throttle opening causes manifold vacuum to decrease whereby the diaphragm 38 will instantaneously move to the position of Fig. 2 and advance the throttle stop 34. This advancing movement of the stop 34 occurs almost simultaneously with movement of the throttle valve from a fully closed position to an open position by reason of the instantaneous decrease in manifold vacuum communicated to the chamber 40. Accordingly, the device will operate as a return check for the throttle valve irrespective of the rapidity of accelerator pedal maneuvering.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A dashpot for use with a source of sub-atmospheric pressure including, a housing having first and second walls, a flexible diaphragm disposed in said housing and dividing it into first and second chambers, a reciprocable rod attached to said diaphragm, a vent in the first wall of said housing whereby said first chamber is always subjected to atmospheric pressure, means connecting said second chamber with the source of sub-atmospheric pressure through a fitting having a stepped bore therein, said rod having a portion with a diameter complementary to one step of said stepped bore, said rod having interconnected axial and transverse passages therein, a check valve disposed within said axial passage and adapted to engage a seat for blocking said axial passage against the source of sub-atmospheric pressure, and resilient means for urging said diaphragm in a direction for exhausting air from the first chamber, said housing having a calibrated orifice through the second wall thereof interconnecting said second chamber and atmosphere, said calibrated orifice and second chamber being constructed and arranged that upon communication of sub-atmospheric pressure to said second chamber said rod portion will remain in the other step of said bore during the initial movement of said diaphragm to compress said resilient means, said rod portion being adapted to enter the complementary diameter of the stepped bore during the final movement of said diaphragm in compressing said resilient means to thereby provide a dashpot effect.

2. A dashpot for use with a source of sub-atmospheric pressure including, a housing having first and second walls, a flexible diaphragm disposed in said housing and dividing it into first and second chambers, a reciprocable rod attached to said diaphragm, a vent in the first wall of said housing whereby said first chamber is always subjected to atmospheric pressure, a fitting attached to the second wall and having a stepped bore therein, means connecting said fitting with the source of sub-atmospheric pressure, said rod having a portion with a diameter complementary to one step of said stepped bore, said rod having interconnected axial and transverse passages therein, a ball type check valve disposed within said axial passage and arranged to engage a seat for blocking said axial passage, and resilient means for urging said diaphragm in a direction for exhausting air from the first chamber, said housing having a calibrated orifice through the second wall thereof interconnecting said second chamber and atmosphere, said calibrated orifice in said second chamber being constructed and arranged that upon communication of sub-atmospheric pressure to said second chamber said rod portion will remain in the other step of said bore during the initial movement of said diaphragm to compress said resilient means, said rod portion being adapted to enter said complementary diameter during the final movement of said diaphragm in compressing said resilient means to thereby provide a dashpot effect.

3. A dashpot for use with a source of sub-atmospheric pressure including, a housing having first and second walls, a flexible diaphragm disposed in said housing and dividing it into first and second chambers, a reciprocable rod attached to said diaphragm, a vent in the first wall of said housing whereby said first chamber is always subjected to atmospheric pressure, means connecting said second chamber with the source of sub-atmospheric pressure through a fitting having a stepped bore therein, said rod having a portion with a diameter complementary to one step of said stepped bore, said rod having interconnected axial and transverse passages therein, a check valve disposed within said axial passage and adapted to engage a seat for blocking said axial passage, and a spring acting constantly on said diaphragm and disposed within said second chamber for urging said diaphragm in a direction for exahusting air from the first chamber, said housing having a calibrated orifice through the second wall thereof interconnecting said second chamber and atmosphere, said calibrated orifice and said second chamber being constructed and arranged that upon communication of sub-atmospheric pressure to said second chamber said rod portion will remain in the other step of said bore during the initial movement of said diaphragm to compress said resilient means, said rod portion being adapted to enter the complementary diameter during the final movement of said diaphragm in compressing said resilient means to thereby provide a dashpot effect.

4. The dashpot set forth in claim 1 wherein said check valve comprises a ball and wherein the seat for the check valve comprises an annular member having an opening therethrough carried by said rod and disposed within said axial passage.

5. A dashpot for use with a source of vacuum including, a housing, a flexible diaphragm disposed in said housing and dividing it into an air chamber and a vacuum chamber, resilient means for urging said diaphragm in a direction exhausting air from said air chamber, means connecting said vacuum chamber with the source of vacuum, and means controlling the rate of diaphragm movement in a direction opposing said resilient means so that between first and second predetermined positions of said diaphragm its movement is substantially unretarded while between said second and a third predetermined position of said diaphragm, its movement is substantially retarded, said rate controlling means including a check means interconnecting said source of vacuum and said vacuum chamber, said check means being open between said first and second predetermined diaphragm positions and being closed between said second and third predetermined diaphragm positions, and a calibrated orifice in said housing interconnecting said vacuum chamber and atmosphere.

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