

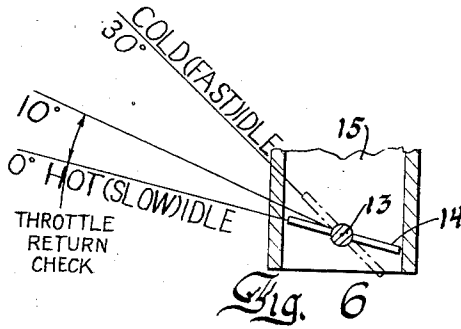
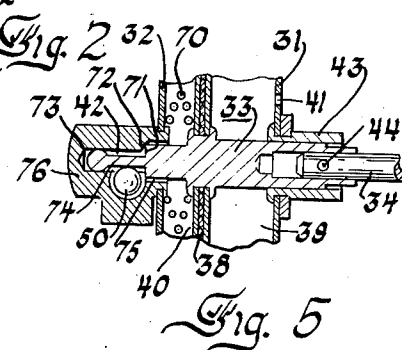
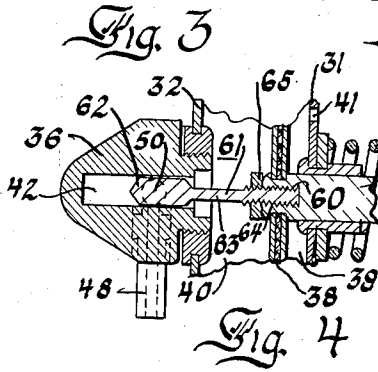
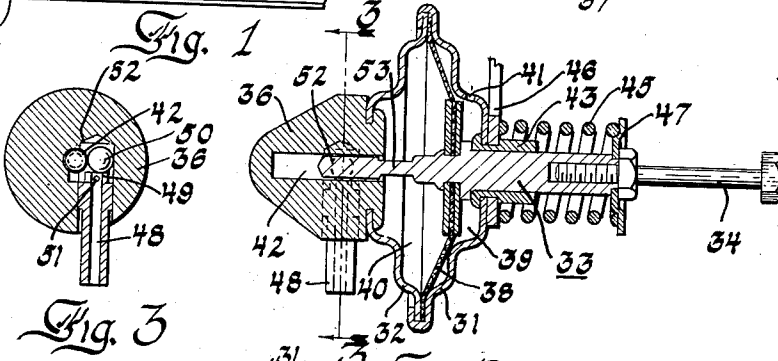
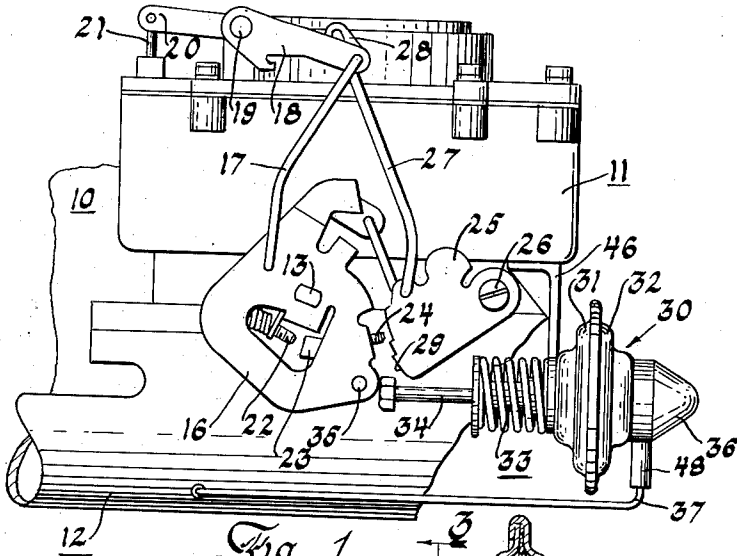
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THROTTLE VALVE CONTROL MECHANISM

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1

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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, vacuum responsive flexible diaphragm for positioning a movable throttle stop. Specifically, the device includes a 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, and the other chamber is subjected to engine vacuum posterior to the throttle valve through a check valve and bleed orifice arrangement which constitutes a dashpot for travel in one direction only, i.e. increasing vacuum.

The flexible diaphragm is spring urged in one direction, so that when the pressure differential acting on said diaphragm in opposition to said spring is less than the preload of said spring, the spring will extend the movable throttle stop. Thus, when the engine is inoperative, the diaphragm spring will position the throttle stop so as to open the throttle valve to an optimum engine cranking and starting position. If the carburetor is of the type having an automatic choke, the throttle cracking action automatically permits the automatic choke to position the fast idle cam for cold idle operation, thereby eliminating the necessity of the operator having to depress the accelerator prior to starting.

The throttle stop device permits substantially unretarded, rapid movement of the throttle valve, upon engine 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 con-

2

trolled by a small bleed orifice having a parallel connection with the manifold. 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, thus reaching the limit of diaphragm travel, 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, without any delay, reposition the throttle stop for return checking action.

Three embodiments of the combined throttle cracker and return check are disclosed herein. In the first embodiment, the spring acts on the diaphragm rod, and the rod has an integral valve actuating stem that permits closure of a ball type check valve at a predetermined diaphragm position. In another embodiment, the diaphragm rod carries an adjustable length check valve actuating stem, thereby constituting means for altering the initiation of the throttle return checking action. In the preferred embodiment, the spring acts constantly upon the diaphragm, and the rod has an integral valve actuating stem.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein preferred embodiments of the present invention are 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 first form of the combined throttle cracking and return check device.

Fig. 3 is a sectional view taken along lines 3—3 of Fig. 2.

Fig. 4 is a fragmentary sectional view depicting a modified embodiment.

Fig. 5 is a fragmentary sectional view depicting another modified embodiment.

Fig. 6 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, now Patent No. 2,771,282, 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 6, the valve being of the butterfly type, as indicated in numeral 14. As seen in Fig. 6, 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 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 yielding 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. 6.

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 valves 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. 6, which accelerator depression is sometimes referred to as throttle cranking.

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, or bearing, 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 pump and the accelerator pedal controlled linkage, which controls the throttle. 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, the preferred embodiment of the combined throttle cracking and return check device of this invention will be described. 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 vent 41 in the housing part 31. Chamber 40 communicates with a bore 42 in the fitting 36. The diaphragm

38 is connected to the rod 33, which extends through the housing wall 31 and is slidably supported by a sleeve 43. The internally threaded rod 33 is locked by means of a pin 44, as shown in Fig. 5, to an externally threaded movable throttle stop 34. A spring 45 is interposed between a supporting bracket 46 for the device and a washer 47 connected to the rod 33. The force of spring 45 is stronger than the throttle valve return spring forces, so that when the pressure differential on opposite sides of the diaphragm 38 is less than a predetermined value, or substantially zero, the spring 45 will move the diaphragm 38, the rod 33 and the stop 34 to the position depicted in Figs. 1 and 2.

As seen in Fig. 3, the bore 42 of the fitting 36 communicates with a tube 48, which is connected to the conduit 37. The tube is formed with a valve seat 49, which may be sealed by a ball check valve 50. The upper portion of the tube 48 is formed with a small bleed orifice 51 that communicates with the bore 42 at all times. The left-hand portion, as viewed in Fig. 2, of the diaphragm rod 33 includes a portion 52 of large diameter and a portion 53 of smaller diameter. The ball check valve 50 is confined within the fitting 36 and cannot move longitudinally of the rod 33. When the larger diameter portion 52 engages the ball 50, it cannot engage its seat 49, and, consequently, the chamber 40 will be evacuated at a rapid rate when the valve is open. However, when reduced diameter portion 53 of the rod 33 is positioned in alignment with the ball 50, the suction effect in the tube 48 will cause the ball 50 to engage its seat 49, after which, vacuum can only be applied to the chamber 40 through the bleed orifice 51. It should be noted that the check valve operates in parallel with the bleed orifice so that upon any subsequent decrease in manifold vacuum, the check valve will immediately open, thereby permitting the spring 45 to advance the throttle stop 34 without any delay.

When the engine 10 is inoperative, the spring 45 moves the diaphragm 38, the rod 33 and the throttle stop 34 beyond the fast idle position, thereby opening the throttle valve 14 to an optimum engine cranking and starting angle. By reason of the stop 34 imparting clockwise movement to the throttle lever 16, the device also permits the automatic choke to position the fast idle cam 25 through the link 27. During movement of the diaphragm 38 to the position depicted in Fig. 2, the ball 50 will be moved off its seat 49 by the large diameter portion 52 of the rod 33. When the engine fires, engine intake passageway, or manifold, vacuum applied through conduit 37, tube 48 and bore 42 will evacuate the chamber 40. Inasmuch as the chamber 39 is vented to atmosphere, the diaphragm 38 will move rapidly to the left, as viewed in Fig. 2, thereby retracting the throttle stop 34, thereby permitting progressive closure of the throttle lever 16 to approach either the cold or hot idle stops 24 and 22, respectively. When the smaller diameter portion 53 of the rod 33 is in alignment with the ball 50, the rate of diaphragm movement to the left will be retarded and controlled inasmuch as evacuation of chamber 40 is limited by the rate of flow through bleed orifice 51 which results in a dashpot effect. At this point, the device operates as a throttle return check and, as indicated graphically in Fig. 6, retards the final closing movement of the throttle valve between approximately 10° and slow idle, or substantially fully closed. The initial movement of the stop 34 from the fully extended to the minimum throttle stop position of 10° is only slightly retarded. This initial slightly retarded rate of closure has the beneficial effect of overcoming the tendency of the engine to stall due to throttle closure and, yet, obviates the undesirability of perceptible engine overrun. The highly retarded rate of closure between 10° and 0°, likewise, prevents engine stalling. It is to be understood that the specific throttle angles are only exemplary, and are not to be construed as limitations.

5

After the movement of the throttle valve 14 has been checked and the throttle valve has completed its closure to the normal carburetor idle stop, any subsequent throttle opening causes manifold vacuum to drop whereby the diaphragm 38 will 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 ball 50 being displaced from its seat by the air rushing in to fill the vacuum in chamber 40 and by the enlarged diameter 52 of the rod 33. Accordingly, the device will operate as a return check for the throttle valve irrespective of the rapidity of the accelerator pedal maneuvering.

A second embodiment of the combined throttle cracking and return check device of this invention is disclosed in Fig. 4 wherein the rod 33 is formed with an internally threaded opening 60. A valve actuating stem 61 having a large diameter portion 62, a small diameter portion 63 and an externally threaded portion 64 is employed to control the ball check valve 50. The operative length of the valve stem 61 may be adjusted in the Fig. 4 embodiment so as to vary the timing of the highly retarded throttle valve checking action to best meet the requirements of the engine with which the device is used. Thus, by unscrewing the stem 61 from the rod 33, the highly retarded checking action will be effective during a greater portion of the movement of the diaphragm 38, while by screwing the stem 61 further into the rod 63, the retarding action will only be effective during a lesser amount of movement of the diaphragm 38. After the optimum operating length of the stem 61 for a given engine has been determined, the stem is locked in position by the nut 65.

A third embodiment is depicted in Fig. 5 wherein the diaphragm actuating spring is constituted by a spring 70, which is disposed in the vacuum chamber 40 of the housing and acts constantly upon the diaphragm 38. In the embodiment of Fig. 5, the diaphragm rod 33 is formed with an abrupt shoulder at 71 arranged to engage an internal shoulder 72 in the fitting 76. As in the preferred embodiment, the rod includes a large diameter portion 73 and a small diameter portion 74 for actuating the check valve 50. When the shoulder 71 abuts the shoulder 72, movement of the diaphragm 38 to the left is positively stopped. In this device, the chamber 40 is subjected to manifold vacuum through a passage 75, which communicates with the bore 42 when the rod shoulder 71 abuts the surface 72.

While the embodiments of the present invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A retarder 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, said air chamber openly communicating with atmosphere, 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 operatively connected to the diaphragm for controlling the rate of diaphragm movement in a direction opposing said resilient means so that as vacuum moves said diaphragm between first and second predetermined positions its movement is substantially unretarded, while such movement between said second and a third predetermined position of said diaphragm is substantially retarded.

2. A retarder for use with a source of sub-atmospheric pressure including, a housing, 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 one wall of said housing connecting the first chamber with atmosphere, a check valve in another wall of said housing for controlling the rate of fluid flow

6

from said second chamber, resilient means for urging said diaphragm between first and second predetermined positions in a direction whereby the air is exhausted from the first chamber, a bleed orifice bypassing said check valve, means connecting the second chamber with the source of sub-atmospheric pressure through said check valve and said bleed orifice, and means connected to said diaphragm for holding said check valve open when the diaphragm is in said first predetermined position and permitting closure of said check valve when the diaphragm is in the second predetermined position whereby the air in said second chamber can only be exhausted through said bleed orifice, thereby appreciably retarding the movement of said diaphragm beyond said second predetermined position under the influence of the source of sub-atmospheric pressure.

3. A retarder for use with a source of sub-atmospheric pressure including, a housing, 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 one wall of said housing connecting the first chamber with atmosphere, a fitting attached to another wall of said housing having a bore in alignment with said rod, a check valve in said fitting for controlling the rate of fluid flow from said second chamber, resilient means for urging said diaphragm between first and second predetermined positions in a direction whereby the air is exhausted from the first chamber, a bleed orifice bypassing said check valve, means connecting the second chamber with the source of sub-atmospheric pressure through said check valve and said bleed orifice, and means connected to said diaphragm and disposed in said bore for holding said check valve open when the diaphragm is in said first predetermined position and permitting closure of said check valve when the diaphragm is in the second predetermined position whereby the air in said second chamber can only be exhausted through said bleed orifice, thereby appreciably retarding the movement of said diaphragm beyond said second predetermined positions under the influence of the source of sub-atmospheric pressure.

4. A retarder for use with a source of sub-atmospheric pressure including, a housing, a flexible diaphragm and disposed in said bore disposed in said housing and dividing it into first and second chambers, a reciprocable rod attached to said diaphragm, a vent in one wall of said housing connecting the first chamber with atmosphere, a fitting attached to another wall of said housing having a bore coaxial with said rod, a ball type check valve in said fitting for controlling the rate of fluid flow from said second chamber, resilient means for urging said diaphragm between first and second predetermined positions in a direction whereby the air is exhausted from the first chamber, a bleed orifice bypassing said check valve, means connecting the second chamber with the source of sub-atmospheric pressure through said check valve and said bleed orifice, and means connected to said diaphragm and disposed in said bore for holding said check valve open when the diaphragm is in said first predetermined position and permitting closure of said check valve when the diaphragm is in the second predetermined position whereby the air in said second chamber can only be exhausted through said bleed orifice, thereby appreciably retarding the movement of said diaphragm beyond said second predetermined position under the influence of the source of sub-atmospheric pressure.

5. The retarder set forth in claim 3 wherein said last recited means comprise a check valve actuating stem fixed to and movable with said diaphragm and having portions of a large and a small diameter for engaging said check valve, said check valve adapted to be unseated when engaged by said large diameter.

6. The retarder set forth in claim 3 wherein said last recited means comprise a check valve actuating stem having portions of different diameter, said stem being

threadedly connected with said rod so as to be longitudinally adjustable relative thereto.

7. The retarder set forth in claim 3 wherein said last recited means comprise a check valve actuating stem integral with the rod and having portions of different diameter, said fitting and said rod having complementary shoulders arranged to abut so as to limit movement of said diaphragm in the direction opposed to said resilient means.

5

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