

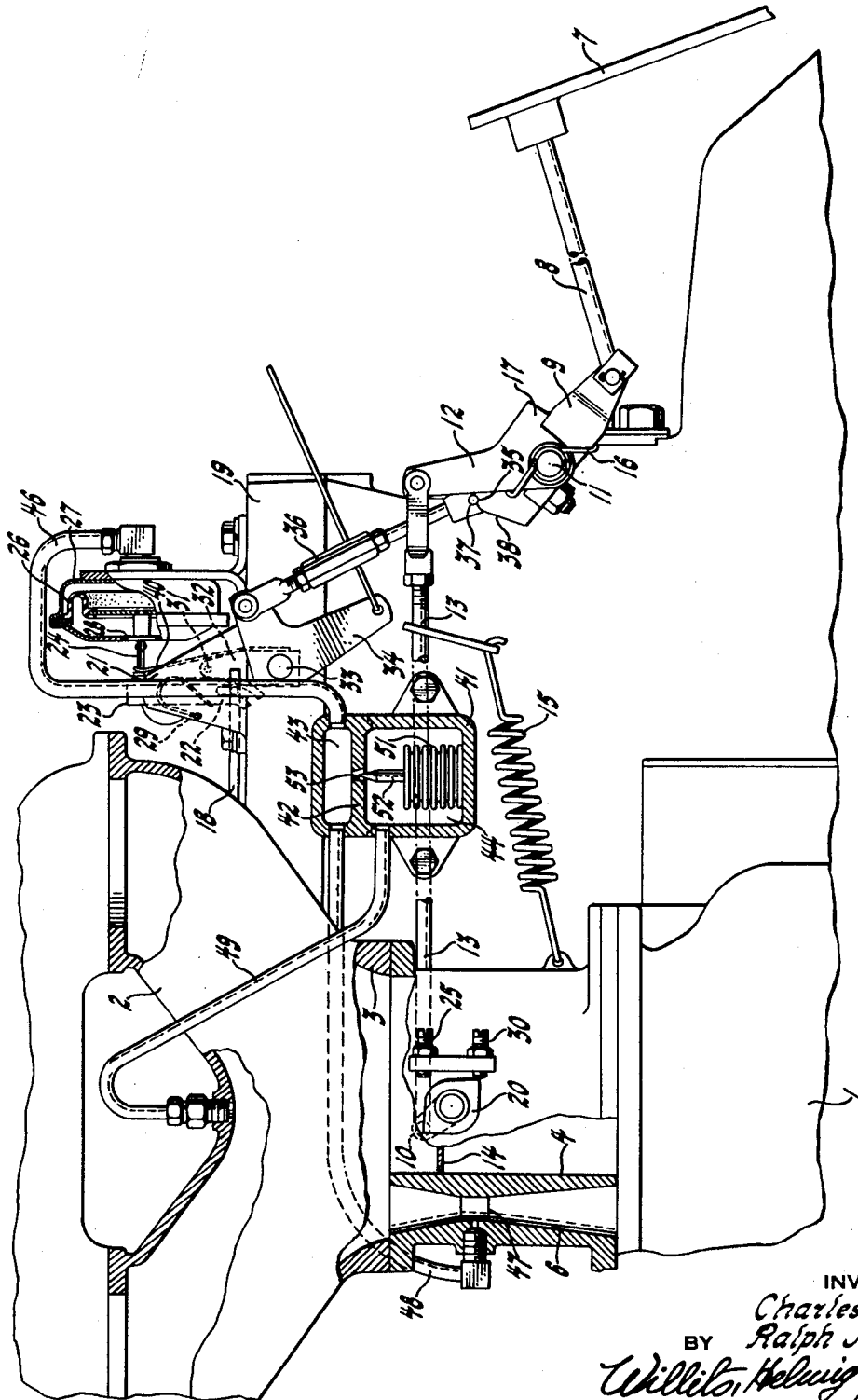
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ALTITUDE COMPENSATED PNEUMATIC GOVERNOR

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ALTITUDE COMPENSATED PNEUMATIC GOVERNOR

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This invention relates to internal combustion engines and particularly speed governors therefor operatively controlling the fluid supply to the engine.

The present invention has as its principal object to improve the pneumatic governors disclosed in the United States patent applications Serial No. 157,556 of Charles E. Ervin, Jr., filed April 22, 1950 now Patent No. 2,617,396 and Serial No. 314,868 of Charles H. Frick and Ralph J. Rays filed October 15, 1952, now Patent No. 2,706,975 such that the engine governed speeds will be substantially unaffected by changes in operating altitude. In the main, this is accomplished in accordance with our invention by incorporating means for introducing air at substantially atmospheric pressure into the low pressure side of the governor diaphragm and for regulating the amount of such air introduced as a function of change in engine operating altitude.

A better understanding of the invention will be had from the following description, having reference to the drawing which illustrates a preferred embodiment of our improved governor.

An internal combustion engine is indicated generally by the numeral 1, and the combustion supporting air therefor is introduced from a suitable air cleaner, not shown, through a receiver 2 having an outlet 3. Between the outlet 3 and the engine is a connecting conduit having a main air passage 4 and a restricted second passage 6 in the form of a venturi in parallel with the main passage 4. At 7 is shown a manually controlled member in the form of a conventional accelerator pedal linked by the member 8 to a lever 9 which is pivoted on a shaft 11 suitably secured to the engine. Also pivoted on this shaft is a lever 12 linked by the rod 13 to a relatively short lever 10 fixed to one end of the shaft of a butterfly valve 14 controlling the main air passage 4. A tension spring 15 suitably linked to the rod 13 and a stationary portion of the engine serves to return the valve 14, levers 9, 10 and 12, and pedal 7 to their engine idle positions shown. Fixedly carried by the other end of the butterfly valve shaft is a lug 20 adapted to engage adjustable stops 25 and 30 for limiting the valve's opening and closing movements. A torsion spring 16 wrapped about the shaft 11 and hooked to the levers 9 and 12 serves to cause the lever 12 to pivot clockwise about the shaft 11 during the initial pivotal movement of the lever 9 while accommodating further clockwise pivoting movement of the lever 9 as the pedal 7 is moved to the left from its position shown. An ear 17 on the lever 12 engages the lever 9 during the return movement of the pedal 7 and effects the return of the valve 14 to its closed position shown.

At 18 is an engine fuel injector control rod which is suitably mounted on the engine cylinder head 19 for movement in opposite directions to increase and decrease the engine fuel supply. Pivotaly supported as by a bracket 21 secured to the cylinder head is a lever having a slotted arm 22 drivably linked to the injector rod 18 and a second arm 23 linked as at 24 to a piston member shown in the form of a flexible diaphragm 26 mounted in an air cylinder 27 secured to the bracket 21. One end of the air cylinder 27 has an opening 28 leading to atmosphere and the other end of the air cylinder is closed to atmosphere. Suitable means such as the torsion spring 29 is provided for biasing the control lever in a counter-

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clockwise direction to urge the fuel injector rod 18 to the right toward its maximum fuel position. At normal engine speeds above "idle," the movement of the rod 18 in this direction in response to the biasing action of the torsion spring 29 is manually limited by a pin 31 which forms an adjustable limiting abutment for the control lever arm 22. This pin 31 as shown is carried by a lever 32 suitably fixed to a shaft 33 journaled in the cylinder head 19. Control of the lever 32 is effected by a bellcrank 34, one arm of which is pivoted to a drag link 36 carrying a pin 37 which follows a cam surface 38 on the lever 9. In the engine idling positions of the parts (as shown) this pin 37 drops into a notch 35 at the high end of the cam surface 38, causing the pin 31 to move out of abutment with the notched lever arm 22, and a buffer spring 40 carried by the lever 32 serves as a resilient stop for arm 23 in opposition to the action of the diaphragm 26 tending to rotate the lever 22, 23 to its full off position under the high vacuum then existing with the butterfly valve closed.

Suitably secured to the engine is a closed housing 41 whose interior is divided by a partition 42 into upper and lower compartments 43 and 44. The upper compartment 43 is in communication with the closed end of the air cylinder 27 as by a conduit 46, and is also in communication with the throat 47 of the venturi 6 as by a conduit 48. A conduit 49 is shown for providing communication between the lower compartment 44 and the engine combustion air receiver 2 above the outlet 3. Disposed within the lower compartment 44 is an altitude sensitive member in the form of an aneroid bellows 51 having its lower end fixedly supported by the housing 41. The opposite end of the bellows has freedom to move within the compartment 44 and carries a metering member 52 in the form of a needle valve which controls the effective area of a bleed opening 53 in the partition 42.

In operation, movement of the pedal 7 to the left from its position shown causes the lever 9 to drive the lever 12 in a clockwise direction through the torsion spring 16 and shift the butterfly valve 14 to its fully opened position. This opening movement of the butterfly valve is resiliently opposed by the tension spring 15 which yields under the greater force of the torsion spring 16 to allow a full opening movement of the butterfly valve during the initial movement of the pedal 7 concurrently with the clockwise rotation of the lever 9. Continued movement of the pedal to the left after the lug 20 engages the stop 25 is then resiliently opposed by the torsion spring 16, during which the pin 37 moves to the left of its position shown along the cam surface 38, allowing the drag link 36 to rotate the bellcrank 34, shaft 33 and lever 32 all in a clockwise direction. The torsion spring 29, in tending to maintain the slotted arm 22 in contact with the pin 31, causes the injector rod 18 to move to the right in the fuel increasing direction.

Both at the "idle" governed speed (when the butterfly valve is closed or substantially closed) and at the maximum governed speed (when the butterfly valve is in full open position), the vacuum created in the venturi throat 47 is sufficiently great to restrain further counterclockwise rotation of the control lever 22, 23 to increase the engine fuel supply. Likewise, in the event the engine speed tends to exceed the governed value as the result of a decrease in engine load for a given setting of the accelerator pedal, the resulting increase in vacuum created at the venturi throat will act through the diaphragm 26, link 24 and lever arms 22 and 23 to move the injector control rod 18 to the left, thereby to decrease the engine fuel supply sufficiently to maintain the governed speed.

At relatively low engine operating altitudes, the needle valve 52 allows air at substantially atmospheric pressure to be bled into the upper housing chamber 43 from the

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air receiver chamber 2. Such air as is introduced into the chamber 43 flows through the conduit 48 to the throat of the venturi, effecting a reduction in the vacuum impressed upon the diaphragm 26. The bellows 51 expands with increase in engine operating altitude to effect a progressive closing of the bleed opening 53, thereby compensating for the tendency of the vacuum at the venturi throat to decrease with increase in altitude. As a result, the force transmitted by the diaphragm through the lever 22, 23 to the fuel control rod 18 will be sufficient at both "idle" and at the maximum governed speed to balance the opposing force of the torsion spring 29 tending to increase the engine fuel supply. The effective area of the diaphragm 26 and the dimensions of the venturi 6, are, of course, designed with relation to the other parts of the system to provide for a sufficient governing force being applied to the control lever 22, 23 to obtain the desired governed speed limits under minimum altitude conditions when the bleed passage 53 is fully opened.

While it is appreciated that various minor changes or alterations in the construction and relation of the parts will readily suggest themselves to persons skilled in the art, such changes shall not depart from the spirit and scope of the invention which is set forth in the following claims.

We claim:

1. In an engine speed governing device having an engine fuel delivery regulating member, an engine air supply conduit means including a main passageway, a valve for controlling said passageway and a venturi bypassing said valve in parallel with the main passage, said venturi being effective to cause a sub-atmospheric depression of air passing therethrough proportional to the engine intake vacuum under all engine operative conditions, a piston member responsive to increased engine intake vacuum for limiting increasing fuel delivery movements of said regulating member, means for modulating the effect of engine intake vacuum on said piston member to compensate for changes in engine operating altitude, said means including a passage for the introduction of fluid to the intake vacuum side of said piston at a pressure exceeding that of the intake vacuum, a second valve controlling said passage and an operating member for said second valve responsive to atmospheric pressure at the engine operating altitude, and manually controlled means for effecting full opening of the first-mentioned valve and providing a one-way driving connection with said engine fuel delivery regulating member.

2. The combination of an engine having a regulating member movable in opposite directions to increase and decrease the engine fuel supply, an engine air supply conduit having a restriction effective to cause a subatmospheric depression of the air passing therethrough proportional to the engine operating speed under all engine operative conditions, a piston member operatively connected to said regulating member for moving the same in the direction of decreased fuel, a duct connecting one side of the piston member to said restriction, said duct having an opening for the introduction of air thereinto at substantially atmospheric pressure, a valve controlling said opening and a member expansible with increased engine operating altitude to close said valve.

3. In an engine speed limiting device including a fuel control member movable in opposite directions to increase and decrease the engine fuel supply, a piston member drivably linked to said control member for limiting fuel delivery movements of said control member and a conduit subjecting one side of said piston member to engine air intake suction under all engine operative conditions, the combination therewith of means forming a chamber in series with said conduit with an opening thereinto for the introduction of air at substantially atmospheric pressure, a valve movable to vary the effective size of said opening, an aneroid bellows subject to at-

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mospheric pressure, and a stationary support on the engine for one end of said bellows, said valve being movable with the other end of the bellows in the direction to close said opening as the bellows expands with increasing engine operating altitude.

4. A speed limiting device for an internal combustion engine, comprising an engine combustion air receiver having an outlet, means for conducting air to the engine from said outlet including a main passage and a venturi in parallel with the main passage, a rod movable in opposite directions to increase and decrease the engine fuel supply, a pivotable fuel control lever having one end drivably linked to said rod, an air cylinder having an aperture in one end leading to atmosphere and its other end closed to atmosphere, a flexible diaphragm separating the respective ends of the air cylinder, a link extending through said end of the cylinder and interconnecting the diaphragm and the other end of said lever, a closed housing having first and second compartments separated from each other by a partition, one of said compartments being in communication with both the throat of said venturi and the other end of said air cylinder, the other of said compartments being in communication with said air receiver, said partition having an opening interconnecting said compartments, an aneroid bellows mounted in said other compartment, and a valve operatively controlled by the expansion and contraction of said bellows to reduce and increase the effective area of said opening as the operating altitude of the engine is increased and decreased, respectively.

5. In an engine speed controlling mechanism, an engine combustion air receiving chamber having an outlet, means for conducting air to the engine from said outlet including a main passage controlled by a valve and a venturi by-passing said valve, yieldable means biasing said valve closed, a rod movable in opposite directions to increase and decrease the engine fuel supply, a pivoted two-armed lever having one arm drivably linked to said rod, resilient means biasing said lever in the fuel increasing direction, an air cylinder having one end in communication with atmosphere and its other end closed to atmosphere, a flexible diaphragm separating the respective ends of said air cylinder and linked to the other arm of said lever, a closed housing having first and second compartments separated by a partition, conduits connecting one of said compartments to the throat of said venturi and to said other end of the air cylinder, a conduit connecting the other of said compartments to said air receiving chamber, said partition having an opening interconnecting said compartments, an aneroid bellows disposed in said other compartment, a metering member operative in accordance with the rate of expansion of said bellows to reduce the flow of air through said opening, a manually controlled member movable through a range from a minimum engine speed setting position to a maximum engine speed setting position, and means linking said valve to said manually controlled member for effecting full opening of the valve in response to the initial movement of the manually controlled member from its minimum speed position, said manually controlled member having a one-way driving connection with said lever in opposition to said resilient means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,091,163	Schweizer	Aug. 24, 1937
2,315,912	Udale	Apr. 6, 1943
2,330,650	Weiche	Sept. 28, 1943
2,341,257	Wunsch	Feb. 8, 1944
2,442,419	Lee, 2d	June 1, 1948
2,455,344	Waring	Nov. 30, 1948
2,633,115	Waring	Mar. 31, 1953

FOREIGN PATENTS

497,380	Great Britain	Dec. 19, 1938
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