May 7, 1940. J. S. JENNINGS, JR 2,200,065

GOVERNOR

Filed Dec. 7, 1935 3 Sheets-Sheet 1

FIG. 1.

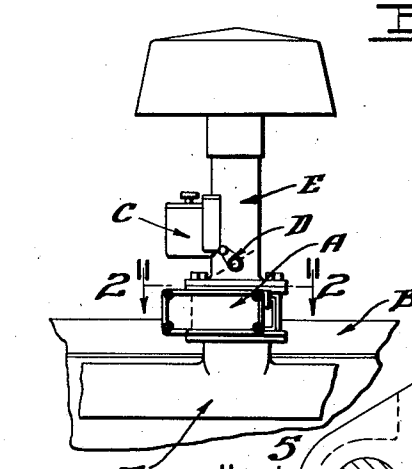


FIG. 2.

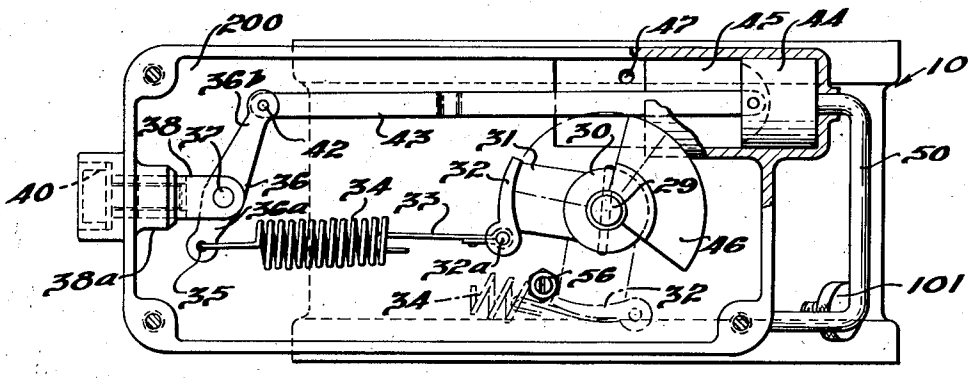


FIG. 3.

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GOVERNOR

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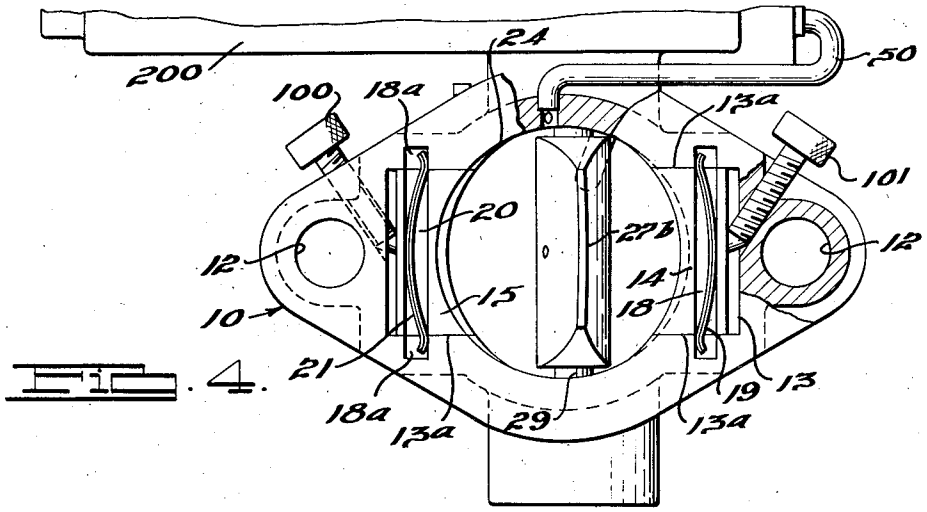


Fig. 4.

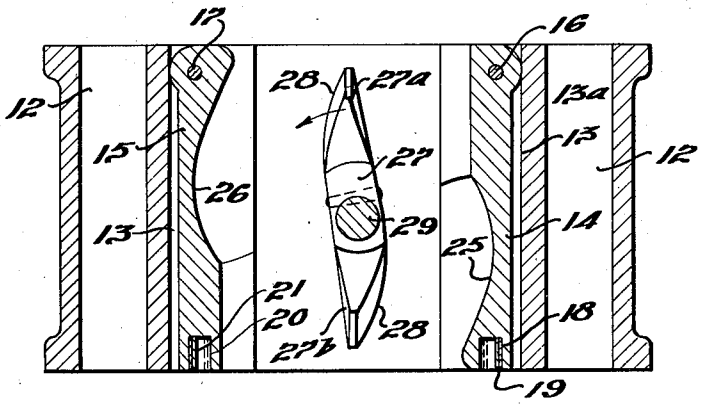


Fig. 5.

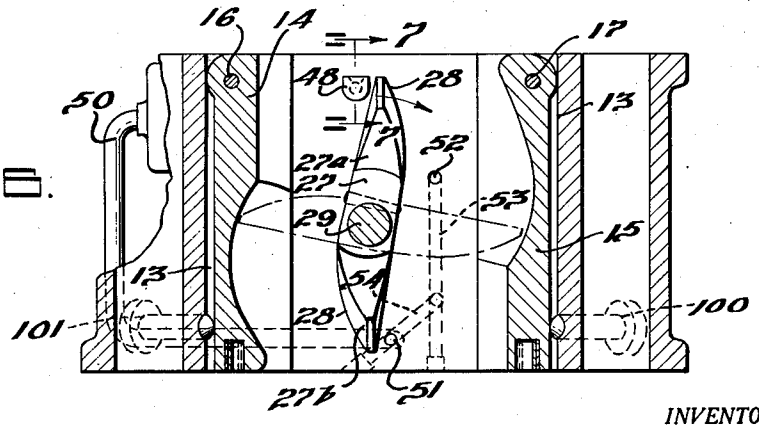


Fig. 6.

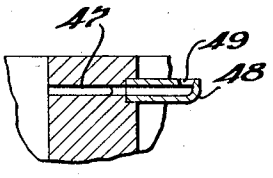


Fig. 7.

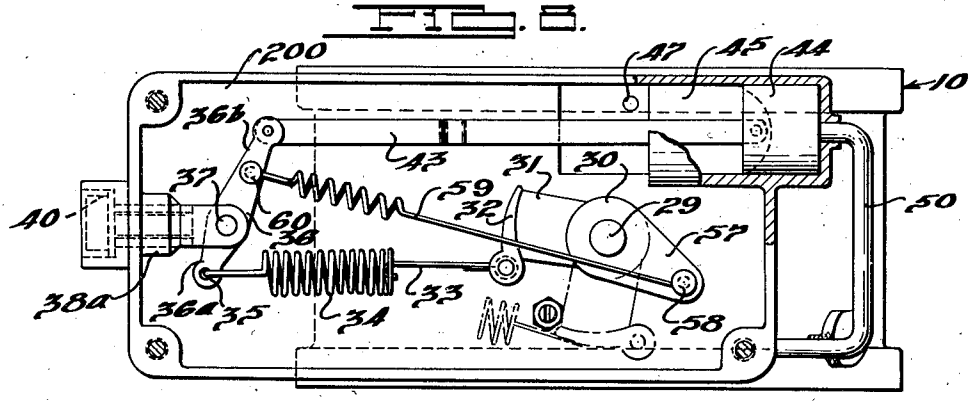
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GOVERNOR

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FIG. 3.



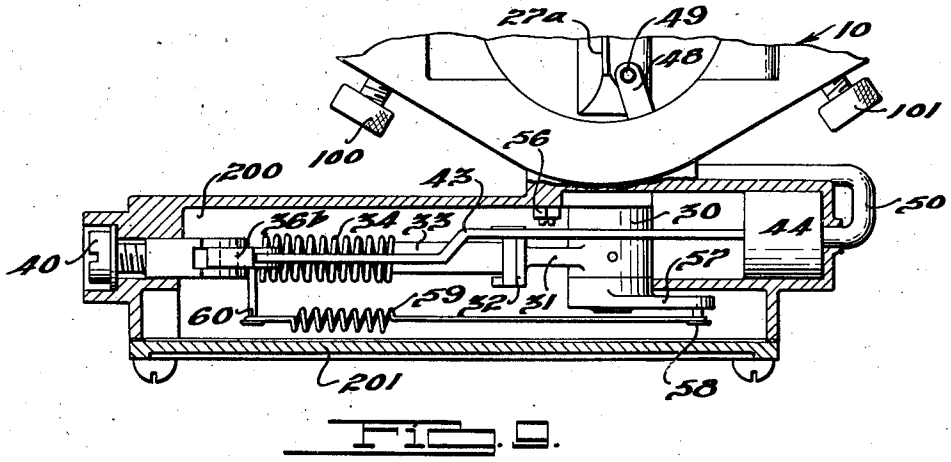


FIG. 4.

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UNITED STATES PATENT OFFICE

2,200,065

GOVERNOR

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Application December 7, 1935, Serial No. 53,347

15 Claims. (Cl. 137—153)

This invention relates to governors for internal combustion engines and more particularly to governors of the suction or vacuum operated type provided with a governing valve, such as a pivoted butterfly valve of either the balanced or unbalanced kind, actuated toward its closed position in the intake passage by the operation of the engine.

An object of the invention is to provide a governor of the foregoing class having a butterfly valve eccentrically pivoted so as to unbalance the same and wherein novel and improved anti-stealing means is provided which is effective to prevent overrunning of the engine under relatively light load by manipulation of the carburetor throttle valve.

A further object of the invention is to provide an anti-stealing device including a piston subject not only to the pressures existing in the intake passage above and below the valve but also preferably to the velocity of the fluid or gaseous mixture flowing through the passage.

A still further object of the invention is to provide an anti-stealing device operative preferably as a result of differences in pressure above and below the valve and which is in turn operative to control the tension of the main governing spring, as when the carburetor valve is closed under light load to overrun the engine.

A further object is to provide a governor in which the governing valve, such as a pivoted butterfly valve of either the balanced or unbalanced type, is movable to close by the operation of the engine and to open by the action preferably of a simple straight-line spring, and in which a rotatable crank arm acts on the spring to produce a disproportionately less deflection of the spring as compared with the valve movement near the open position of the valve than near the closed position thereof, and in which the effective arm, through which the spring turns the valve shaft, is increased by maintaining the length of the arm constant when it reaches its maximum.

A further object of the invention is to provide a simplified governor of the foregoing type capable of functioning with maximum efficiency and economy and characterized by its wide range of adaptability to various engines or by its wide range of adjustability for any given engine or engines.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Fig. 1 is a side view of a governor constructed in accordance with the present invention and installed on an engine in connection with a down-draft carburetor.

Fig. 2 is a fragmentary sectional top view of the governor taken through lines 2—2 of Fig. 1 in the direction of the arrows.

Fig. 3 is a section taken through lines 3—3 of Fig. 2 in the direction of the arrows.

Fig. 4 is a bottom plan view of the governor.

Fig. 5 is a section taken through lines 5—5 of Fig. 2 in the direction of the arrows.

Fig. 6 is a section taken through lines 6—6 of Fig. 2 in the direction of the arrows.

Fig. 7 is a detail section taken through lines 7—7 of Fig. 6 in the direction of the arrows.

Fig. 8 is a view similar to Fig. 3 but illustrating a modification.

Fig. 9 is a fragmentary plan view, partly in section, of the governor shown in Fig. 8.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation, and it is not intended to limit the invention claimed herein beyond the requirements of the prior art.

In the embodiments of the invention illustrated, by way of example, in the drawings, there is provided a governor A for an internal combustion engine B adapted for use with a carburetor C of the down-draft type. Although designed for this purpose, it will be understood that the governor is equally adapted for use in connection with an up-draft carburetor. As shown in Fig. 1, the carburetor throttle valve of the conventional butterfly type is indicated at D and is operated manually in the usual manner to control the flow of gaseous mixture through the intake pipe or passage E. The governor A is interposed in the intake passage between the carburetor throttle valve D and the intake manifold F. The illustrated governor comprises a suitable casing 10 cast to provide oppositely projecting ears or bosses 11 vertically drilled to provide bolt holes 12 for the reception of bolts 12a by means of which the governor casing is attached in position in the intake passage. In the position of the governor illustrated in Figs. 5 and 6, the carburetor C is located at the upper side of the casing and the intake manifold at the bottom side, there being an axial passage through the casing which forms a part of the intake passage.

The casing 10 is cast and machined at diametrically opposed sides of the intake passage to provide interior recesses 13 which are herein shown as having parallel rectilinear side walls

13a. Within the recesses 13 are mounted a pair of adjustable inserts 14 and 15 which are preferably formed of metal suitable for die casting. The insert 14 is pivotally mounted at its upper end on a transverse pivot pin 16 driven into a hole drilled through the casing and removable therefrom for the purpose of changing or replacing the insert. The insert 15 in the present instance is also pivotally mounted at its upper end on a transverse pivot pin 17, this pin being driven into a transverse drilled hole and likewise removable for the purpose of changing or replacing the insert. The upper end of the insert 14 is transversely slotted or grooved at 18 for the reception of a bowed leaf spring 19, the ends of which project freely into notches 18a formed in the casing at opposite sides of the insert. In like manner, the upper end of the insert 15 is transversely slotted at 20 to receive a similar leaf spring 21 having its ends confined within similar notches in the casing at opposite sides of the insert. Adjustment of the insert 14 about its pivotal axis 16 is obtained by means of an adjusting screw 101 having a knurled head and a threaded shank extending obliquely through a tapped hole in the casing and engaging the upper end of the insert 14. In like manner, adjustment of the insert 15 about its pivotal axis 17 is obtained by a similar adjusting screw 100 engaging the upper end of the insert. The inserts, which form walls of the passage, are thus independently adjustable by means of the adjusting screws and the adjustment of either insert is opposed by its spring 19 or 21.

The inner vertical walls of the inserts 14 and 15 are arcuate or concaved in formation and form with the side walls 13a of the recesses 13 lateral enlargements of the intake passage in the governor casing. The enlargement of the intake passage intermediate the inlet and outlet orifices of the casing is accomplished by forming the insert 14 with an outwardly extended arcuate recess 25 arranged below the shaft 16 and forming the insert 15 with a similar recess 26 located above its pivot 17.

Mounted within the intake passage of the governor casing 10 is a governing valve 27 which is herein illustrated as of the butterfly type. The central portion of the valve is arcuate in shape and of a diameter to fit the corresponding arcuate wall portions 24 of the passage and to substantially engage the same when the valve is in closed position. From its central portion the valve blade at opposite sides of its pivot is extended to provide portions 27a and 27b having rectilinear edges fitting closely within the straight faces of the vertical walls 13a, the end edges of the valve being curved in a horizontal plane to conform substantially to the curvature of the recesses 25 and 26 thereby permitting the valve to be moved into position, as shown in dotted lines in Fig. 6, to substantially close off the passage. The width of the valve in the direction of the inserts is, therefore, increased so that the valve in this direction is wider than the effective diameter of the intake passage axially of the valve shaft. The valve, in the present instance, is shown as an unbalanced valve, being secured eccentrically to a cross-shaft 29 so as to provide a longer side 27a and a relatively shorter side 27b. It will be noted that the faces 28 of the valve blades are curved to produce a streamlined configuration.

The valve shaft 29 is journalled in suitable bearings at opposite sides of the casing and projects laterally through a hole in one side wall of a casing 200 secured to the valve casing 10. Fixed to the outer end of this shaft is a sleeve 30 provided with a laterally projecting crank arm 31 terminating in a shoe 32 having an outer curved bearing face. The lower edge of this shoe is bifurcated to receive a transverse pin 32a to which is attached a length of steel tape 33. The band or tape 33 is also attached to one end of a tension spring 34, the other end of which is anchored at 35 to the short arm 36a of a lever 36 pivoted at 37 to the outer end of an adjusting member 38. The latter has a sliding fit in a boss 38a of the casing and its end is drilled and tapped to receive the threaded shank 39 of an adjusting screw 40. By adjusting this screw the member 38 may be adjusted within the boss 38a so as to vary the position of the supporting pivot 37 for the lever 36. The head of the adjusting screw is housed within a housing or boss 41. The longer arm 36b of the lever 36 is pivoted at its outer end at 42 to a connecting rod 43 and the inner end of the latter is pivotally connected by means of a wrist pin to a piston 44. The piston has a sliding fit within the cylindrical bore of a barrel or cylinder 45, one end of which is open to the interior of the casing 200 which in turn has a cover or closure plate 201 completely sealing the casing from the atmosphere. At the opposite side of the shaft 29 from the crank arm 31 the sleeve 30 is provided with a projecting member 46 forming a counter-weight.

The interior of the casing 200 is subject to the pressure in the intake passage existing at a suitable point between the valve 27 and the carburetor throttle valve, and accordingly a hole 47 is drilled through the walls of the casing to provide a passage opening into the main intake passage at a point well above the valve axis. The passage 47, see Figs. 6 and 7, is extended into the intake passage by means of a short section of tubing 48 which has a right angle bend with a lateral opening 49 facing upwardly or toward the carburetor throttle valve. The tube 48, therefore, is in the nature of a Pitot tube, being positioned within the intake passage so that its flaring open end 49 will be directly exposed to the flow of fluid. Hence, by reason of the velocity of the fluid in the intake acting on the column of air in the tube, the static pressure in the casing 200 will be increased or built up. The closed end of the piston chamber 45, and hence the outer end of the piston 44 is subjected to the pressure in the intake passage existing at a point between the governing valve and the intake manifold. This is accomplished by means of a pipe 50 leading from the closed end of the piston chamber and communicating with a passage 51 drilled through the side wall of the casing 10 and opening in the passage, as shown in Fig. 6, at a point well below the valve axis. At a point slightly above the valve axis which is traversed by the valve when moved from open to closed position is a bleeder port 52 opening into the intake passage through the wall of the casing and connected by means of communicating passages 53 and 54 with the main vacuum passage 51. The bleeder passage is controlled by means of a metering pin 55, as shown in Fig. 2, which may be adjusted by means of an adjusting nut 56 so as to close off to the desired extent communication between the bleeder passages 52—54 and vacuum passage 51.

Referring to the embodiment illustrated in Figs. 8 and 9, in this instance the construction of

the governor is identical with that illustrated in Figs. 1 to 7 inclusive with the exception that the counter-weight **46**, fixed to the valve shaft **29** in the previous embodiment, is omitted. In this instance the sleeve **30**, which is pinned or otherwise fixed to the valve shaft, is provided with a projecting arm **57** located at the opposite side of the valve shaft from the crank arm **31**. An auxiliary spring **59**, substantially lighter than the spring **34**, is interposed between the arm **57** and the long arm **36***b* of the lever **36**. This spring is connected to pins **58** and **60** projecting respectively from the sides of the arms **57** and **36***b* in such manner, as shown in Fig. 8, that the axis of the spring intersecting the points **58** and **60** will lie below the valve axis when the valve is in wide open position, at which time the spring will exert a force tending to hold the valve in open position.

It will be seen in this embodiment that when the governing valve is in its wide open position, as shown in full lines in Fig. 8, the tension of the auxiliary spring **59** acts upon the valve shaft through a very small effective arm, acting at the same time upon the main spring **34** with a much greater arm. Thus, the auxiliary spring **59** exerts a slight force upon the governing valve when the valve is wide open, tending to hold it in this position. This opening force diminshes to a zero value when the arm **57** reaches its dead center position. During this closing movement from wide open valve position the crank arm **57**, after a travel of approximately 15°, passes through its zero value, during which time the crank arm **31** will have rotated sufficiently to stretch or elongate the main spring **34**. As the arm **57** continues in a counter-clockwise direction past dead center, and during a considerable portion of this travel, the spring **59** will be maintained under sufficient tension to exert a substantial turning effort on the lever **36** not only assisting in holding the arm **36***a* of the lever and hence the piston in its fully retracted position but also exerting a closing effort on the valve.

It, therefore, follows that at the wide open position of the valve the auxiliary spring **59** through crank arm **57** exerts an opening effort on the valve which effort diminishes to zero as the crank arm rotates to its dead center position, the moment of the spring force in this direction being greatest when the valve is fully open. After the crank arm **57** passes dead center, however, the spring exerts through this arm a closing effort on the valve which effort gradually diminishes to zero value as the governing valve approaches its closed position. It will be seen that the maintenance of the retracted position of the piston is assisted by the auxiliary spring **59**. When the governing valve is closed, there is substantially no deflection of the auxiliary spring. But as the valve opens under the influence of the main spring, the tendency of the piston to be displaced, due to the pull of the main spring, is progressively offset by the stretching or elongation of the auxiliary spring, the effect of which is transmitted through the longer arm of the lever **36**.

In the operation of the governor it will be understood that under conditions of low engine speed and relatively high load, when it is necessary to have both the carburetor throttle valve and the governing valve in wide open positions, or nearly so, the flow of the fuel mixture in the intake passage will be relatively slow and the difference in pressures above and below the governing valve will be slight. Under such conditions only a very slight force is necessary to maintain the governing valve in its wide open position, and since the effort exerted by the main spring **34** at this time is negligible, the counter-weight **46** is utilized to provide this opening effort. In the embodiment illustrated in Figs. 8 and 9, the action of the counter-weight to produce this result is accomplished by the light auxiliary spring **59**.

The valve **27** is, of course, maintained, as by means of a suitable stop, in a slightly inclined position as shown in Figs. 5 and 6, which position is due in part to the fact that the valve is stream-lined and also offset in two planes. When the valve is in this wide open position, there is a substantial closing torque on the valve resulting from the force due to the velocity of the fluid and also to local pressure differences which are augmented by reason of the stream-lined form of the valve. As the engine speed increases and due to this slightly inclined position of the valve and the offset thereof, two phenomena occur in the closing of the valve by the operation of the engine. The moving fluid strikes the valve and tends to close it. In addition to the foregoing, due to the fact that the valve creates an obstruction in the passage, the pressure at the carburetor side of the valve rises and the pressure at the engine side drops as the valve moves toward closed position. By virtue of this differential in pressure and the unbalance of the valve, a closing force is exerted on the valve in addition to the force due to the velocity of the fuel mixture. It will be understood that while the force, due to the velocity of the fluid, diminishes as the valve closes, the force, due to static pressure differences, increases very rapidly as the valve approaches its closed position. In the present embodiments of the invention, the principal means for resisting the closing forces on the valve is in the form of a single straight-line spring **34**, and the construction is such that the closing forces on the valve, i. e. the closing moments on the valve shaft, are resisted by the spring up to the maximum permissible speed, and at the set speed the opening and closing moments on the valve shaft are substantially equal.

In its preferred forms, the operation of the governor, by which the opening or resisting moments produced by the spring are caused to balance the closing moments produced by the action of the fluid or vacuum on the governing valve, is produced in three ways: (1) by increasing the closing moment produced by the action of the fluid on the governing valve **27** during the early closing movement of the valve; (2) by decreasing the closing moment produced by the action of the vacuum on the governing valve when the latter is approaching its closed position, and (3) by balancing the resistance force and, consequently, the opening moment produced by the spring **34** against the closing effort of the valve throughout the range of travel of the valve.

The increase in the closing moment produced by the action of the fluid on the governing valve is achieved by shaping the valve so as to have a stream-lined configuration and by increasing the size or area of the valve. In stream-lining the valve, as shown at **28**, it is made of such a cross-section that the passage, formed between the valve surfaces and the walls of the conduit, operates to prevent turbulences and to produce non-turbulent flow of high effect, thereby increasing the velocity force acting on the valve by decreasing the static pressures past the end

portions of the valve. By increasing the size or area of the valve, it is possible to amplify the effect of velocity force and vacuum force produced as a result of the stream-lined shape of the valve. The increase in length of the valve produces a greater rate of closing of the valve for a given angular movement thereof, and as a result of this an increase in the closing torque or moment on the valve shaft in the initial movement of the valve away from its open position is achieved.

The decrease in the closing moment produced by the action of the vacuum upon the valve, when the valve 27 is approaching its closed position, is accomplished by controlling the effective opening of the valve through the medium of the insert walls 14 and 15, the construction and operation thereof, together with their advantages, being particularly shown and described in my copending application Serial No. 46,939, and in these respects reference is made to said copending application.

The balancing of the resistance force of the spring 34 against the closing effort of the valve throughout its travel is in the present instance accomplished in three ways: (1) by increasing the total deflection of the spring 34; (2) by increasing the effective arm through which the spring acts upon or turns the valve shaft 29 and by maintaining the length of the arm 31 constant when it reaches its maximum, see dotted line position in Fig. 3; and (3) by the action of the counter-weight 46 or the auxiliary spring 59.

It will be understood that during any intermediate engine speed, the closing of the governing valve 27 will turn the crank arm 31 thereby stretching or elongating the straight-line spring 34. By providing the rotating crank arm 31, it will be seen that the distance to which the spring is stretched, or the deflection thereof, is made non-proportional to the angular movements of the governing valve. When the valve is initially moving away from its open position, the arm 31 moves nearly perpendicularly to the spring axis and, therefore, stretches the spring but slightly. As the crank arm 31, however, moves toward the dotted line position shown in Fig. 3, the distance through which the spring 34 is stretched or deflected per unit of angular movement of the governing valve increases, and when the crank arm reaches the dotted line position, the elongation of the spring per unit of angular movement of the crank arm or valve and the moment of the spring force reach their maximum. Ordinarily, upon passing this position, the reverse action of the spring takes place.

In accordance with one aspect of the present invention, means is provided for maintaining the elongation of the spring 34 as also the moment of the spring force at its maximum, as shown in dotted lines in Fig. 3, after this point has been reached. Thus, as the crank arm 31 moves further to the right from the dotted line position, the steel band or tape 33 commences to wind or wrap upon the arcuate surface of the shoe 32. This results in keeping the effective arm at its maximum, and after the dotted line position of the crank arm is reached, the effect of angularity of the crank arm movement is eliminated. Thus, it will be seen that the desirable advantages of the angularity of the crank arm movement in increasing the resistance force of the spring during the closing of the valve is preserved whereas the undesirable effects, after the crank arm has reached the dotted line position in Fig. 3, are eliminated. As a consequence of this feature of the invention, combined with the action of the counterweight or the auxiliary spring, it is possible to permit the governing valve to move through a greater angle than 90°, i. e. as much as 120°, without losing the final effective resistance force of the spring. The lower deflection rate made possible by the greater arc of travel of the valve thus diminishes the resisting force of the spring during the early closing movement of the valve.

Due to the connection of the spring 34 to the lever 36 which in turn is connected to the piston 44, it will be seen that the effective tension of the spring at any time is dependent upon the position of the piston in its cylinder and hence the position of the lever 36. With the piston held in the position shown in Fig. 3, the spring will be capable of exerting its maximum resistance to the closing of the valve, but any movement of the piston to the left will effect a relaxation of the spring tension. During operation it will be understood that a balance between the opposed forces of the spring and piston on the lever will be reached at all times. During normal governing operation, with the carburetor valve wide open, the pressure in the casing 200 acting on the inner end of the piston, which pressure is increased by the effect of the tube 48, must be sufficient to hold the piston retracted as in Figs. 3 and 8.

It is, of course, essential during governing conditions that the piston be held in fully retracted position, see Fig. 8, regardless of the position of the governing valve. If the piston has such a size or effective area that it will just barely overbalance the pull of the main spring 34 when the governing valve is in no-load or substantially closed position, it will not have large enough area to exert sufficient force to hold the lever arm 36b fully retracted against the pull of the main spring when the valve is nearly open, i. e. in any of those positions of the valve when the velocity forces become a factor and the force due to static pressure differences is small. Although under such conditions the Pitot tube effect of the member 48, by increasing the pressure in the casing 200, assists in holding the piston retracted, yet it has been found desirable to supplement this. Therefore, the piston 44 is made slightly larger than necessary to maintain a balance against the main spring at no-load position. By this slight increase in the piston area it is capable of exerting sufficient force, assisted by the effect of the velocity tube 48, to maintain a balance against the main spring at near-open positions of the valve. In order, however, to compensate for this increase in piston area or oversize of the piston (which is beneficial when the valve is in its open positions as above explained) the adjustable air bleed 52 into the main vacuum line 50—51 is provided, the bleed 52 being opened or exposed to the higher pressure at the carburetor side of the governing valve at a predetermined time when the latter approaches no-load position.

The anti-stealing device, in the present instance, is such as to be very sensitive, responding to stealing attempts under all conditions, particularly when the carburetor valve is partially closed and attempt is made to overrun the engine under a very light load. When the carburetor throttle valve is partially closed, the pressure in the intake passage between the carburetor and governing valves drops, thus reducing the difference in pressure between the up and down stream

sides of the governing valve acting on the piston **44**. As a consequence of the reduction in the closing effort on the governing valve under such conditions, the main spring **34** normally would tend to overbalance the closing effort on the valve thereby causing it to open and hence speed up the engine. This, however, is obviated in accordance with the present invention. The operation of the piston **44** in the present governor is such as to decrease or relax the tension of the main spring **34** under such conditions so as to cause the governing valve to close despite the fact that the effective vacuum action or effort on the governing valve is decreased.

Assuming that a condition of balance exists between the main spring, governing valve and piston during normal governing operation, if the carburetor valve is partially closed by the operator and manipulated for the purpose of stealing, the pressure in passage **47** and in the casing **200** will be reduced due to the reduction in pressure in the intake passage between the carburetor and governing valve. This will effect a reduction in the pressure on the inner end of the piston which pressure, it is assumed, was theretofore sufficient to hold the piston extended and balanced against the main spring tension. As a consequence the piston will move to the left under the pull of the main spring on the lever **36** until a balance is reached, but this action results in relaxing the spring force acting through crank arm **31** on the governing valve. By thus reducing the spring resistance, the governing valve will close in accordance with the closing of the carburetor throttle valve.

It will be noted that the insert **14** with its contoured portion of the intake passage is pivoted somewhat past or beyond the point where the adjacent portion of the valve **27** normally comes to rest at no-load position, as shown in dotted lines in Fig. 6. Hence, adjustment of this insert toward the valve results in a diminishing rate of increase in the effective opening as the valve swings open and hence a lower governed speed, and conversely adjustment of insert **14** away from the valve produces a higher rate of increase in the effective valve openings as the valve swings open and hence a higher governed speed. The insert **15**, on the other hand, with its contoured portion of the passage is in the present instance pivoted in advance of the point where the adjacent portion of the governing valve normally comes to rest at no-load position. By thus mounting the insert **15** in this manner a greater range of adjustment at the idling position of the governing valve is possible, since adjustment of this insert about its axis **17** primarily increases or decreases the effective opening at or near the idling or no-load position shown in dotted lines in Fig. 6.

It will be understood that the contour of the walls **25** and **26** of the inserts may be widely varied, and although but an approximate 90° travel of the governing valve is indicated in the drawings, it will be understood that by varying the contour of the walls **25** and **26** or adjusting outwardly the lower ends of the inserts through the adjusting screws, increased range of travel of the governing valve may be had. The design and arrangement, however, of the crank arm **31** and associated parts are such as to permit a range of valve movement up to approximately 120°.

It will also be understood that the curvatures of the faces **25** and **26** are so designed and calculated that all portions thereof swept over by the edges of the blade portions **27***a* and **27***b* are the correct distances therefrom in all angular positions of the valve. Consequently, the correct effective openings past the valve may be predetermined so as to induce the required degrees of vacuum to balance the force exerted by the main spring **34**. In this manner the vacuum curve may be made to correspond substantially to the modified spring curve. Since near the wide open position of the valve no departure from the conventional straight wall passage has any appreciable effect on the closing rate of the valve, the balance of spring and vacuum forces is assisted at this time by varying the rate of deflection or movement of the spring **34** through the angularity of the crank arm **31**, as previously described. Thus, near wide open position there is obtained a large angular movement of the valve for a slight deflection of the spring. As soon as a point is reached in the valve travel when the disproportionate relationship due to the angularity of the crank arm **31** disappears, as at the dotted line position shown in Fig. 3, the balance of the forces is to a substantial extent achieved by shaping the walls **25** and **26** so as to produce the areas of effective valve opening calculated to induce the manifold pressures necessary to balance the spring loads at all points in the range of closing travel of the valve. Hence, as the governing valve nears its closed position, the differential action due to the angularly shaped walls **25** and **26** produces a disproportionately small valve movement as compared with the movement or deflection of the spring. It might be said in this respect that the vacuum curve is thus modified so as to conform to the spring curve.

I claim:

1. A governor for an internal combustion engine comprising an unbalanced governing valve movable towards closed position by the operation of the engine, a spring opposing said movement, an anti-stealing device for exerting a closing effort on the valve and actuated both by static pressure in the intake manifold and the velocity of the fluid flowing through said passage, and means for augmenting the action of the main spring at wide open valve position but substantially ineffective at its closed position.

2. A governor for an internal combustion engine comprising an unbalanced governing valve movable towards closed position by the operation of the engine, a spring opposing said movement, an anti-stealing device for exerting a closing effort on the valve and actuated both by static pressure in the intake manifold and the velocity of the fluid flowing through said passage, and an auxiliary spring for augmenting the action of the main spring at wide open valve position but substantially ineffective at its closed position.

3. A governor for an internal combustion engine comprising a governing valve movable toward closed position by the operation of the engine, a spring for resisting closing movement of the valve, a shaft upon which said valve is mounted to turn, a crank arm through which said spring turns the valve shaft and having an increasing effective arm as the valve moves from open toward closed position, and means for rendering said effective arm constant upon reaching its maximum effective length.

4. A governor for an internal combustion engine comprising a casing having an intake passage therethrough and inlet and outlet portions, a governing valve in said passage pivoted on an eccentric axis to provide an unbalanced condition

and movable toward closed position by the operation of the engine, said passage intermediate said inlet and outlet portions being widened in the direction of closing of the valve at one side above the valve axis and at the opposite side below the valve axis to provide curved contoured surfaces swept by the outer edges of the valve.

5. A governor for an internal combustion engine comprising a casing having an intake passage, a butterfly valve in said passage pivoted eccentrically to provide an unbalanced condition, a spring resisting closing movement of said valve, the wall of said casing at each side of the valve axis having a recess cooperating with an edge of the valve and providing a progressive widening of the passage in the direction of closing of said edge of the valve, the major portion of one of said recesses being above the valve axis and the major portion of the other recess being below the valve axis and the wall of each recess sloping inwardly toward the wide open position of the adjacent cooperating valve edge.

6. A governor for an internal combustion engine comprising a casing having an intake passage, an unbalanced butterfly valve in said passage, a spring resisting closing movement of said valve, means interposed between said spring and valve for causing near the open position of the valve a less movement of the spring as compared with the movement of the valve, the walls of said valve passage being contoured to produce a less movement of the valve near its closed position than the movement of the spring, and a piston actuated at least in part by differences in pressure in the passage for controlling the tension of said spring relatively to the valve.

7. In a governor for internal combustion engines, a casing having an intake passage, a governing valve in said passage eccentrically mounted to provide an unbalanced condition and movable toward closed position by the operation of the engine, a spring opposing said closing movement, means for varying the rate of spring deflection as compared with the valve movement, separate means for varying the rate of effective closing movement of the valve as compared with the rate of spring deflection, and vacuum responsive means for controlling the tension of said spring relatively to the valve.

8. A governor for an internal combustion engine comprising an unbalanced governing valve movable toward closed position by the operation of the engine, a spring opposing said closing movement, a piston connected to the valve and disposed out of the path of flow of the fluid in the intake passage, said piston being subject to the difference in pressures at opposite sides of the valve, and means for decreasing such effective difference at a predetermined point in the closing travel of the valve.

9. A governor for an internal combustion engine comprising an unbalanced governing valve movable toward closed position by the operation of the engine, a spring opposing said closing movement, a piston connected to the valve and disposed out of the path of flow of the fluid in the intake passage, said piston being subject to the difference in pressures at opposite sides of the valve, means for decreasing such difference at a predetermined point in the closing travel of the valve, and means for subjecting said piston to the velocity force of the fluid flowing through the intake passage.

10. A governor for an internal combustion engine comprising a governing valve movable toward closed position by the operation of the engine, a spring opposing said closing movement, a piston connected to the valve and disposed out of the path of flow of the fluid in the intake passage, said piston being subject to the difference in pressure at opposite sides of the valve, and means for varying such difference at a predetermined point in the travel of the valve.

11. A governor for an internal combustion engine having an intake passage, comprising a pivoted unbalanced butterfly governing valve mounted in said passage and adapted to be partially rotated toward closed position by the operation of the engine, spring means resisting said closing movement and adapted to substantially balance the closing effort on the valve at different positions thereof during governing operation, and a vacuum actuated device disposed outside said passage for varying the resistance of said spring means.

12. A governor for an internal combustion engine having an intake passage, comprising a pivoted butterfly governing valve mounted in said passage and adapted to be partially rotated toward closed position by the operation of the engine, a spring resisting said closing movement and adapted to substantially balance the closing effort on the valve at different positions thereof, and a vacuum actuated device subject to the pressure in said passage upstream of the governing valve and acting upon said spring to render the spring ineffective at a predetermined time to impart an opening movement to the valve, said spring being connected at one end to the valve and at its opposite end to the device.

13. A governor for an internal combustion engine having an intake passage, comprising an unbalanced governing valve in said passage movable towards closed position by the operation of the engine, a spring opposing said movement, an anti-stealing device for exerting a closing effort on the valve and subject to the pressure in said passage upstream of the valve, and a lever connecting said device and spring for transmitting a force from said device to the spring.

14. A governor for an internal combustion engine having an intake passage, comprising an unbalanced governing valve in said passage movable towards closed position by the operation of the engine, a spring opposing said movement, an anti-stealing device for exerting a closing effort on the valve and subject to pressure in said passage, and a lever connecting said device and spring for transmitting a force from said device to the spring, said lever being fulcrumed intermediate its ends and having a shorter arm connected to the spring and a longer arm connected to the piston.

15. In a governor for an internal combustion engine, a governing valve, a shaft supporting said valve for turning movement, a spring for resisting closing movement of the valve, a crank arm on the shaft, a flexible member connecting said spring to that outer end of said arm which is more remote from the axis of the valve shaft, said crank arm having a predetermined angular movement while the valve is closing effective to produce a disproportionately greater deflection of the spring near the closed position of the valve than near its open position, and a member on the outer end of said crank arm adapted to engage said flexible member only after said angular movement of the valve.

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