July 30, 1940. J. W. ANDERSON, JR 2,209,374

GOVERNOR

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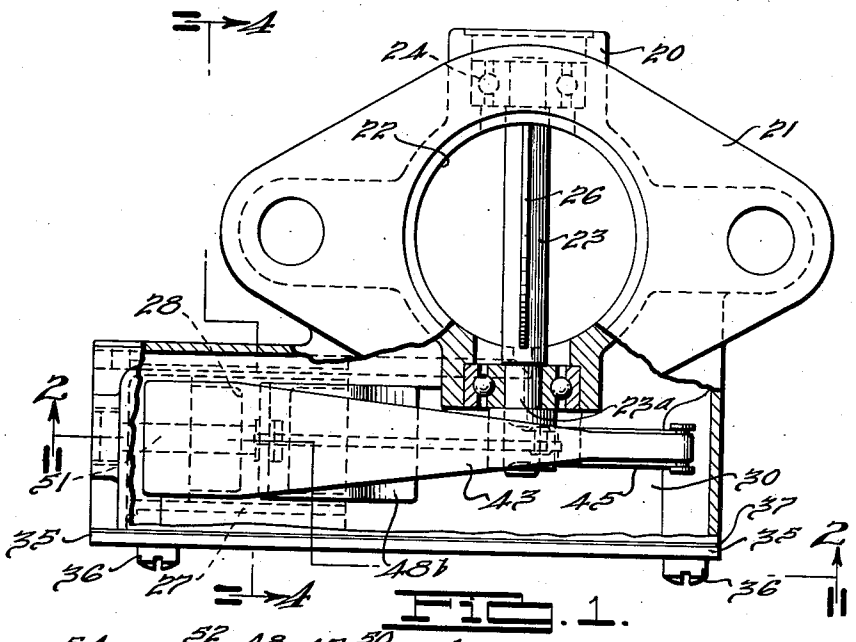


FIG. 1.

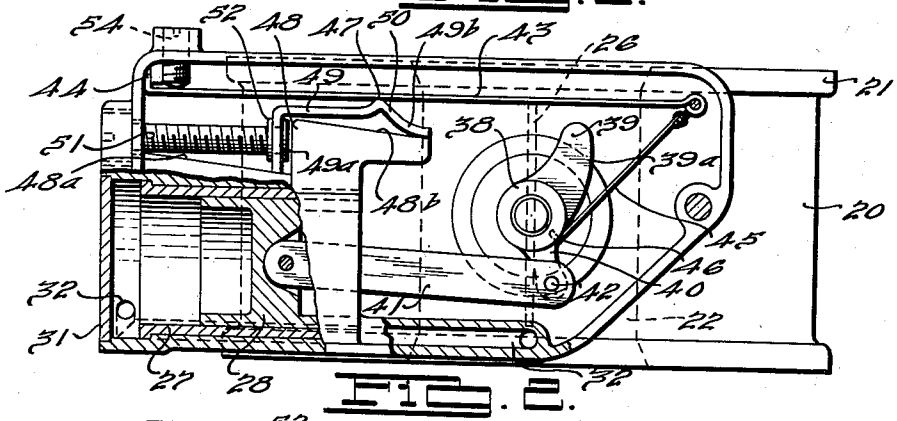


FIG. 2.

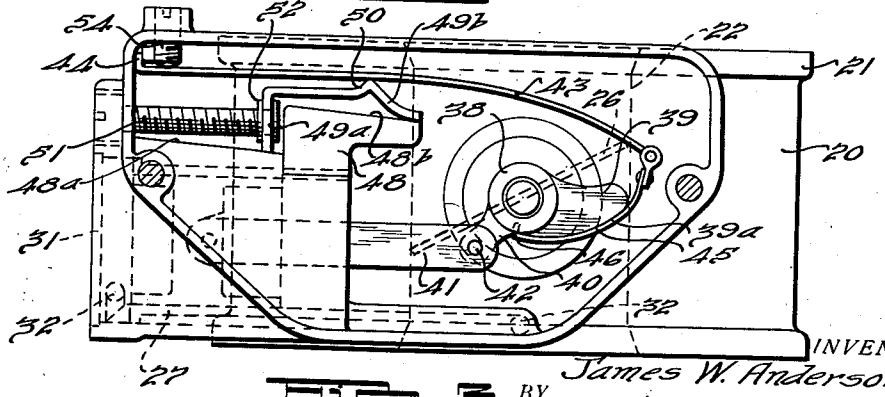


FIG. 3.

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GOVERNOR

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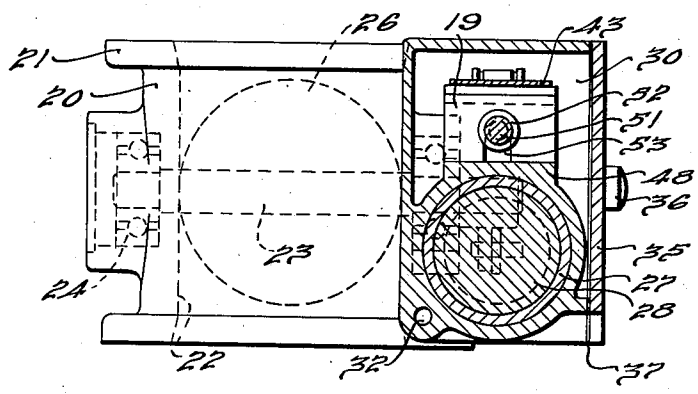


FIG. 4.

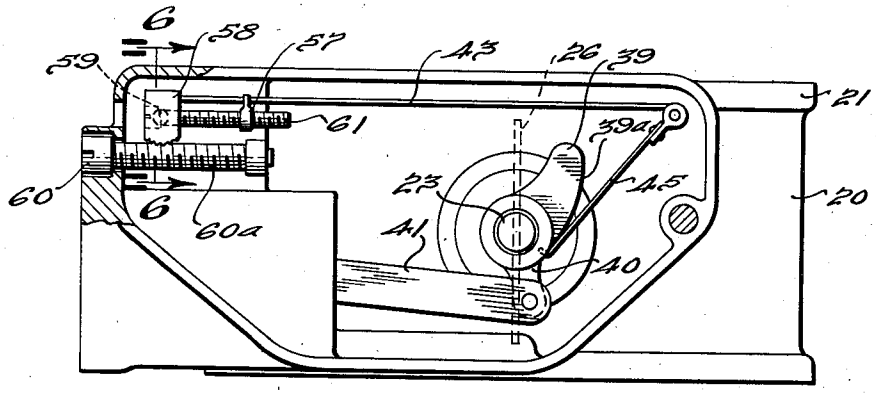


FIG. 5.

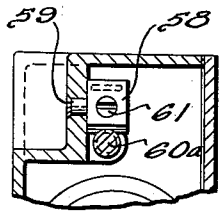


FIG. 6.

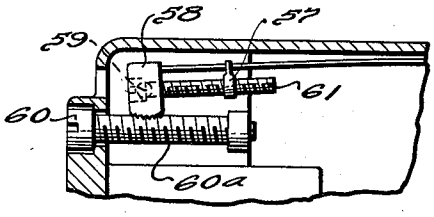


FIG. 7.

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GOVERNOR

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Application November 17, 1937, Serial No. 175,080

9 Claims. (Cl. 137—153)

This invention relates to governors for internal combustion engines and more particularly to governors in which the governing valve is actuated, usually in a closing direction, by the operation of the engine.

Governors of this character are known in the art under the general name of suction or vacuum operated governors and they may be of several types, such, for example, as the so-called velocity type utilizing an unbalanced butterfly valve actuated directly by the difference of pressures on its sides and by the impact of the fluid flowing through the engine intake passage; or the static pressure type utilizing a substantially balanced butterfly valve actuated by a piston, or the like, responsive to the vacuum created in operation in the intake passage of the engine; or the combination of these types. All such governors are herein termed suction of vacuum operated governors, in order to indicate that the governing valve is actuated by forces produced by the operation of the engine itself, and particularly by the suction action of the pistons thereof.

The invention herein disclosed is described with a particular reference to a governor of the static pressure type, although it will be understood that the invention is not limited thereto, and that it is equally applicable to suction governors of any type.

Because of the suction action of the engine pistons, a certain degree of vacuum is produced in the intake manifold of an engine, inducing a strong flow of fluid, namely, air and fuel mixture, through the intake passage of the engine. The degree of vacuum produced in the intake passage depends upon the opening of the carburetor throttle valve, and it varies in such a way that when plotted on the axis of ordinates in a system of rectangular coordinates wherein the degree of valve opening is plotted on the axis of abscissae, a curved line is produced. Since the forces produced by the vacuum and available for closing of the governing valve are proportional to the degree of the vacuum, said forces, when similarly represented, will exhibit curve line characteristics. On the other hand, forces resisting closing of the governor valve produced by a spring in deflection (the common way of securing the resisting force) exhibit straight line characteristics. Providing means which would cooperate with the resisting spring in such a way and would so modify the force exerted thereby on the valve operating mechanism that the characteristic line of the spring coincides with the curve of the vacuum operated means substantially throughout the entire operative range of the valve, has proved to be a very difficult problem in this particular art. It must be noted at this point that balancing of the closing torque exerted on the valve shaft by the vacuum operated means and the opening torque exerted on the same shaft by the resisting means is a very important requirement for dependable governing action of the valve.

Another difficulty confronted in the art results from the necessity of providing means whereby governors can be adjusted to give governing action at different speeds. From the foregoing it will be understood that one of the best ways to effect such adjustment is to change the resistance of the spring means. However, such change of resistance should be of such a character that it does not destroy the coincidence of the characteristic curves below the maximum speed for which the governor is so adjusted. In other words, the results sought to be attained with the aid of adjustment means are, when expressed in terms of their graphical representation, simply to move the maximum speed of the engine to a desired point on the axis of abscissae, preserving at the same time the coincidence of the vacuum and spring curves.

One of the objects of the present invention is to provide an improved engine governor having a butterfly governing valve of the balanced or unbalanced type, which valve is actuated in a closing direction by means of a piston subjected to the action of the manifold vacuum, this action being resisted in improved manner by spring means.

A further object of the invention is to provide an improved governor having a valve of the butterfly type, closing of which is resisted by means of a spring, the action of the spring being modified within predetermined portions of the operative range thereof by the effect of the angularity of the valve shaft crank and by additional means changing the effective length of the crank and, consequently, the effective torque arm, whereby a characteristic curve of the spring is made to conform closer to the required curve characterizing the action of the vacuum operated valve closing means.

A still further object of the invention is to provide a governor of the foregoing character in which there are provided improved means enabling adjusting the governor for various maximum speeds without affecting the quality or accuracy of the governor action.

A still further object of the invention is to

provide improved adjustment means for an internal combustion engine governor, whereby adjustments of the spring resistance are effected by changing the amount of initial deflection of the governor spring and by changing the rate of deflection thereof.

A still further object of the invention is to provide improved adjustment means of the above character, in which changes of the amount of initial deflection or of the deflection rate of the spring may be done either separately or in combination.

A still further object of the invention is to provide an improved spring for an internal combustion engine governor, the deflection rate curve of which corresponds very closely to the vacuum curve of the governor, and in which the disadvantage of friction common to laminated springs is eliminated.

It is an added object of the present invention to provide an improved governor of the above specified character, which is simple in construction and dependable in operation, and which is relatively inexpensive to manufacture.

Other objects and advantages of the invention will appear from the following description and appended claims when considered in connection with the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Fig. 1 is a top view of a governor constructed in accordance with one embodiment of the present invention.

Fig. 2 is a side view of the structure shown in Fig. 1, part of the structure being shown in cross section, section being taken on the line 2—2 of Fig. 1, the governing valve being shown in its fully open position.

Fig. 3 is a view similar in part to that of Fig. 2, the parts of the governor being shown in positions corresponding to the fully open position of the governing valve.

Fig. 4 is a sectional view of the governor of Fig. 1, the section being taken on the line 4—4 of Fig. 1 looking in the direction of the arrows.

Fig. 5 is a side view of a governor constructed in accordance with the present invention and employing adjustment means of a modified construction.

Fig. 6 is a fragmentary sectional view of the modified adjustment means, the section being taken on the line 6—6 of Fig. 5 looking in the direction of the arrows.

Fig. 7 is a fragmentary side view of the modified adjustment means, the same being shown in a position in which the support of the spring is raised to a certain position.

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 drawings there are illustrated, by way of example, two governor devices constructed in accordance with the present invention. Referring to Figs. 1 to 4, inclusive, illustrating the first of said governor devices, the device shown therein comprises generally a body 20 made preferably as a die casting and provided with flanges 21 enabling the governor to be installed or interposed in the intake passage of an internal combustion engine between the carburetor and the intake manifold thereof. In said body 20 there is provided a passage 22 through which the fuel mixture from the carburetor flows into the intake manifold and further on into the cylinders of the engine. Within said passage and transversely thereof there is operatively arranged a shaft 23 journalled in ball bearings 24 suitably installed in the governor body 20.

The governing valve 26 is secured to the shaft 23, and therefore rotation of the shaft 23 and of the valve operates to restrict the passage 22 thus limiting the flow of the fuel mixture to the engine cylinders. The valve 26 is herein shown as of the balanced or approximately balanced butterfly type, although it will be understood that the valve may be offset or unbalanced, if desired, to a more or less extent. Since there is practically no friction in the bearings 24, the valve 26 is free to move in the passage 22, and its exact position in the passage 22 is determined by the balance of forces or torques acting on the shaft 23. It can be easily understood in view of the foregoing that if the closing torque acting on the shaft 23 exceeds in its magnitude the torque tending to rotate the shaft 23 in the direction of opening of the valve, the governing valve 26 will begin its closing movement, and such movement will continue until the closing and the opening torques balance, or until the governing valve 26 contacts the walls of the passage 22 or is otherwise limited at its fully closed position. On the other hand, if the opening torque is greater than the closing torque, the valve 26 will begin its opening movement, and such movement will continue until the opening and the closing torques balance, or until the governing valve reaches its fully open position, such as shown in Figs. 1 and 2.

It is very important for proper governing of the engine that at or near the speeds to which the governor is adjusted the opening and the closing torques acting on the shaft 23 balance each other in substantially all positions of the governing valve 26 in order that an increase in the speed above the set speed will result in a closing movement of the valve 26. This particular requirement is often expressed in this art by the statement to the effect that the characteristic curve of the closing torque must coincide substantially at all points of its operative range with the characteristic curve of the valve opening torque. It can be easily understood that the characteristic curve for the closing torque available on the shaft 23 may be easily plotted by measuring the torque which is produced by the valve closing means in the different positions of the valve 23.

The means producing a closing torque on the shaft 23 are, in the present embodiment of the invention, of the static pressure type and they depend for their operation upon the difference between the static pressure in the intake manifold and the atmospheric pressure. Said means are exemplified by a control cylinder 27 integrally formed with the governor body, in which cylinder there is slidably fitted a piston 28. One end of said cylinder 27 opens into a chamber 30 formed in the governor body, while its other end is closed with a cover plug 31 and communicates with the vacuum zone of the intake manifold by means of a vacuum conduit 32. A detachable front

cover 35 is adapted to be secured by screws 36 to the body 20 and to cover the chamber 30, a gasket 37 being provided between the cover 35 and the body 20.

In order to prevent formation of partial vacuum within the chamber 30 when the piston 28 moves toward its retracted position, the cover 35 is not drawn to the body 20 so as to effect a tight joint, and therefore the air may enter into and escape from the chamber 30 in response to the movements of the piston 28. However, if prevention of accumulation of dust within the chamber 30 is desired, a tight joint may be effected between the cover 35 and the body 20, and a suitable opening with necessary air filtering means may be provided in the chamber 30.

The end 23a of the shaft 23 protrudes into the chamber 30 and a bell crank 38 is mounted on said end and is adapted to rotate therewith. The bell crank 38 has two arms 39 and 40 which are set at an angle of about 135° to each other. It is to be understood that the present invention is not limited to the angle of 135°, and that any other suitable angle, preferably between 90° and 180°, answering the particular requirements of the governor may be employed without departing from the spirit of the present invention. The arm 40 is connected with the piston 28 by means of a connecting rod 41 and pin 42, and, therefore, movements of the piston 28 in the cylinder 27 are transmitted to the bell crank 38 and cause rotation of the shaft 23.

Thus, when partial vacuum is created in the intake manifold of the engine, the same is transmitted into the cylinder 27 through the conduit 22 and it operates to draw the piston 28 toward its fully retracted position. Movement of the piston 28 causes rotation of the shaft 23, as mentioned, and closing of the valve 26. This condition is illustrated in Fig. 3. If no means resisting the tendency of the piston 28 to close the governing valve is provided, the governing valve 26 will close immediately after a slight degree of vacuum is created in the intake passage of the engine and the conduit 32.

Means adapted to resist the tendency of the piston 28 to close the governing valve 26 are exemplified in the present embodiment of the invention by a spring 43, one end of which is anchored as shown at 44 while its opposite end carries a flexible strip 45 hingedly connected with the spring 43 and secured to the bell crank 38 at the foot of the arm 39 as indicated at 46. Intermediate its ends the spring 43 is supported as indicated at 47. It will now be clear in view of the foregoing that closing of the valve 26 causing rotation of the shaft 23 produces winding of the flexible strip 45 onto the cam portion 39a of arm 39 in consequence whereof a force is exerted on the free end of the spring 43. Thus, the spring 43 acts as a beam, i. e., a member subjected to transverse loads. In the present embodiment a flat single leaf spring of varying width is employed. By virtue of such a construction the operation of the spring is made more in conformance to the character of vacuum change and also substantially uniform fiber stresses are insured in the spring throughout the entire operative length thereof.

It should be noted at this point that the effect of crank angularity of the arm 40 operates to decrease the effective torque arm and, consequently, the torque produced by the piston 28 as the valve 26 moves toward its closed position. In order to counteract a similar tendency in the resisting means, the cam portion 39a is provided, the same operating to increase the effective torque arm and the desired rate of change thereof as the valve 26 closes. By virtue of the above described construction valve opening means are provided which substantially balance the torque produced by the valve closing means substantially throughout the entire operative range of the governing valve.

An important feature of the present invention consists in the provision of improved means whereby both the initial deflection of the spring 43 and the deflection rate of said spring, i. e., deflection of spring per unit of load, may be adjustably varied.

In the structure illustrated in Figs. 1 to 4 inclusive, the adjustment means comprise a shelf 48 provided on the governor body 20 and preferably formed integral therewith. On the shelf 48 there are provided two parallel cam surfaces 48a and 48b along which an angular bracket 49 having contacting legs 49a and 49b is adapted to slide. An extension 50 is provided on the bracket 49, said extension being formed in the present instance by bending the bracket. The extension 50 furnishes a support for the spring 43 intermediate the ends thereof at 47. By moving the angular bracket 49 longitudinally of the spring 43, the point of support of the spring may be moved longitudinally thereof, whereby a deflection rate of the spring 42, that is the deflection thereof per unit of load applied at its free end, may be varied. If the angular racket 49 is moved transversely of the spring 43, the same may be deflected in a desired degree. Such initial deflection or loading of the spring 43 does not substantially change the deflection rate of the spring.

By a proper combination of transverse and longitudinal movements of the point of support 47, the spring 43 may be so adjusted that it gives the proper resistance for the desired governing action of the valve 26. In the structure illustrated, the transverse and the longitudinal movements of the points of support are made simultaneously and in a predetermined relationship to each other, which relationship is determined substantially by the angle which the cam surfaces 48a and 48b form with the longitudinal axis of the spring 43. Said angle is in turn determined by the desired governing characteristics of the governor, and it may be easily determined experimentally for a spring of given dimensions and resistance characteristics. Means for moving the bracket 49 are exemplified by a screw 51 carrying a round nut 52 provided with an annular recess or groove into which is fitted the vertical leg 49a of the bracket 49. As the screw 51 is rotated, for which purpose a suitable slot is provided in the head thereof, the bracket 49 moves longitudinally of the spring and being kept in constant contact with the cam surfaces 48a and 48b by the downward pression of the spring 43, the bracket 49 moves at an oblique angle, following the cam surfaces. Vertical movements of the bracket are permitted because of the provision of a slot 53 in the vertical leg 49a thereof, which slot is clearly shown in Fig. 4. Additional adjustments of initial loading of the spring may also be made with the aid of a screw 54 adapted to exert a vertical pressure on the anchored end of the spring 43.

In the structure illustrated in Figs. 5 to 7 inclusive, the transverse and the longitudinal movements of the support piece 57 are effected with

the aid of separate means. In this structure the spring 43 is anchored in a block 58 rotatably supported on the governor body by means of a hinge 59. The lower surface of the block has a portion of a gear formed on it, said portion meshing with the threads 60a of a worm screw 60 rotatively supported in the governor body but restrained from the longitudinal movement with respect thereto. The support piece 57 constitutes a nut for a screw 61 carried by the block 58.

By turning the screw 61 the support piece may be moved longitudinally of the spring thereby adjustably changing the deflection rate of the spring. By rotating the worm screw 60, the block 58 may be rotated, thereby swinging the screw 61 partly around the axis of the hinge 59. As the end of the screw 61 moves up or down in response to the axial rotation of the worm screw 60, the support piece 57 moves transversely of the spring thereby changing the initial loading thereof. By virtue of the above described construction adjustments of the deflection rate and the initial loading of the spring may be made independently of each other and in any desired relationship. This feature permits adjustment of the governor for the requirements of any particular engine, if the operative characteristics and the governing requirements thereof are not known at the time of designing of the governor therefor.

I claim:

1. In a governor for an internal combustion engine having an intake passage, a butterfly governing valve mounted in said passage and actuated in a closing direction by the operation of the engine, a flat spring adapted to resist closing movement of said valve, means anchoring one end of said spring, means operatively connecting the opposite end of said spring with the governing valve in such a way that closing of the valve causes bending of the spring, a member having an inclined cam surface, and a support for said spring intermediate its ends, said support being adapted to be moved adjustably along said inclined surface, whereby the initial bending and the deflection rate of said spring are varied.

2. In a governor for an internal combustion engine having an intake passage, a butterfly governing valve mounted in said passage and actuated in a closing direction by the operation of the engine, a flat spring adapted to resist the closing movement of said valve, means anchoring one end of said spring, means operatively connecting the opposite end of said spring with the governing valve in such a way that closing of the valve causes bending of the spring, a shelf having a surface extending at an oblique angle to said spring, a support piece adapted to support said spring intermediate its ends, and means for moving said support piece along said surface, whereby the initial bending and the deflection rate of said spring are adjustably varied.

3. In a governor for an internal combustion engine having an intake passage, a butterfly governing valve mounted in said passage and actuated in a closing direction by the operation of the engine, a flat spring adapted to resist closing movement of said valve, means anchoring one end of said spring, means operatively connecting the opposite end of said spring with the governing valve in such a way that closing of the valve causes bending of the spring, a fixed cam element having a surface extending at an oblique angle to said spring, a bracket adapted to support said spring intermediate its ends, and means for moving said bracket along said surface, whereby the initial bending and the deflection rate of said spring are adjustably varied.

4. In a governor for an internal combustion engine having an intake passage, a butterfly governing valve mounted in said passage and actuated in a closing direction by the operation of the engine, a flat spring adapted to resist closing movement of said valve, means anchoring one end of said spring, means operatively connecting the opposite end of said spring with the governing valve in such a way that closing of the valve causes bending of the spring, a member having two parallel cam surfaces extending at an oblique angle to said spring, a device having portions adapted to engage said surfaces, a support for said spring intermediate its ends; and a screw for adjustably moving said device along said cam surfaces, whereby the place of support of said spring moves along a path extending obliquely to said spring, and the initial bending and the deflection rate of said spring are adjustably varied.

5. In a governor for an internal combustion engine having an intake passage, a butterfly governing valve mounted in said passage and actuated in a closing direction by the operation of the engine, a flat spring adapted to resist the closing movement of said valve, an anchor for one end of said spring, means operatively connecting the opposite end of said spring with the governing valve in such a way that closing of the valve causes bending of the spring, cam means having two parallel cam surfaces extending at an oblique angle to said spring, a bracket having legs resting on said cam surfaces and adapted to move therealong, said bracket having means to support said spring at one point intermediate its ends, and a screw engaging said bracket and adapted, when rotated, to move said bracket along said cam surfaces, thereby adjustably moving the point of support of said spring along a path extending obliquely to said spring, whereby the initial bending and the deflection rate of said spring may be adjustably varied.

6. In a governor for an internal combustion engine having an intake passage, a butterfly governing valve mounted in said passage and actuated in a closing direction by the operation of the engine, a flat spring of varying width adapted to resist the closing movement of the valve, said spring adapted to function as a beam of substantially constant length, means for adjustably varying in a predetermined relationship to each other the deflection rate and the initial loading of said spring, a support piece adapted to move along said spring and to furnish a support therefor intermediate the ends of said spring, a screw engaging said support piece and adapted adjustably to move the same longitudinally of said spring, and threaded means adapted to move said piece transversely of said spring, whereby the initial loading and the deflection rate of said spring are adjustably varied.

7. In a governor for an internal combustion engine having an intake passage, a butterfly governing valve mounted in said passage and actuated in a closing direction by the operation of the engine, a spring adapted to resist closing movement of the valve and adapted to function as a beam of substantially constant length, means for adjustably varying in a predetermined relationship to each other the deflection rate and the initial loading of said spring, a support piece adapted to move along said spring and to fur-

nish a support therefor intermediate the ends of said spring, a screw engaging said support piece and adapted adjustably to move the same longitudinally of said spring, and a worm and gear means adapted to carry said screw and to rotate the same bodily in such a way as to move the support piece transversely of said spring, whereby the initial bending and the deflection rate of said spring are adjustably varied.

8. In a governor device for an internal combustion engine having an intake passage, a governing valve mounted in said passage and adapted to be actuated by the vacuum produced in the intake passage, a flat spring of varying width adapted to resist movements of said valve in response to the vacuum, said spring being adapted to operate as a beam of substantially equal length, means for applying the operative forces to said spring substantially in the transverse direction thereto, means provided intermediate the ends of said spring for adjustably varying within a predetermined range the deflection rate of the spring, and means for adjustably controlling the initial loading of said spring.

9. In a governor device for an internal combustion engine having an intake passage, a governing valve mounted in said passage, a flat spring of varying width having one end operatively connected to said valve to cause bending of the spring as the valve moves in the closing direction, means anchoring the opposite end of said spring and adapted to vary adjustably the initial bending of said spring, a member adapted to support said spring at a point intermediate its ends in all operative positions of the spring, and means for adjustably moving said member and, consequently, the point of spring support longitudinally of said spring to vary within predetermined limits the deflection rate of the spring.

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