Oct. 27, 1942. R. D. FAGEOL ET AL 2,300,378

GOVERNOR

Filed Nov. 24, 1939

Fig. 2.

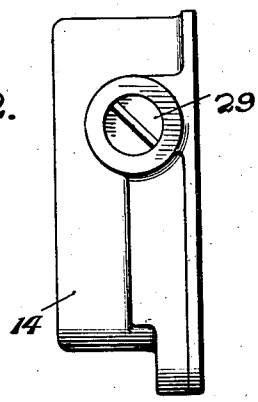


Fig. 4.

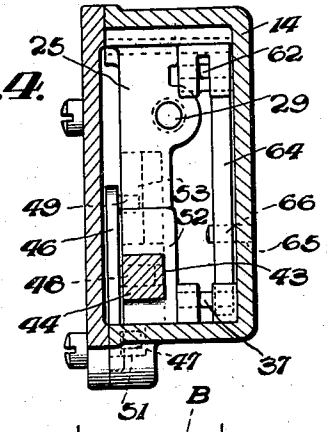


Fig. 1.

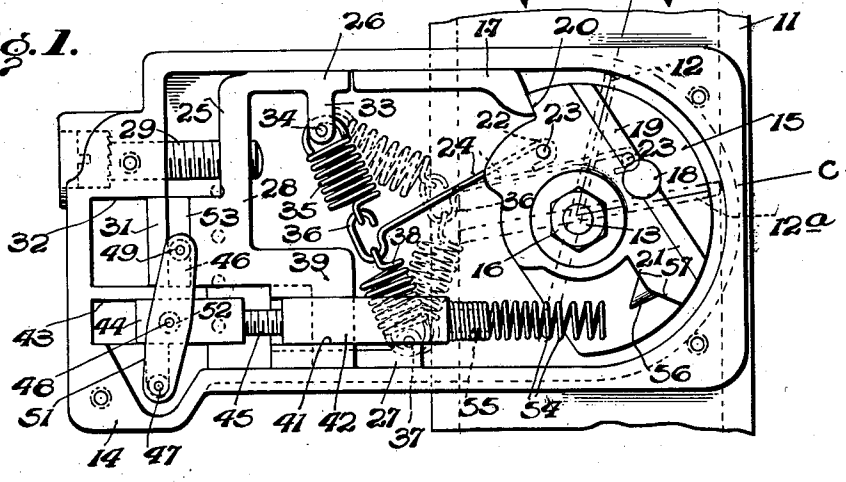
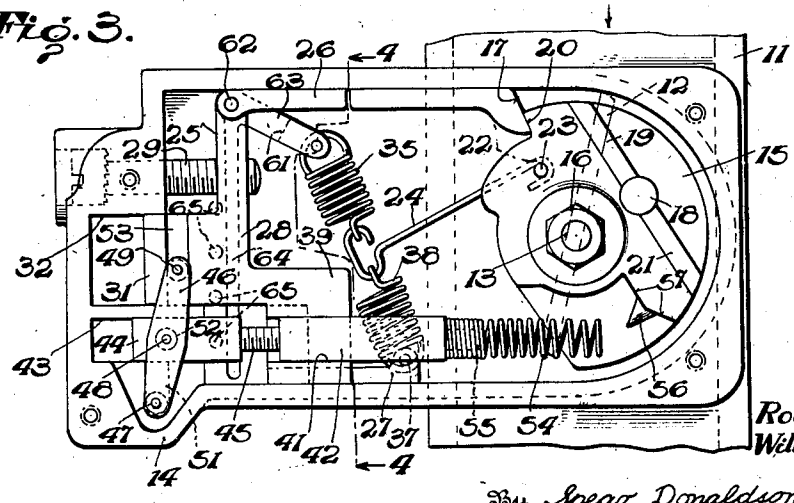


Fig. 3.



Inventors

Robley D. Fageol

William E. Leibing

By Spear, Donaldson & Hall

Attorneys

Patented Oct. 27, 1942

2,300,378

UNITED STATES PATENT OFFICE

2,300,378

GOVERNOR

Robley D. Fageol, Grosse Pointe Farms, Mich., and William E. Leibing, San Rafael, Calif., assignors to Leibing-Fageol Company, Detroit, Mich., a partnership

Application November 24, 1939, Serial No. 305,998

3 Claims. (Cl. 137—152)

This invention relates to governors for internal combustion engines, and more particularly to novel means for opposing the closing movement of valves in governors of the velocity type.

When reference is made herein to governors and governor valves, it is to be understood that reference is intended to governing devices adapted to be added as an accessory to an internal combustion engine, or to so-called built-in governors where the carburetor valve is used both as the throttle valve of the carburetor and the governor valve, such, for instance, as disclosed in application Serial No. 171,298, filed October 27, 1937.

Present day commercial governors are not entirely satisfactory, and do not measure up to the most desirable specifications of the trade.

One of the desired characteristics of such a governor is that it must be capable of a very wide range of adjustment, and wherever it is set within that range, it must have the ability to govern the engine speed from the no load position to the full load position with no more than approximately 12% variation from the no load speed to the full load speed.

For example, a governor of the above type should be capable of being set at any point between 1,000 R. P. M. no load and 3,500 R. P. M. no load, and at 1,000 R. P. M. no load it should give wide open throttle or full load at not less than 880 R. P. M., while at 3,500 R. P. M. no load it should have full load at 3,080 R. P. M. The same tolerances should apply at any intermediate speeds for which the governor is set to operate.

The prime difficulty encountered in designing such a long range governor resides primarily in the springs which must oppose the closing movement of the throttle valve and must change their characteristics entirely where adjusting over such a wide range.

To illustrate the problem, if a velocity governor is built to operate correctly at 3,500 R. P. M. no load, and it is desired to go from such a setting to a new setting of 1,000 R. P. M. no load, it is apparent that at the lower speed a higher vacuum will exist in the manifold, and the usual offset throttle will therefore have more force in the closing direction at the no load position, which means that the spring mechanism must be stiffer in this no load position to oppose the throttle than it was at 3,500 R. P. M. no load, while at the tripping or wide open position the throttle must start to go closed at flows corresponding to only 880 R. P. M., whereas in the case of the setting at 3,500 R. P. M. no load, the spring mechanism at tripping or wide open position must be set to resist flows corresponding to as high as 3,080 R. P. M.

It is thus apparent that while the effect of the spring at tripping or wide open throttle is lessened when the adjustment is changed from 3,500 R. P. M. no load to 1,000 R. P. M. no load, at no load position at the lower speed setting, the effect of the spring must be increased to oppose the throttle closing because of the higher vacuum that will exist in the manifold at the lower speed at no load.

In some prior types of velocity governors, an effort has been made to solve this problem by adding and taking out active wire from the springs by the act of adjusting the governor. Other designs such as that disclosed in application Serial No. 171,298, above identified, have attacked the problem by a differential positioning of the two springs used in that design. While the latter arrangement has been satisfactory to some degree, it has not met the full requirements.

In overcoming the disadvantages of the prior art, it is a major object of this invention to provide a governor of the velocity type having novel resilient means associated therewith, whereby the governor may be adjusted for a wide range of speeds and perform at any of those speeds within the desired tolerance, and more correctly than hitherto possible.

A further object of this invention is to provide novel means in combination with a governor of the velocity type whereby the accuracy of adjustment and governing is increased, and the necessity for a series of governors for the same engine eliminated.

Still a further object of this invention is the provision of a novel spring assembly in a governor whereby the spring movement relative to the throttle movement is materially reduced when compared with prior governors whereby the life of the spring assembly is increased, and the accuracy of the governor improved.

Still a further object of this invention is to provide a novel spring mechanism for a velocity governor wherein the connecting linkage between the governor valve and the spring means is such that there is a substantially constant lever arm effective on the valve, any change therein being by way of a reduction in the effective lever arm as the valve goes to closed position, thus confining the adjustment problem to the spring mechanism beyond the linkage.

Further objects and advantages of this inven-

tion will appear from the following description, claims, and attached drawing which is intended as illustrative and not as limiting the invention to the exact structure disclosed.

With reference to the attached drawing

Figure 1 is a side elevation of a governor embodying the preferred form of the invention, the view being taken of the spring assembly housing with the cover removed, the governor being shown set at its lowest speed.

Fig. 2 is an end elevation of the spring assembly housing as viewed from the left of Figure 1, the cover plate being again omitted.

Fig. 3 is a view similar to Figure 1, but of a further embodiment of the invention.

Fig. 4 is a section taken on the line 4—4 of Fig. 3 looking in the direction of the arrow with the springs omitted, but the cover plate added.

For the sake of brevity, reference is made to application Serial No. 171,298, above identified, for a description of the manner of mounting the mechanism herein described with a carburetor, the types of bearings and connections employed, and the general method of operation.

The governor shown herein which has been selected for purposes of illustration includes a conduit 11 (Figure 1) which is part of the intake conduit of the internal combustion engine, all the fuel for the engine passing therethrough. As the device illustrated is adapted for use with a down-draft carburetor, the direction of fuel flow through conduit 11 is indicated by the arrow.

If the device be embodied in an accessory governor which is placed between the conventional carburetor and the intake manifold of the engine, conduit 11 will form part of the governor. If the device be embodied in a built-in governor, the conduit 11 is the carburetor barrel. In such a built-in governor, a throttle valve 12 is provided which operates both manually and as part of the governor assembly. The details of such an arrangement are fully disclosed in the application already referred to, and need not be repeated.

To insure flow responsiveness of valve 12, it is mounted to rotate with a shaft or pivot 13, the center of which is offset to the left from the center of the barrel as viewed in Fig. 1. In the specific governor illustrated, the arrangement and size of parts is such that throttle 12 in wide open position is limited to an angle of 17° from the vertical, and in the closed position, to an angle of approximately 10° from the horizontal, at which point throttle 12 abuts the barrel as shown at 12a. The maximum travel then from B to C (Fig. 1) is thus confined to about 63°. These angles, as well as the amount of offset of valve 12, vary in different makes and styles of governors.

A housing 14 is secured to the side of barrel 11, pivot 13 extending into said housing. A disc-like member 15 of considerable mass is secured to pivot 13, as by nut 16, to rotate therewith. Member 15 is of considerable mass to increase the inertia of the throttle valve assembly and prevent fluttering thereof.

Adjacent its upper edge (Fig. 1) member 15 is formed with a shoulder 20 arranged to abut a stop 17, preferably formed integral with housing 14, to limit the opening movement of valve 12. Member 15 is also formed with an aperture 18 and slots 19 and 21 to provide means for attaching the necessary weighing machine beam as disclosed in Patent No. 2,094,405.

Member 15 is slotted at 22 to receive a link 24 secured by a pin 23 passing through an aperture in member 15. Pin 23 is so positioned with reference to member 15 and its relation to the extent of movement of throttle 12, that the effective lever arm of link 24 on shaft 13 is substantially constant as throttle 12 goes from full open position to full closed position. The practically negligible change in length of the lever arm that takes place involves a decrease as throttle 12 goes from full open to full closed position. In full open position, the longitudinal axis of link 24 and a line connecting pin 23 and the valve pivot are substantially at right angles to one another.

A bracket 25 is mounted to reciprocate within housing 14, the bracket including an arm 26 extending along the top of the housing, an arm 27 extending along the bottom of the housing, a connecting leg 28 having a threaded aperture therein arranged to be engaged by an adjustable screw 29 mounted in housing 14, and of the same general type as disclosed in application Serial No. 171,298, and an adjusting block 31 arranged to slide in a guide slot 32 formed in housing 14. Block 31, arm 26, and arm 27 are so dimensioned that bracket 25 will slide easily in the housing when moved by screw 29, yet it will not tend to twist or jam.

Arm 26 has a bifurcated lug 33 thereon having a pin 34 secured in an aperture therein to which is fastened one end of a spring 35 of the tension type. The opposite end of spring 35 is secured to an eye 36 on the left end of link 24.

Arm 27 of bracket 25 is also formed with a bifurcated lug 37 to which is secured one end of a spring 38 of the tension type, the opposite end of the spring being secured to eye 36 of link 24.

By reason of the relative positioning of lugs 33 and 37 on bracket 25, the secured ends of the spring assembly proper are normally supported in a plane parallel to but spaced from pivot 13, this plane being displaced as a whole as bracket 25 is adjusted by screw 29, the point of connection of link 24 to springs 35 and 38 remaining fixed, and link 24 remaining of fixed length. As valve 12 opens and closes, this point of connection follows a substantially straight line.

Bracket 25 is formed with an enlarged section 39 having a non-circular, or preferably square, aperture 41 therein to receive and support a spring block 42 of similar shape, the non-circular shape being selected to permit longitudinal movement of block 42, but not rotation of the same.

In the position shown in Figure 1, springs 35 and 38 have their axes substantially normal to link 24 so that regardless of the tension on the springs, the force effective on link 24 will not change. If bracket 25 be moved to the left, the axes of springs 35 and 38 will be at such an angle to link 24 that not only will the tensions of the springs be increased, but they will also be effective at an angle to develop a force component along link 24. Thus by adjustment of bracket 25, both the degree and the direction of the force of the spring mechanism is changed.

Housing 14 is provided with a slot 43 in alignment with aperture 41, and of similar shape to receive an adjusting block 44 which is secured to spring block 42 by the threaded connector 45. Connector 45 enables independent adjustment of spring block 42 with reference to adjusting block 44, the elements being removed from the assembly for that purpose. Upon replacement in the assembly, maintenance of the adjustment is in-

sured because of the securing of blocks 42 and 44 against rotation.

To provide for adjustment of block 44 in predetermined proportion to the adjustment of bracket 25, a lever 46 is provided having three pins or pivots 47, 48, and 49 extending therefrom. Pin 47 is positioned to operate in a slot 51 in the lower lefthand portion of housing 14, pin 48 is arranged to pivot in a hole 52 drilled in block 44, and pin 49 in a transverse slot 53 in block 31.

With this arrangement, upon movement of block 31 by screw 29, lever 46 will pivot around pin 47 and effect movement of block 44 in the same direction as block 31. By varying the relative positions of the pins 47, 48, and 49, the proportion of movement of block 44 to the movement of block 31 can be readily varied.

At its right end, spring block 42 carries a helical spring 54 of the compression type. The left end of spring 54 is frictionally secured on a tit 55 on block 42 while the right end of the spring is suspended freely in space when throttle 12 is in fully open position.

As throttle 12 goes from open to closed position, disc 15 will rotate clockwise, as viewed in Fig. 1, until at a point usually somewhat beyond the halfway point, a cone 56 on disc 15 will engage the free end of spring 54, which will be compressed as clockwise rotation of disc 15 continues. It will be noted that the surface of disc 15 adjacent the point of attachment of cone 56 is formed with angled faces 57 which cause disc 15 to properly compress spring 54 without distorting the spring, as disclosed in application Serial No. 171,298, above identified.

To enable a more correct understanding of the operation of the device, let it be assumed that it is desired to set the governor to operate at a low speed, such as 1,000 R. P. M. no load, and that throttle 12 is at full open position, when shoulder 20 of disc 15 will contact stop 17.

While springs 35 and 38 of the proper characteristics to insure tripping at the desired speed of 880 R. P. M. may have been selected, there is no assurance that a no load speed of 1,000 R. P. M will be obtained unless spring 54 is properly positioned. If connector 45 be adjusted to set spring 54 too far to the right (Fig. 1), it may hold the throttle open too far and permit, for example, a no load speed of 1,200 R. P. M. Or if it be set too far to the left, it may fall off to a speed below its tripping speed, at which point the governor would surge.

However, by removing assembly 42—44—45—54 from the housing, and either lengthening or shortening the same by threaded connector 45, spring 54 can be adjusted so that a final no load speed of 1,000 R. P. M. is obtained. At this point, if spring 54 has been properly selected, the first essential of a correct governor, namely, a correct low speed setting of wide open at 880 R. P. M. and a no load of 1,000 R. P. M. will have been obtained.

Now let it be assumed that the no load speed is to be raised to 2,000 R. P. M., and that in order to do so, bracket 25 must be moved ⅛" to the left. In moving bracket 25 to the left, the assembly supporting compression spring 54 has likewise been moved to the left, the amount of movement of the latter being determined by the relative positions of the pins in lever 46. In the example shown, as spring 54 is effective on disc 15 at a point on the side of the disc opposite from pin 23, it is found that in moving bracket 25 to the left ⅛", the spring pull of springs 35 and 38 in the closed position have been increased by about $\frac{11}{64}$" in tension, and the effort of spring 54 has been reduced by about $\frac{1}{16}$".

This double change by the single adjustment is required because of the necessity for throttle 12 to stay open at a speed now of 1,760 R. P. M. Yet this same throttle will not exert the same force at the no load position due to the lower vacuum at 2,000 R. P. M. than existed at 1,000 R. P. M.

In engines which are particularly sensitive, and where it is difficult, if not impossible, at times to set any governor anywhere near correct at any speed, the embodiment of the invention as shown in Fig. 3 is of particular value.

As the governor of Fig. 3 resembles that of Fig. 1 except in one major respect, like reference characters have been applied to like parts, and description of the identical parts is omitted.

The governor of Fig. 3 differs from that of Fig. 1 in the manner of the support for one end of the spring assembly 35—38, more particularly, the upper end of spring 35. Instead of a lug 33, as in the governor of Fig. 1, a crank 61 is pivoted to bracket 25 at 62, crank 61 having one arm 63 to which the end of spring 35 is secured, and a second arm 64 normally extending downwardly from pivot 62.

In the position shown, wherein the governor is set for low speed operation, the left face of arm 64 lies adjacent a series of holes 65 in housing 14. A pin 66 (Fig. 4) is provided to fit any of these holes and abut the left face of the arm 64. After selecting the proper hole, pin 66 is placed therein to provide an abutment against which crank arm 64 abuts. Thus the rate of movement at which crank 61 rotates about pin 62 when bracket 25 is adjusted is controlled, and may be varied by placing pin 66 in different holes. The lower the hole 65 selected, the slower arm 63 will raise on moving block 25 to the left, while the higher the hole selected, the faster lever 61 will raise.

This feature is advantageous in controlling the characteristics of spring assembly 35—38. For instance, if crank 61 were rigid with bracket 25, a predetermined movement of bracket 25 to the left would only stretch springs 35 and 38 $\frac{1}{16}$" in their initial position, and would influence the final position by a stretch of about $\frac{7}{32}$" of springs 35 and 38.

With some engines, this assumed condition would not be correct for the increased tripping torque of the throttle from 880 R. P. M. to 1,760 R. P. M., and would not make proper allowances in the no load position for the higher vacuum existing at 1,000 R. P. M. no load than at 2,000 R. P. M. no load. In other words, there would not be a change in the characteristics of springs 35 and 38, which might be desirable under the circumstances.

This condition is corrected by the device shown, because crank 61, in rotating counter-clockwise at any desired speed or radius relative to the movement of bracket 25, contributes to a considerable degree to the initial or wide open position torque or springs 35 and 38. Thus the characteristics of the springs can be changed any desired amount.

In its counter-clockwise rotation, crank 61 moves to the right as well as upwardly, and the point of support of spring 35 is correspondingly changed. As the movement of crank 61 can be readily controlled, a position for it can be selected wherein the final effect of the spring as-

sembly 35—38 is neutral, or not changed, while the tripping or starting torque of the springs is changed by any desired amount.

It is to be noted that in the embodiment of Fig. 1, when bracket 25 is adjusted, the points of connection of the spring assembly to the bracket remain in transverse planes parallel to one another and shaft 13, whereas in the embodiment of Fig. 3, the succeeding transverse planes containing the points of connection of the spring assembly are not parallel to one another because of the movement of crank arm 63 relative to lug 37.

A major advantage of the present invention is found in the spring assembly 35—38 as associated with link 24. If a single spring were secured to bracket 25, with its other end fastened to eyelet 36, its extension on the throttle going from open to closed position would be about $3\frac{1}{64}$", aside from the additional extension required when bracket 25 is adjusted to the left for high speed. With the arrangement here shown, the actual extension of springs 35 and 38 is only $\frac{3}{16}$", or about 60% less. Consequently, continued accuracy of the governor springs over a longer period can be assured.

It is to be understood that the invention may be embodied in specific forms other than that illustrated without departing from the principle or essential characteristics thereof. The embodiments shown are therefore to be considered as illustrative and not restrictive, the scope of the invention being defined by the appended claims rather than the foregoing description and drawing. All modifications and changes which come within the meaning and range of equivalency of the claims are therefore intended to be included therein.

We claim:

1. In a velocity governor for an internal combustion engine of the type including a conduit forming part of the fuel intake to said engine, and a valve in said conduit of a type to be urged toward closed position by fluid flow therethrough, the combination of spring mechanism to oppose closing movement of said valve comprising a plurality of extension springs, a link connecting said valve and said extension springs, the latter being positioned at an angle to said link, a compression spring, means to adjust said extension springs in tension and in their angle relative to said link without changing the length of said link, and means to change the effect of said compression spring in a reverse direction as said extension springs are adjusted.

2. A velocity governor for an internal combustion engine comprising a conduit forming part of the fuel intake to said engine, a valve in said conduit of a type to be urged toward closed position by fluid flow therethrough, a pivot to support said valve, means to oppose closing movement of said valve comprising a member secured to said pivot, a bracket, means to adjust said bracket relative to said pivot, a pair of arms on said bracket, spring means supported between said arms, means to connect said member and said spring means at a point intermediate of the ends of the latter, additional resilient means arranged to contact said member as said valve moves toward closed position, and a connection between said bracket and said additional resilient means whereby the latter is adjusted in a predetermined proportion to said bracket as the latter is adjusted.

3. A velocity governor for an internal combustion engine comprising a conduit forming part of the fuel intake to said engine, a valve in said conduit of a type to be urged toward closed position by fluid flow therethrough, a pivot to support said valve, means to oppose closing movement of said valve comprising a member secured to said pivot, a bracket, means to adjust said bracket, a pair of arms on said bracket, spring means supported between said arms, means to connect said member and said spring means at a point intermediate of the ends of the latter, additional resilient means arranged to contact said member as said valve moves toward closed position, means non-circular in shape to support said additional resilient means, said bracket having an aperture of similar shape to support said non-circular means for axial movement while preventing rotation thereof, means to connect said non-circular means to said bracket whereby said additional resilient means is proportionally adjusted when said bracket is adjusted, and means to adjust said additional resilient means independently of said bracket.

ROBLEY D. FAGEOL.
WILLIAM E. LEIBING.