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

GOVERNOR

Filed Nov. 24, 1939

Fig. 2.

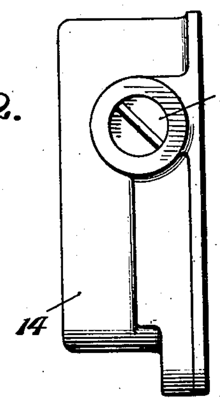


Fig. 4.

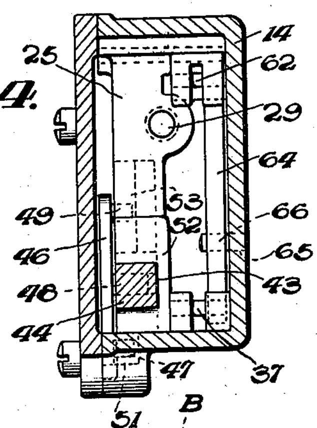


Fig. 1.

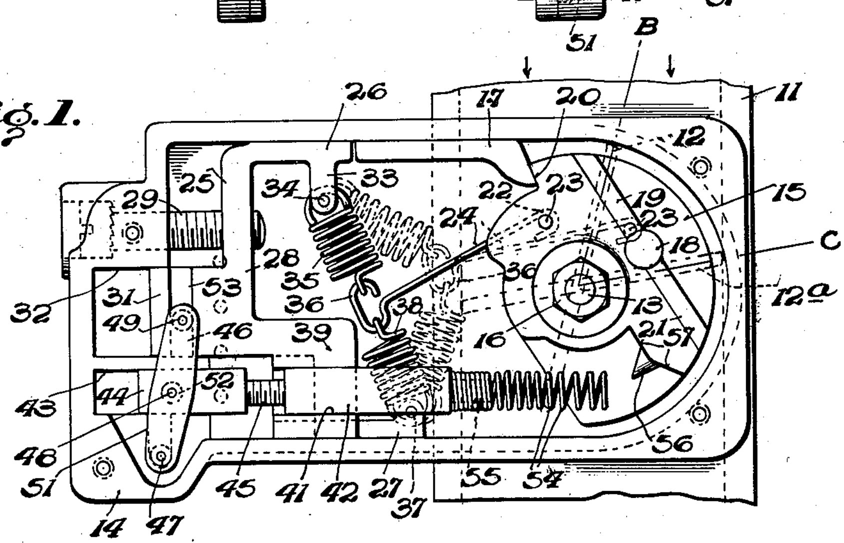
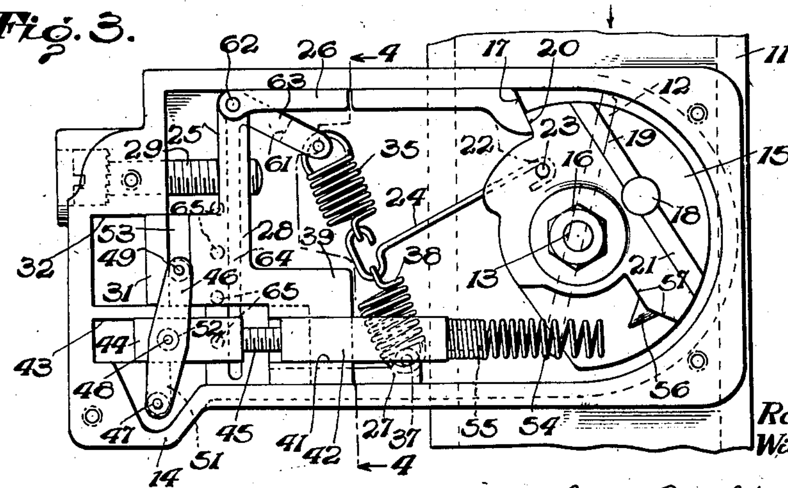


Fig. 3.



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2,300,378

GOVERNOR

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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 invention 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 **12***a*. 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 insured 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 $\frac{1}{8}$'' 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 $\frac{1}{8}$'', 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 assembly 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 31/64'', 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 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.

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