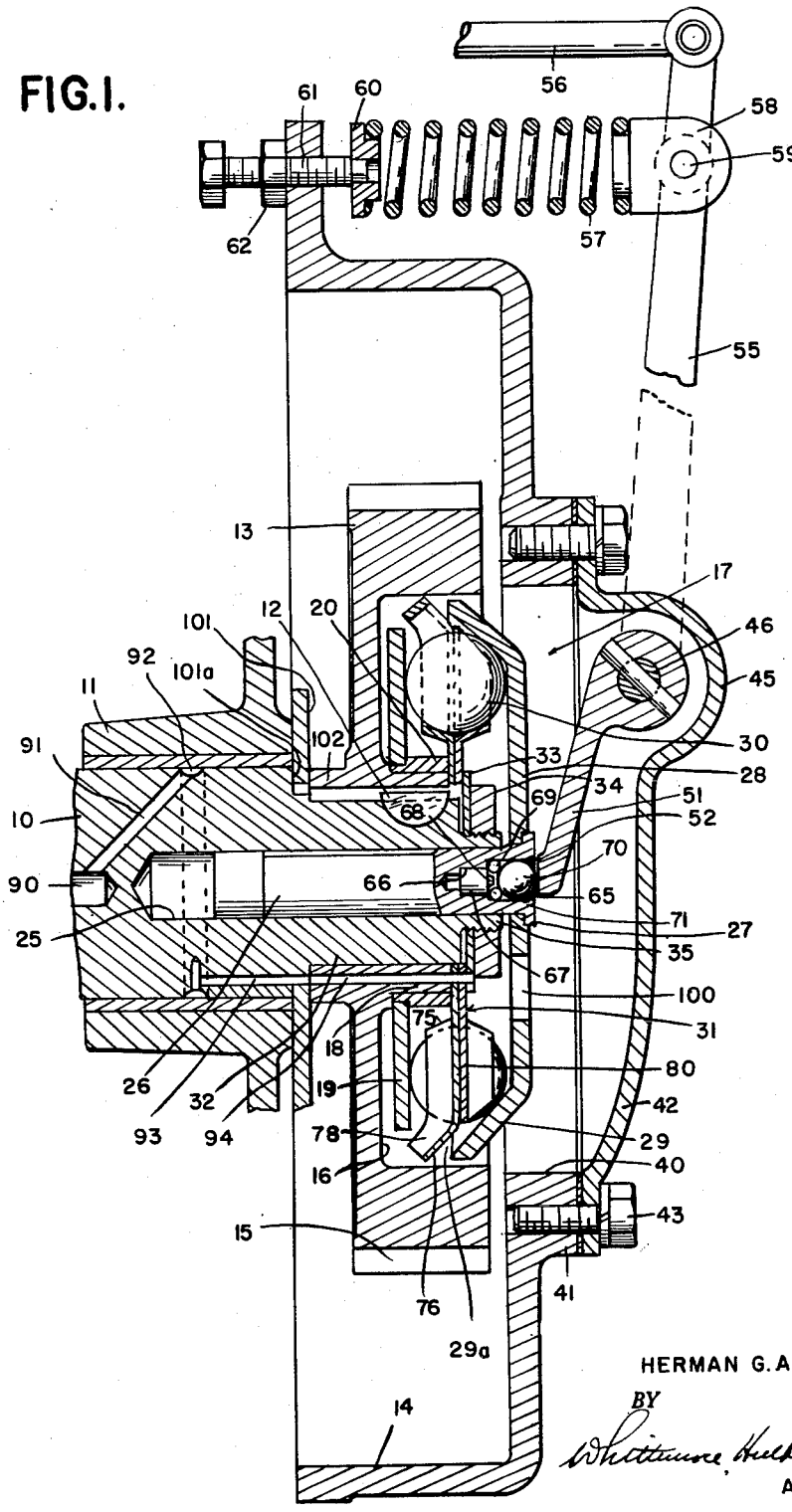
Sept. 28, 1943. H. G. ADLER 2,330,657

GOVERNOR STRUCTURE

Original Filed Oct. 27, 1941 2 Sheets-Sheet 1

FIG. 1.



INVENTOR.

HERMAN G. ADLER

BY

Whittemore, Hulbert & Belknap

ATTORNEYS

Sept. 28, 1943. H. G. ADLER 2,330,657

GOVERNOR STRUCTURE

Original Filed Oct. 27, 1941 2 Sheets-Sheet 2

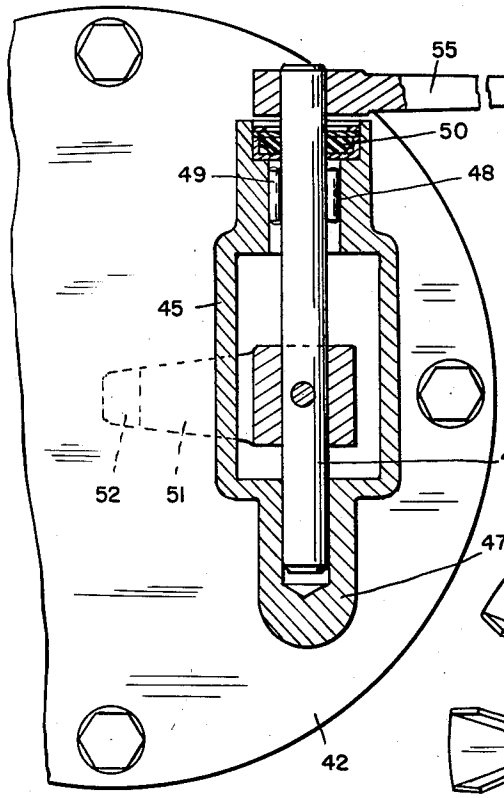


FIG.3.

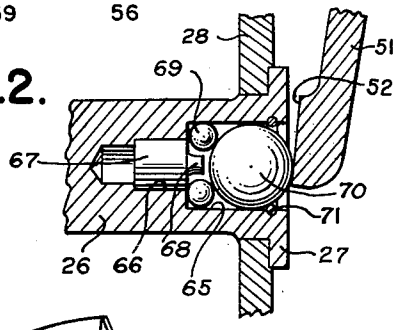


FIG.5.

FIG.2.

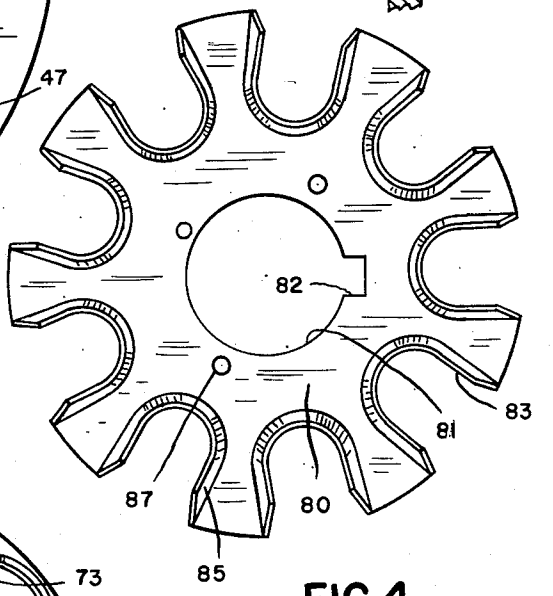
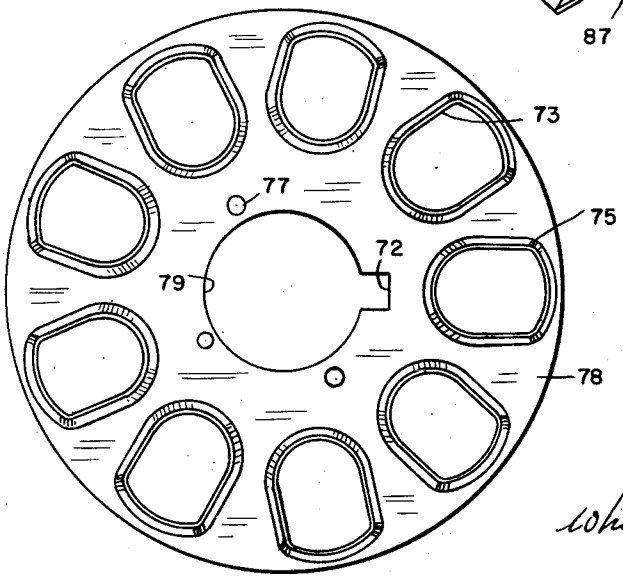


FIG.4.



INVENTOR.

HERMAN G. ADLER

BY

Whittemore, Hulbert & Belknap

ATTORNEYS

Patented Sept. 28, 1943 2,330,657

UNITED STATES PATENT OFFICE

2,330,657

GOVERNOR STRUCTURE

Herman G. Adler, Detroit, Mich., assignor to Novi Equipment Company, Novi, Mich., a corporation of Michigan

Original application October 27, 1941, Serial No. 416,760, now Patent No. 2,319,654, dated May 18, 1943. Divided and this application April 12, 1943, Serial No. 482,784

8 Claims. (Cl. 308—233)

This invention relates generally to governor structures and constitutes a division of my application filed October 27, 1941, bearing Serial No. 416,760, now matured into Patent No. 2,319,654, issued May 18, 1943.

One of the essential objects of the invention is to provide a governor that may be combined in such a way with a rotating shaft and gear that space may be conserved and the efficiency of the governor will be increased.

Another object is to provide a governor wherein the speed responsive mechanism thereof is located within a recess in the gear and is adapted to actuate means movable axially of the shaft to impart a thrust to a spring biased control lever.

Another object is to provide a governor wherein the thrust imparting means includes an antifriction element engageable with a flattened free end of the spring biased control lever.

Another object is to provide a governor wherein provision is made for adjusting the spring employed to bias the control lever.

Another object is to provide a governor that is simple in construction, economical to manufacture, easy to install and effective in operation.

Other objects, advantages and novel details of construction of this invention will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawings, wherein:

Figure 1 is a horizontal section through my complete governor assembly;

Figure 2 is a fragmentary end view of the governor construction, partly in section;

Figure 3 is a detail elevation of one element of the drive plate assembly;

Figure 4 is a detail elevation of the other element of the drive plate assembly; and

Figure 5 is an enlarged fragmentary sectional view through the thrust bearing and associated parts.

Referring first to Figure 1, I have illustrated at 10 a cam shaft of an internal combustion engine mounted for rotation in a crank case bearing 11 and having keyed or otherwise secured thereto, as indicated at 12, a gear 13.

A detachable engine gear case cover 14 is normally provided, and in the present instance I have modified this cover, as will subsequently be described. The gear 13 is provided with teeth 15, and is also formed with a laterally open annular recess 16 which houses a portion of the governing mechanism.

The governing mechanism comprises centrifugal means, indicated generally at 17, which will now be described.

The annular, laterally open recess 16 is formed so as to leave a hub portion 18 on the gear, and rotatably mounted on the hub portion 18 is a plate 19 and sleeve 20 which rotate together as a unit. The sleeve 20 may be spun or swedged to the plate 19.

The outer end of the cam shaft 10 has a counterbore 25 in which is rotatably received a shaft 26 that in turn is counterbored at its outer end, as will subsequently be described in detail, and has a flange 27 securing in place a second annular plate or disc 28. The plate 28 is secured against rotation on the shaft 26, as for example by providing a brazed connection between the flange 27 and the plate or disc 28.

The plate 28 is flat throughout its central portion but its periphery is inclined inwardly toward the plate 19 as indicated at 29.

As a result of this construction, a space 29a tapering in a radially outward direction is defined by the plate 19 and the inclined portion 29 of the plate 28.

Intermediate the plates 19 and 28 I provide a plurality of steel balls 30, and in the present instance I have illustrated nine such balls. A drive plate assembly indicated generally at 31 is provided for rotating the balls about the axis of the cam shaft 10 as the cam shaft rotates while the engine is running.

The drive plate assembly 31 will subsequently be described in detail, but for the present it is sufficient to note that the same is keyed or otherwise secured to a reduced portion 32 of the cam shaft and is held in place thereon by means of a washer 33 and a nut 34 threaded on a further reduced portion 35 of the cam shaft.

The engine gear case cover 14 is provided with a central opening 40 surrounded by a thickened portion 41, and a cover plate 42 is provided for the opening 40 and is secured to the thickened portion 41 by means of bolts 43. The cover plate 42 is shaped to provide an outwardly projecting inwardly open boss 45, in which is mounted a pin or shaft 46, best seen in Figure 2. The pin 46 is seated at one end, as indicated at 47, in a socket formed at one end of the boss and extends outwardly through an opening, as indicated at 48, at the other end of the boss. Suitable roller bearings for supporting the shaft 46 are indicated at 49, and an oil seal is provided as indicated at 50.

Pinned to the shaft 46 at substantially its mid portion and within the inwardly opening recess provided by the boss 45 is a short lever arm 51

which terminates at its free end in a flat portion 52, which is preferably hardened for a purpose which will later appear. The outer end of the shaft 46 has secured thereto a lever 55 which is provided at its free end with a link 56 adapted to be connected in the usual manner to the carburetor throttle (not shown).

Resilient means are provided for biasing the levers 55 and 51 in a clockwise direction so as to cause the flattened surface 52 of the lever 51 to engage a portion of the centrifugal means. This resilient means takes the form of a coil compression spring 57 having a seat 58 pivoted at 59 to the lever 55 and an adjustable seat 60 carried by an adjusting bolt 61 provided with a lock nut 62. As will be apparent, the compression of the spring and hence the adjustment of the governor may be varied by suitable adjustment of the bolt 61.

The shaft 26 is provided at its free end with a relatively large counterbore 65 and a smaller counterbore 66. Seated within the counterbore 66 is a plug 67 having a forwardly extending projection 68 which projects beyond the bottom of the counterbore 65. A plurality of small ball bearings 69 are provided in the bottom of the counterbore 65 about the projection 68. A larger ball 70 is seated within the counterbore 65 and engages the plurality of ball bearings 69. The ball 70 is retained within the counterbore 65 by reason of a locking ring 71, and a portion of the ball 70 projects outwardly beyond the adjacent end of the shaft 26.

As will be apparent from an inspection of Figure 1, the ball 70 engages the flat hardened surface 52 of the lever 51 when the shaft 26 is moved outwardly in its counterbore by reason of radial outward movement of the balls 30 under centrifugal action. This movement of the parts is of course opposed by the compression spring 57, as will be readily apparent.

During operation of the governor, when the outer plate 28 moves axially as a result of radially outward movement of the balls 30, it causes lever 51 to rotate about its axis. As a result of this movement of the lever 51, a point on the surface 52, which engages the ball 70, moves in an arc. Therefore, if the ball 70 were not mounted for rotation, there would be rubbing and friction between this ball and the flat surface 52. However, since the ball 70 is free to rotate within the counterbore 65, and since it is further supported by a plurality of ball bearings 69, friction between the ball 70 and the surface 52 is reduced to a negligible quantity. This in turn reduces the side thrust on the shaft 26, making the governor performance highly responsive and eliminating lag.

The counterbore 65 is so small that the use of tools during assembly of balls 69 is impossible. In order to permit this assembly to be easily made without tools, the projection 68 causes the balls to assume their proper relationship. Accordingly it is only necessary to introduce the proper number of ball bearings 69 into the counterbore 65 and to thereafter introduce the large ball 70 therein. The ball 70, in conjunction with the projection 68, will thereupon force the ball bearings 69 to assume their proper operating position, and the ring 71 may then be snapped into the groove provided therefor in the interior of the counterbore 65.

As is apparent, the governor may be assembled on the cam shaft 10 while the same is in horizontal position, and it is accordingly very desirable to introduce the governor balls 30 in properly assembled relation. I have found that this may be accomplished in a very satisfactory manner by providing a governor ball drive assembly which serves as a cage to retain the balls in properly assembled relation. Generally described, this cage comprises an annular plate having generally radially extending slots, the side walls of which are inclined inwardly so as to retain the balls 30 in place.

More specifically, the drive plate assembly 31 is made up of two separate metal plates 78 and 80 respectively. As shown, the plate 78 is provided with a central opening 79, adapted to receive the reduced portion 32 of the cam shaft 10. A keyway 72 is provided at an edge of the opening 79 whereby the plate 78 may be keyed upon the cam shaft to rotate therewith. A plurality of radially extending elongated slots 73 are provided in the plate 78, and flanges 75 which taper inwardly at a slight angle are provided throughout the edges of said slots. The slots 73 are closed at their opposite ends, and the outer edge of the plate 78 is bent upwardly as indicated at 76. A plurality of oil holes 77 are also provided in the plate 78 for a purpose which will presently appear.

The plate 80 has a central opening 81 adapted to receive the reduced portion 32 of the cam shaft 10, and has a keyway 82 at an edge of the opening 81 so that the plate 80 may be keyed upon the cam shaft to rotate therewith. The plate 80 is of smaller diameter than the plate 78 and is provided with slots 83 which are open at their outer ends. The slots 83 are the same in number, spacing and general arrangement as the slots 73 previously referred to, and differ therefrom primarily in the fact that they are not closed at their outer ends. The plate 80 is provided throughout the edges of the slots 83 with inwardly tapering flanges 85, and is provided with oil holes 87, similar to the oil holes 77.

From the foregoing, it will be apparent that when the plates 78 and 80 are assembled as shown in Figure 1, the balls 30 located within the slots 73 and 83 will be retained in position by reason of the inward inclination of the flanges 75 and 85. Accordingly, in order to assemble the plates and balls, the balls are first positioned in the slots of one of the plates, the second plate is then brought into registry with the first plate, and the two plates are secured together as for example by spot welding. By virtue of this arrangement, the balls 30 are permanently retained in the drive plate assembly 31 but are freely movable in a radial direction an amount depending upon the length of the elongated slots thus provided. The foregoing construction is very desirable in assembling my improved governor structure, since the balls are first permanently assembled in the drive plate assembly therefor and may be introduced as a unit into the recess 16 formed in the gear 13.

Lubrication is provided for the governor through an oil hole 90, to which oil is introduced under pressure. A second oil passage 91 and an oil receiving ring 92 are formed in the cam shaft 10 and are adapted to receive oil in the order named from the oil hole 90. From the oil receiving ring 92 oil flows through a passage 93 to a similar passage 94 formed in the gear 13, thence through oil holes 77 and 87 formed in the plates 78 and 80 respectively, and thence out-

wardly through similar holes formed in the washer 33.

As best seen in Figure 1, the plate 28 has a very slight clearance with respect to the radially extending outward walls of the recess 16, and I have found that the provision of the transverse openings 100 in this plate are desirable to prevent any possibility of a dash-pot effect taking place upon inward or outward movement of the plate 28 under the influence of the centrifugal means 17 on the one hand, and the resiliently biased levers 55 and 51 on the other hand.

For holding the cam shaft 10 against axial displacement, I have provided a washer 101 between a shoulder 101a formed on the cam shaft and a second shoulder 102 formed on the gear 13.

With the foregoing description in mind, the assembly of the governor should be apparent. The gear 13 is mounted on the reduced portion 32 of the cam shaft 10. The sleeve 20 and its associated plate 19 are mounted on the inner hub portion of the gear 13. The drive plate assembly together with the preassembled balls 30 is placed on the reduced portion 32 of the cam shaft in keyed relation and is assembled thereon by the washer 33 and nut 34. The shaft 26 with its preassembled ball 70 and its plate 28 is then slipped into the counterbore in the end of the cam shaft 10. This completes the assembly of the centrifugal part of the governor.

In like manner the operation of the governor should be readily apparent. Upon rotation of the cam shaft 10 a like rotation is imparted to the drive plate assembly 31, thus rotating the balls 30 about the axis of the cam shaft 10. As a result of the centrifugal action thus developed, the balls 30 tend to move radially outwardly, such movement being limited by the elongated slots 73 and 83 which receive the balls. Outward movement of the balls tends to move the plate 28 axially, thus moving the shaft 26 also axially of the cam shaft 10. This motion of the shaft 26 is opposed by the lever 51, which is resiliently urged in a clockwise direction by the compression spring 57. Accordingly, the radially outward movement of the balls 30 is arrested at a point dependent upon the geometry of the governor. The governor is lubricated by oil passing through the oil passages 91, 92, 93, 94, 77 and 87.

My improved governor not only is characterized by the small amount of space which it takes up but also by its simplicity of design and construction. Attention is also directed to the fact that the thrust developed by the centrifugal means is applied coaxially of the cam shaft. This contributes to the efficiency of the operation and prevents the possibility of any unbalanced force acting on different ones of the centrifugal balls 30.

It may be pointed out that during operation of the governor while the gear 13 is rotating, the plates 19 and 28 will normally pick up the same speed of rotation as the balls 30 but that upon change in speed of the engine, the plates 19 and 28 may have a slight differential rotation in order that the balls 30 may roll smoothly to a new position.

While I have illustrated and described in considerable detail a single preferred embodiment of my improved governor, it will be understood that this has been done solely to enable those skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. In a governor, a shaft having inner and outer axially extending counterbores arranged end to end, the outer counterbore being larger in diameter than the inner counterbore, a plug seated within the inner counterbore and having an axially extending projection within the outer counterbore at its inner end, ball bearings engaging the inner end of the outer counterbore in concentric relation to the projection of the plug, a ball substantially equal in diameter to the outer counterbore seated against the ball bearings and projecting endwise of the shaft for engagement with a spring biased lever of a throttle control, and a locking ring anchored within the outer counterbore at its outer end for retaining the ball in engagement with said ball bearings.

2. In a governor, a shaft having inner and outer axially extending counterbores arranged end to end, the outer counterbore being larger in diameter than the inner counterbore, ball bearings arranged in a circle against the inner end of the outer counterbore, an antifriction element substantially equal in diameter to the outer counterbore seated against the ball bearings and projecting endwise of the shaft for engagement with a spring biased lever of a throttle control, a locking ring anchored within the outer counterbore at its outer end for retaining the antifriction element in engagement with said ball bearings, and means for locating the ball bearings in their proper operating position at the inner end of the outer bore for seating engagement with the antifriction element, including a plug seated within the inner counterbore and having an axially extending projection within the outer counterbore at its inner end.

3. In a governor, a shaft having inner and outer axially extending counterbores arranged end to end, the outer counterbore being larger in diameter than the inner counterbore, ball bearings arranged in a circle against the inner end of the outer counterbore, an antifriction element substantially equal in diameter to the outer counterbore seated against the ball bearings and projecting endwise of the shaft for engagement with a spring biased lever of a throttle control, and a locking ring anchored within the outer counterbore at its outer end for retaining the antifriction element in engagement with said ball bearings.

4. In a governor, a shaft having inner and outer axially extending counterbores arranged end to end, the outer counterbore being larger in diameter than the inner counterbore, a plug seated within the inner counterbore and having an axially extending projection within the outer counterbore at its inner end, ball bearings engaging the inner end of the outer counterbore in concentric relation to the projection of the plug, a ball substantially equal in diameter to the outer counterbore seated against the ball bearings and projecting endwise of the shaft for engagement with a spring biased lever of a throttle control, and means retaining the ball in engagement with said ball bearings, the length of the projection within the outer counterbore being less than the diameter of the ball bearings whereby said projection terminates short of the space occupied by the ball.

5. In a governor, a rotary shaft provided with an axial recess in one end thereof, a centrifugally operated element in said recess movable axially of said shaft, said element having a recess

in its outer end, a projection located centrally of the second mentioned recess at the bottom thereof and forming with the walls of said second recess an annular race, a plurality of small ball bearings in said race, and a single ball mounted in the second mentioned recess in engagement with said bearings, the construction and arrangement of the single ball, second mentioned recess, and ball bearings being such that the single ball projects outwardly from the second recess for engagement with a spring biased member.

6. In a governor, a rotary shaft provided with an axial recess in one end thereof, a centrifugally operated element in said recess movable axially of said shaft, said element having a recess in its outer end, a projection located centrally of the second mentioned recess at the bottom thereof and forming with the walls of said second recess an annular race, a plurality of small ball bearings in said race, a single ball mounted in the second mentioned recess in engagement with said bearings, the construction and arrangement of the single ball, second mentioned recess, and ball bearings being such that the single ball projects outwardly from the second recess for engagement with a spring biased member, and means carried by the centrifugally operated element for maintaining engagement between the single ball and said ball bearings.

7. In a governor, a shaft having inner and outer axially extending counterbores arranged end to end, the outer counterbore being larger in diameter than the inner counterbore, a plug seated within the inner counterbore and having an axially extending projection within the outer counterbore at its inner end, ball bearings engaging the inner end of the outer counterbore in concentric relation to the projection of said plug, and a single ball substantially equal in diameter to the outer counterbore seated against the ball bearings and projecting endwise of the shaft for engagement with a spring biased lever of a throttle control.

8. In a governor, a shaft having inner and outer axially extending counterbores arranged end to end, the outer counterbore being larger in diameter than the inner counterbore, a plug seated within the inner counterbore and having an axially extending projection within the outer counterbore at its inner end, ball bearings engaging the inner end of the outer counterbore in concentric relation to the projection of said plug, a single ball seated against the ball bearings and projecting endwise of the shaft for engagement with a spring biased lever of a throttle control, and means retaining the single ball in engagement with said ball bearings.

HERMAN G. ADLER.