

Nov. 24, 1942.

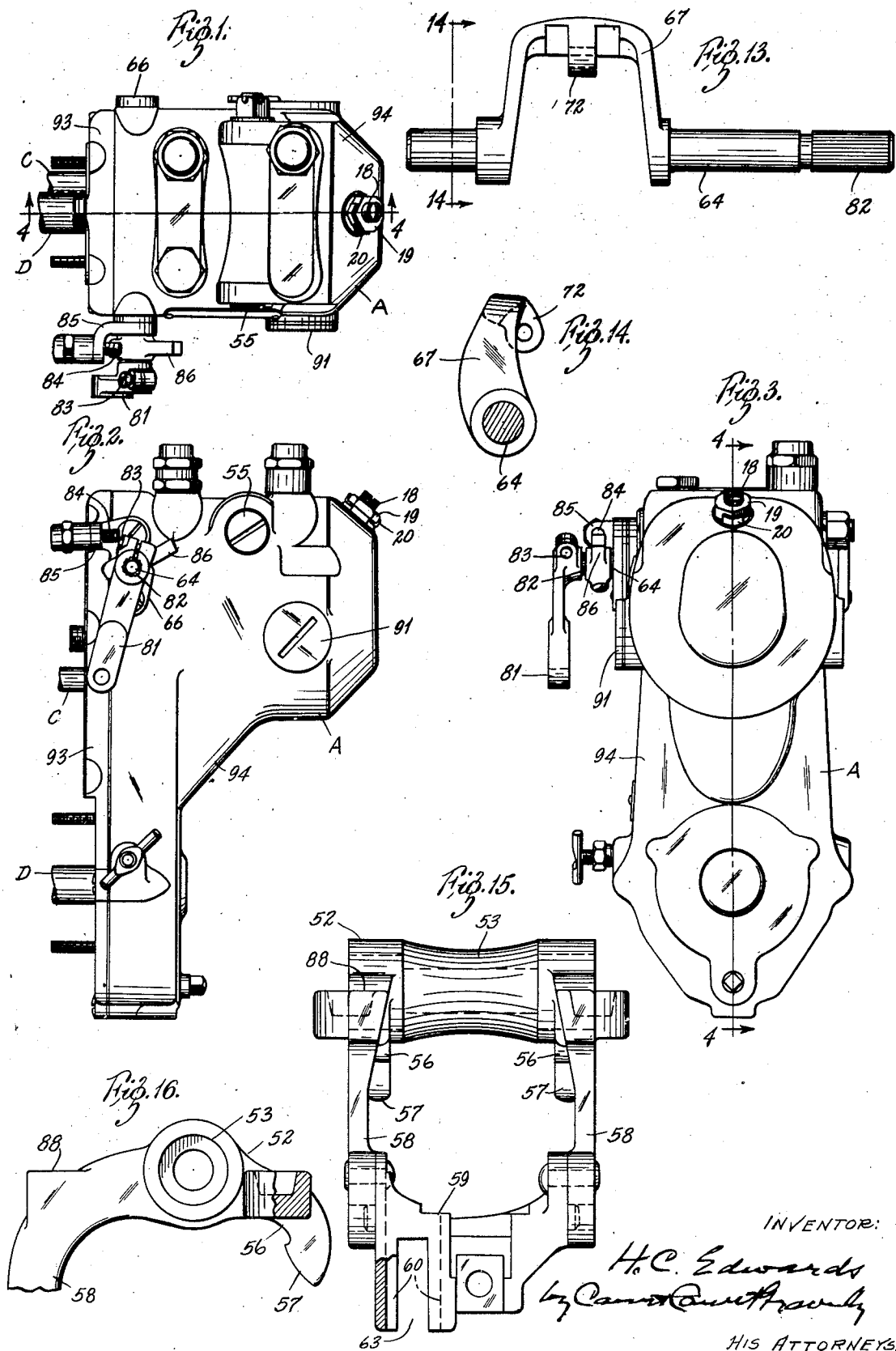
H. C. EDWARDS

2,302,906

GOVERNOR

Filed Aug. 1, 1940

3 Sheets-Sheet 1



INVENTOR:

H. C. Edwards
by *Carroll Smith & Son*

HIS ATTORNEYS

Nov. 24, 1942.

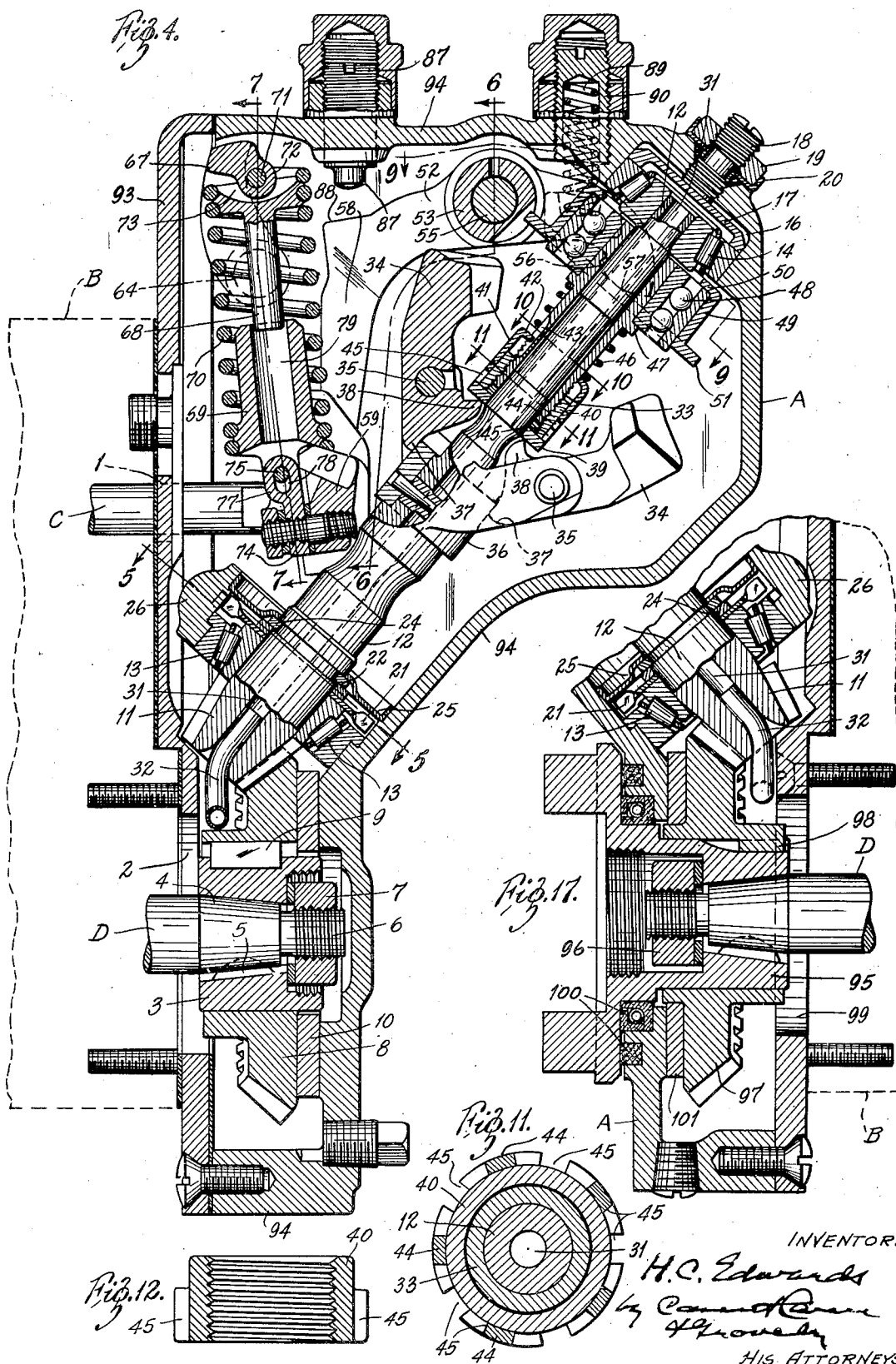
H. C. EDWARDS

2,302,906

GOVERNOR

Filed Aug. 1, 1940

3 Sheets-Sheet 2



Nov. 24, 1942.

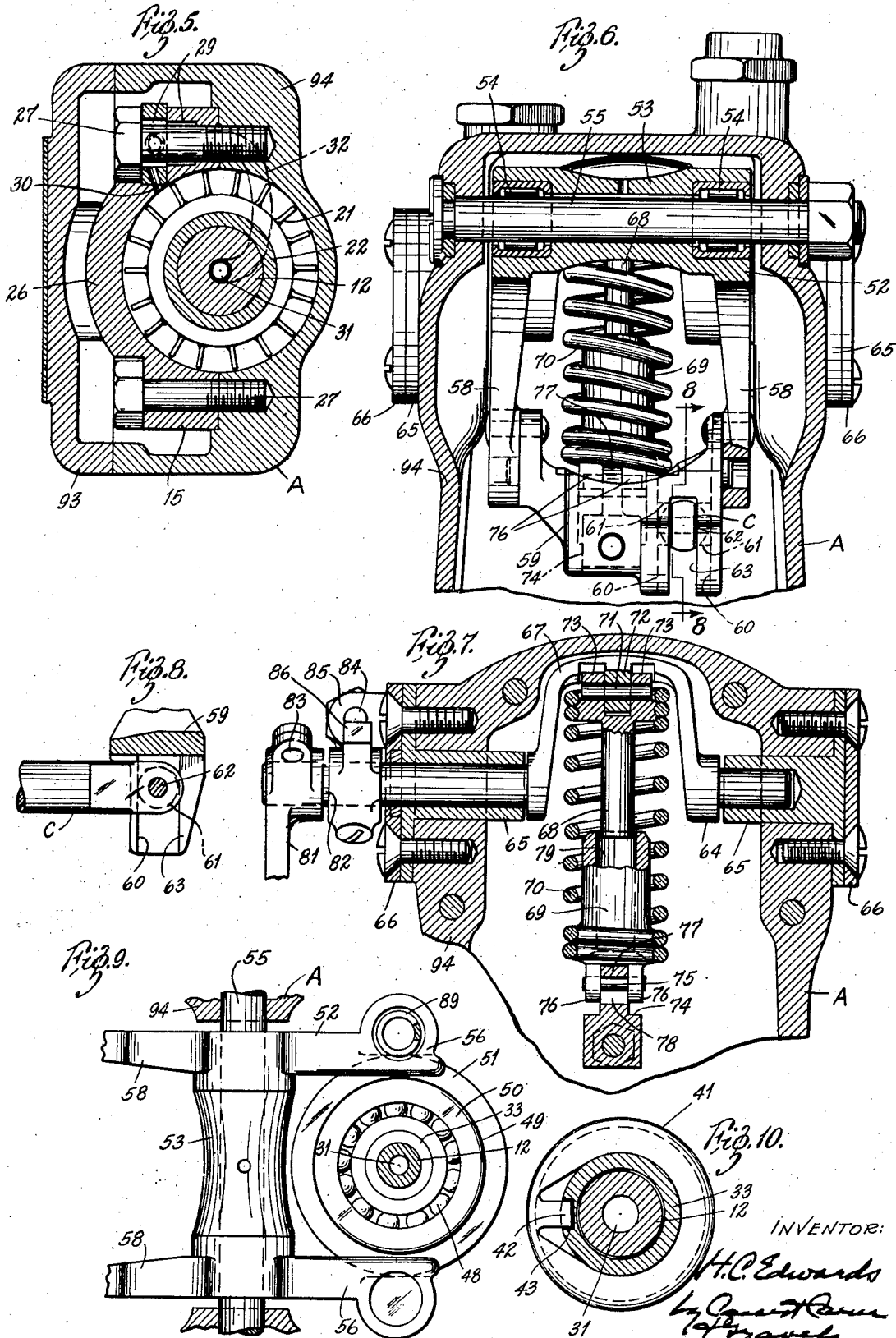
H. C. EDWARDS

2,302,906

GOVERNOR

Filed Aug. 1, 1940

3 Sheets-Sheet 3



INVENTOR:

H. C. Edwards
by *Conrad R. Rame*
Attorney

HIS ATTORNEYS.

UNITED STATES PATENT OFFICE

2,302,906

GOVERNOR

Herbert C. Edwards, Massillon, Ohio, assignor to
The Timken Roller Bearing Company, Canton,
Ohio, a corporation of Ohio

Application August 1, 1940, Serial No. 349,034

15 Claims. (Cl. 264—3)

This invention relates to speed regulating devices for internal combustion engines and more particularly to governors for automatically controlling the output of fuel injection pumps for compression ignition engines. One of the objects of the present invention is to provide a completely enclosed, self-contained compact governor which will maintain the engine speed selected by the operator regardless of the load applied, unless such load is beyond the capacity of the engine. Other objects are to adapt the governor for application to existing types of fuel injection pumps, to adapt the governor for mounting on either end of the injection pump without interfering with the pump drive, to provide a single spring for controlling the full speed range of the engine above idling speed, to decrease the effort required to hold the throttle lever in any position and to obtain other advantages hereinafter appearing. The invention consists in the governor and in the construction, combinations and arrangements of parts hereinafter described and claimed.

In the accompanying drawings, which form part of this specification and wherein like symbols refer to like parts wherever they occur,

Fig. 1 is a plan view of a speed governor embodying my invention,

Fig. 2 is a side elevational view of said speed governor,

Fig. 3 is an outer end view of said governor,

Fig. 4 is an enlarged central vertical longitudinal section on the line 4—4 in Fig. 3,

Fig. 5 is a fragmentary cross-section on the line 5—5 in Fig. 4,

Fig. 6 is a fragmentary vertical section on the line 6—6 in Fig. 4,

Fig. 7 is a fragmentary section on the line 7—7 in Fig. 4,

Fig. 8 is a fragmentary vertical section on the line 8—8 in Fig. 6,

Fig. 9 is a fragmentary section on the line 9—9 in Fig. 4,

Figs. 10 and 11 are enlarged cross-sections on the lines 10—10 and 11—11, respectively, in Fig. 4,

Fig. 12 is an enlarged central longitudinal sectional view of the thrust sleeve nut,

Fig. 13 is a side elevational view of the control lever shaft,

Fig. 14 is a cross-section on the line 14—14 in Fig. 13,

Fig. 15 is an end elevation of the yoke lever, looking at the fuel feed control rod and high speed spring receiving end thereof,

Fig. 16 is a fragmentary side elevational view of said yoke lever; and

Fig. 17 is a central vertical longitudinal section through the lower portion of the governor showing the arrangement of the drive gear therein when the governor is attached to the opposite end of the fuel pump.

The centrifugal speed regulating device or governor shown in the accompanying drawings comprises a housing A adapted to be removably secured flatwise to one end of a fuel injection pump of which only adjacent portions of the housing B, the reciprocatory fuel control rod C and the rotary cam shaft D are shown. The cam shaft D is adapted to be driven by or in unison with the compression ignition engine (not shown) supplied by said pump; and the fuel control rod C is slid in the direction of the governor to decrease the quantity of fuel supplied to the engine and is slid in the opposite direction to increase such fuel supply. The pump opposing end wall of the governor housing A has vertically spaced openings 1 and 2 extending horizontally therethrough adapted to receive the ends of the control rod C and cam shaft D, respectively.

Mounted on the portion of the cam shaft D located within the governor housing A is a sleeve 3 having a tapered bore adapted to fit a tapered seat 4 provided therefor on said shaft adjacent to the end thereof. This sleeve is nonrotatably secured to the tapered portion 4 of the cam shaft D, by means of a key 5. The cam shaft terminates in a threaded end portion 6 having a nut 7 threaded thereon; and this nut serves to clamp the sleeve 3 on the tapered portion 4 of said shaft, thereby preventing relative endwise movement of said shaft and sleeve. Mounted on the sleeve 3 is a bevel drive gear 8, which is secured to said sleeve by means of a spline 9 that permits relative axial movement of said gear and sleeve while preventing relative rotary movement thereof. Surrounding the sleeve 3, between the front end wall of the governor housing A and the adjacent end face of the drive gear 8, is a washer 10 adapted to receive the end thrust of said gear.

Intermeshing with and driven by the bevel drive gear 8 on the cam shaft C is a beveled gear 11 formed on or secured to the lower end of a governor shaft 12 located in the upper portion of the governor housing A above and at an oblique angle to the drive gear 8. This governor shaft 12 inclines upwardly and outwardly in the governor housing A at an angle of about forty-five degrees and is journaled near its lower and

upper ends in suitable tapered roller bearings 13 and 14, respectively, located in said housing. The bearing 13 for the lower end of the governor shaft 12 is mounted in a split pedestal 15 provided therefor in said housing; and the bearing 14 for the upper end of said shaft is supported in a recess 16 provided therefor in the upper outer end corner portion of said housing. Interposed between the inner end of the recess 16 and the bearing 14 therein is a cup-shaped thrust washer or disk 17 which is held in abutting relation to the adjacent end of the outer raceway member of said bearing by means of a stud 18 that is threaded through the governor housing in axial alignment with said bearing and is locked in adjusted position by a suitable lock nut 19 and lock washer 20. By means of this stud, end play of the governor may be adjusted from outside the governor housing.

Mounted on the governor shaft 12 adjacent to the upper end of the bearing 13 therefor is a paddle wheel 21 which is clamped between the end of the inner raceway member of said bearing and a washer 22, which is held in place on the governor shaft by means of a snap ring 24 seated in an annular groove provided therefor in said shaft. The paddle wheel 21 works in the bearing receiving bore of the bearing supporting pedestal beyond the upper end of the bearing 13 therein; and the upper end of said bore is closed by means of an annular closure member 25 that seats in said bore and has a central opening for the governor shaft 12. By this arrangement, the intermeshing gears 8 and 11 pick up oil contained in the lower portion of the governor housing A and throw it against the lower roller bearing 13; and this bearing functions as a pump to force such oil through the bearing into the portion of the bore in the pedestal 12 in which the pedal wheel operates as a centrifugal pump to force the oil out through a small passage in the bearing cap around one of the securing studs therefor. The split pedestal 15 is provided with a cap 26 that is removably secured to the portion of the pedestal formed integral with the governor housing A by means of cap screws 27. As shown in the drawings, one of the cap screw receiving holes in the pedestal cap 27 is counterbored to provide an annular clearance space 29 around the cap screw in said hole; and a passageway 30 in said cap establishes communication between said annular space and the space in which the paddle wheel 21 works. An annular fitting is sleeved on said cap screw between the head thereof and the pedestal cap 26 and has its bore enlarged to form a continuation of the annular oil space 29; and communication is established between the annular space and the lower end of an axial bore 31 in the governor shaft 12 through a tube or conduit 32. Thus, the oil is conveyed through the tube 32 from the annular space 29 to the axial bore 31 in the governor shaft and then forced upwardly through said bore into the supporting recess 16 for the upper bearing 14 from which it is thrown by the pumping action of this bearing into the upper portion of the governor housing to lubricate the parts hereinafter referred to located thereon.

A thrust sleeve 33 is slidably mounted on the governor shaft 12 and is adapted to be slid upwardly along said shaft by means of a pair of weighted centrifugal levers 34 that are pivotally supported one on each side of said shaft on horizontal pivots 35 carried by pairs of ears or lugs on the upper end of a spider 36 that is pinned or other-

wise fixed to said shaft. Each of these centrifugal levers 34 is provided at the end remote from its weighted end with a finger 37, which is adapted to abut against the spider 36 and limit the outward swinging movement of said lever, and a finger 38 that is adapted to exert an end thrust on the lower end of the thrust sleeve 33 through a thrust washer 39 sleeved on the governor shaft 12 in abutting relation to the lower end of the sleeve nut 40 which is threaded on the lower end of said thrust sleeve. The sleeve nut 40 is locked in the desired position of adjustment on the thrust sleeve 33 by means of a locking sleeve 41 that has axially sliding but non-rotary connections with said lock sleeve and with said thrust sleeve. The connection between the lock sleeve 41 and the thrust sleeve 33 comprises a lug 42 on the upper end of the lock sleeve that seats in a longitudinal groove 43 in said thrust sleeve, and the connection between said lock sleeve and the sleeve nut 40 comprises a series of circumferentially spaced lugs 44 on the lower end of said lock sleeve that seat in but are disengageable endwise from a corresponding series of longitudinal peripheral grooves 45 in said sleeve nut. The lock sleeve 41 is yieldably held in engagement with the sleeve nut 40 by means of a coil compression spring 46 that is sleeved on the thrust sleeve 33 between said lock sleeve and an annular flange 47 on said thrust sleeve.

Mounted on the upper end of the thrust sleeve 33 between the collar 47 thereon and the upper end thereof is a suitable ball thrust bearing 48; and mounted on the outer raceway member of this bearing is a sleeve 49 having an inwardly extending annular supporting flange 50 at the upper end thereof that seats on the upper end of said raceway member. The thrust bearing sleeve 48 also has an outstanding peripheral thrust flange 51 at the lower end, the purpose of which will hereinafter appear.

A yoke lever 52 has a hub 53 journaled on roller bearings 54 mounted on a horizontal shaft 55 that extends from side wall to side wall of the governor housing A above and clear of the centrifugal levers 34. This yoke lever is provided on one side of its hub 53 with a pair of relatively short downwardly curved arms 56 that extend on opposite sides of the thrust bearing 48 and terminate in convex ends 57 that bear against the upper surface of the outstanding thrust flange 51 of the sleeve 49 supported on said bearing. The yoke lever 52 is provided on the opposite side of its hub 53 with a pair of spaced, relatively long, downwardly curved arms 58 that are cross connected at their lower ends by a cross bar or head 59 that is riveted or otherwise rigidly secured to said arms. This cross bar 59 is located adjacent to the end of the endwise slidable fuel control rod C of the fuel injection pump and has a rectangular downwardly opening trackway 60 formed therein for a pair of rollers 61 supported on opposite sides of the fuel control rod by means of a pin 62 that extends horizontally therethrough, said trackway having an opening 63 through the sides thereof through which the control rod extends.

The cross bar 59 of the long arms 58 of the yoke lever 52 has an extensible link and spring connection with a horizontal control shaft 64 located thereabove. The control shaft 64 is journaled at its ends in bushings 65 mounted in horizontal openings provided therefor in the side walls of the governor housing A, said bushings being held in said openings by annular plates 66 that

are secured to said housing in abutting relation to the outer ends of the respective bushings; and said shaft has an upwardly offset portion or crank 67 located above the cross bar 59 of the yoke lever 52. The connection between the cross bar 59 and the control lever 52 comprises a pair of axially aligned upper and lower links 68 and 69, respectively, and a coiled tension spring 70 hereinafter referred to as the high speed spring, which surrounds said links and has its end portions seated in helical grooves provided therefor in the respective links. The upper link is pivotally suspended from the top of the control shaft crank 67 centrally thereof, for swinging movement crosswise of the control shaft, by means of a horizontal pivot pin 71 that extends through registering holes provided therefor in a depending central lug 72 at the top of said crank and a pair of upstanding lugs 73 disposed one on each side of said lug on the upper end of said link. The lower end of the lower link 69 has a slot-and-pin connection with a plate 74 secured to the cross bar 59 of the yoke lever 53 centrally of said bar. The connection comprises a horizontal pin 75 that extends through aligned openings in a pair of depending lugs 76 on the lower link 69 and a single upstanding lug 77 on the plate 74, the lug 77 being disposed in line with the axis of said link and parallel with the supporting pin 71 for the upper link 68 and the opening through the lug 77 being elongated in the direction of said axis to form a slot 78 which permits relative movement of said yoke lever and said lower link when the high speed spring 70 is not under tension. The lower spring supporting link 69 has a cylindrical main body portion with an axial bore 79 extending there-through and the upper link 68 has a depending axial stem adapted to enter said bore when the high speed spring 70 contracts.

The control shaft 64 extends exteriorly of the governor housing A on one side thereof and has a manually operable control lever 81 fixed thereto. The cooperating portions of the shaft and lever are provided with interfitting ribs and grooves 82 whereby said lever may be angularly adjusted on said shaft. The hub portion of the control lever 81 is split and provided with a clamping screw 83 for locking said lever in the desired position of its angular adjustment. The swinging movement of the control lever 81 is limited in the direction of its high speed setting by an adjustable stop screw 84 which is threaded through a plate 85 fixed to the side of the governor housing A and is disposed in the path of a lug 86 that projects radially from the control shaft 64 between said lever and said side of said housing. A maximum fuel quantity stop comprises an adjustable stop pin 87 that extends downwardly through the top of the governor housing A in position to be engaged by a flat abutment surface 88 formed on the upper edge of one of the long arms 58 of the yoke lever 52. These two stops limit the operator's control over the output of the fuel pump.

A coiled compression spring 89 hereinafter referred to as the idling speed spring, is located in the governor housing A, with its upper end seated in a fitting 90 threaded through the top wall of said housing above one of the short arms 56 of the yoke lever 52 and with its lower end seated in an upwardly opening recess provided therefor in the top of said arm. This idling spring is placed under compression by the upward pressure of the yoke lever arm 56 thereon

only when the high speed spring 70 is fully contracted.

The operation of the hereinbefore described centrifugal speed governor is as follows: When the centrifugal weights 34 on the governor shaft 12, which is driven by or in unison with the engine, are closed, the fuel control rod C is in its position of maximum fuel feed; and when said weights are fully open, said fuel rod is in its position of minimum fuel feed. As said weights swing outwardly due to increased speed of said shaft, the fingers 38 of these weights force the thrust sleeve 33 and the thrust bearing 48 carried thereby upwardly along the governor shaft. During this upward movement of the thrust bearing 48, the thrust flange 51 carried thereby pushes upwardly against the curved lower ends 57 of the short arms 56 of the yoke lever 52, thus rotating said lever on its supporting shaft 55 and causing the long arms 58 of said lever to swing downwardly toward the front end of the governor and move the fuel control rod C, which is operatively connected to said arms through its track and roller connection 60, 61 with the cross bar 59 thereof, in the direction of decreased fuel feed and thus decrease the speed of the engine. When the control lever 81 is set for idling speed, the crank 67 of the control shaft 64 is moved in the direction of the yoke lever supporting shaft 55 and the high speed spring 70 is under minimum tension and the slot-and-pin connection 75, 78 between the lower spring supporting link 69 and the yoke lever 52 permits the idling speed spring 89 to come into play to stabilize the governor and adapt the spring load to the weight load at the speeds demanded under idling conditions. When the control lever 81 is moved further from its idle speed setting, the links 68 and 69 and the high speed spring 70 act as solid links and move the fuel control rod C to a fuel cut-off position. When the control lever 81 is set for maximum high speed, the crank 67 is swung away from the yoke lever supporting shaft and the high speed spring is stretched to its maximum tension when said crank bumps against the pump opposing end wall of the governor housing. When the control lever 81 is set for any speed above idling speed, the high speed spring 70 is placed under tension by the upward swinging movement of the crank 67 of the control shaft 64, the tension on said spring being at a minimum at the low speed setting and at a maximum at the highest speed setting. In all high speed settings of the control lever 81, the fuel control rod C is set to deliver the proper quantity of fuel and the centrifugal governor weights 34 and the high speed spring 70 cooperate to shift the fuel control rod C in either direction and thus maintain within the regulated limits of the particular setting the engine speed selected by the operator regardless of the load applied, provided the load is within the capacity of the engine. The high speed spring 70 is pivotally suspended from the crank 67 centrally thereof and extends in a straight line from this pivotal support to its pivotal connection with the yoke lever 52 midway of the length of the cross bar connection 59 between the long arms 58 of said lever. Thus, as the crank 67 swings about the axis of the throttle or control shaft 64, the spring 70 has a varying moment arm relative to the line of action of the weight force on the thrust sleeve 33 that is greater at high speed and lesser at idle speeds. On the other hand, the weight forces at the various speed settings of the control lever 81 also increase as the speed of the engine

increases. At any fixed setting of crank 67 the high speed spring 70 has the same moment arm relative to line of weight action and, therefore, the same slope of increment of force over the weight force over the full range of travel of control rod. This spring arrangement provides a closer regulation in the various high speed settings of the control lever and it enables the same spring to be used for all high speed settings and limits the top speed of the governor to any one of these settings with satisfactory regulation. It is noted that the crank or control shaft 64 which constitutes the throttle shaft, is arranged so that, as the high speed spring tension increases, its effect on the yoke lever 52 is decreased due to the angle of action of said spring having a decreased moment arm about the center of the crank shaft. This arrangement greatly reduces the effort required to hold the control or throttle lever in the desired position.

The governor may be adjusted to adapt it to the particular injection pump controlled thereby by adjusting the sleeve nut 40 relative to the thrust sleeve 33 which has the effect of lengthening or shortening said thrust sleeve; and this adjustment is made through an opening which is located in the governor housing opposite said sleeve nut and is closed by a screw plug 91. The governor shaft end thrust adjustments are made from the outside of the governor housing by means of the adjusting screw 18. The beveled drive gear 8 is adapted to rotate with and also slide axially of the pump shaft D, this endwise floating movement of the drive gear being limited in one direction by the gear 11 of the governor shaft 12 and in the other direction by the thrust washer 10 back of the drive gear. This floating gear arrangement provides proper meshing of the gears 8 and 11 and tends to iron out impulses due to the separate fuel injections and prevents such impulses from being transmitted to the centrifugal governor weights, thereby improving the governor action on the engine. Proper lubrication of all of the parts in the upper portion of the governor housing is provided by the pumping action of the lower bearing 13 and the paddle wheel 21 which force the lubricant upwardly through the bore of the governor shaft 12 into the upper bearing 14 and thence into the upper portion of the governor housing.

The governor housing A is preferably made in two sections, one of these sections being a mere plate 93 that is bolted to one end of the injection pump housing B and the other section 94 containing all of the working parts which are assembled and adjusted therein at the factory.

The beveled drive gear 8 of the hereinbefore described governor is shown attached to the end of the pump cam shaft D remote from the drive receiving end thereof. In some instances, however, it is desirable to connect said gear to the drive receiving end of said shaft. In such case, as shown in Fig. 17, one of the members 95 of the coupling, which connects the cam shaft D to the driving shaft (not shown) therefor, is rigidly secured by means of a nut 96 to the drive receiving end of said cam shaft and the drive gear 97 is mounted on said coupling member and has a longitudinal spline connection 98 therewith which permits relative axial sliding movement of said gear and coupling member while preventing relative rotary movement thereof. In this construction, the outer end wall of the governor housing has a horizontal opening 99 therethrough through which the hub of the coupling member 75

95 extends, suitable oil seals 100 are provided between said coupling member and said housing and an end thrust washer 101 is disposed between the drive gear 97 and said end wall of said housing.

Obviously, numerous changes may be made without departing from the spirit of my invention. Therefore, I do not wish to be limited to the precise arrangement shown and described.

Reference is hereby made to my copending application Serial No. 461,182 filed October 7, 1942, for subject matter shown but not claimed herein.

What I claim is:

1. A speed governor for internal combustion engines including a horizontally reciprocable fuel feed control member, said governor comprising a horizontal drive shaft adapted to operate in unison with said engine, a governor shaft located above and at an oblique to said drive shaft, a driving connection between said drive shaft and the lower end of said governor shaft, centrifugally actuated means mounted on said governor shaft, a lever pivoted on a horizontal axis disposed above and transversely of said governor shaft and having one arm arranged for actuation by said centrifugal means when the speed of said governor shaft increases, and another, downwardly extending, arm adapted to be operatively connected adjacent to its free lower end to said fuel feed control member, and a manually operable rock shaft disposed parallel to said lever axis above the point of connection of said second mentioned arm of said lever and said fuel feed control member, said rock shaft having a crank portion, and a tension spring having its upper end sustained by said crank and its lower end operatively connected to said second mentioned arm of said lever adjacent to its point of connection to said fuel feed control member.

2. A speed governor for internal combustion engines including a horizontally reciprocable fuel feed control member, said governor comprising a horizontal drive shaft adapted to operate in unison with said engine, a governor shaft located above and at an oblique to said drive shaft, a driving connection between said drive shaft and the lower end of said governor shaft, centrifugally actuated means mounted on said governor shaft, a lever pivoted on a horizontal axis disposed above and transversely of said governor shaft and having one arm arranged for actuation by said centrifugal means when the speed of said governor shaft increases, and another, downwardly extending, arm adapted to be operatively connected adjacent to its free lower end to said fuel feed control member, a manually operable rock shaft disposed parallel to said lever axis above the point of connection of said second mentioned arm of said lever and said fuel feed control member, said rock shaft having a crank portion adapted for swinging movement towards and away from the pivotal axis of said lever, and a tension spring having its upper end pivotally sustained by said crank and its lower end pivotally connected to said second mentioned arm of said lever adjacent to its point of connection to said fuel feed control member, and a compression spring cooperating with said first mentioned arm of said lever and operating to yieldably resist movement imparted to said lever by said centrifugal means when said tension spring is substantially fully contracted.

3. A speed governor for internal combustion engines including a movable fuel feed control

member, said governor comprising a horizontal shaft adapted to operate in unison with said engine, a housing having an opening therein for said shaft, a governor shaft mounted in said housing above and at an angle to said first mentioned shaft, a gear mounted in said housing and having an axially slidable but nonrotatable connection with said first mentioned shaft, a gear on said governor shaft intermeshing with and driven by said first mentioned gear, means for adjusting said governor shaft axially in said housing, centrifugally actuated means mounted on said governor shaft, a lever journaled in said housing for vertical swinging movement therein, said lever having one arm operatively engaging said centrifugal actuated means and another arm adapted to be operatively connected to said fuel feed control member, a horizontal rock shaft journaled in said housing and having a crank disposed above the point of connection between said lever and said fuel feed control member, a coil tension spring, a support for the upper end of said coil tension spring pivotally suspended from said crank, and a support for the lower end of said tension spring having a connection with said second mentioned arm of said lever.

4. A speed governor for internal combustion engines including a movable fuel feed control member, said governor comprising a horizontal shaft adapted to operate in unison with said engine, a housing having an opening therein for said shaft, a governor shaft mounted in said housing above and at an angle to said first mentioned shaft, a gear mounted in said housing and having an axially slidable but nonrotatable connection with said first mentioned shaft, a gear on said governor shaft intermeshing with and driven by said first mentioned gear, means for adjusting said governor shaft axially in said housing, centrifugally actuated means mounted on said governor shaft, a lever journaled in said housing for vertical swinging movement therein, said lever having one arm operatively engaging said centrifugal actuated means and another arm adapted to be operatively connected to said fuel feed control member, a horizontal rock shaft journaled in said housing and having a crank disposed above the point of connection between said lever and said fuel feed control member, a coil tension spring, a support for the upper end of said coil tension spring pivotally suspended from said crank, a support for the lower end of said tension spring having a slot-and-pin connection with said second mentioned arm of said lever, and a coil compression spring mounted in said housing above said first mentioned arm of said lever and adapted to yieldably resist movement imparted to said lever by said centrifugal means when said tension spring is substantially fully contracted.

5. A speed governor for internal combustion engines including a horizontally reciprocable fuel feed control member with a roller rotatably secured thereto, said governor comprising a horizontal shaft adapted to operate in unison with said engine, a housing having an opening therein for said shaft, a governor shaft mounted in said housing above and at an oblique angle to said first mentioned shaft, a bevel gear mounted in said housing and having an axially slidable but nonrotatable connection with said first mentioned shaft, a bevel gear on the lower end of said governor shaft intermeshing with and driven by said first mentioned bevel gear, a thrust washer interposed between said first mentioned

gear and said housing, means accessible from outside of said housing for adjusting said governor shaft axially therein, centrifugally actuated means mounted on said governor shaft, a lever journaled in said housing for vertical swinging movement therein, said lever having one arm operatively engaging said centrifugal actuated means and another arm having a trackway adapted to receive the roller on said fuel feed control member, a horizontal rock shaft journaled in said housing and having a crank disposed above the point of connection between said lever and said fuel feed control member, a coil tension spring, a support for the upper end of said coil tension spring pivotally suspended from said crank, and a support for the lower end of said tension spring having a connection with said second mentioned arm of said lever.

6. A speed governor for internal combustion engines including a horizontally reciprocable fuel feed control member with a roller rotatably secured thereto, said governor comprising a horizontal shaft adapted to operate in unison with said engine, a housing having an opening therein for said shaft, a governor shaft mounted in said housing above and at an oblique angle to said first mentioned shaft, a bevel gear mounted in said housing and having an axially slidable but nonrotatable connection with said first mentioned shaft, a bevel gear on the lower end of said governor shaft intermeshing with and driven by said first mentioned bevel gear, a thrust washer interposed between said first mentioned gear and said housing, means accessible from outside of said housing for adjusting said governor shaft axially therein, centrifugally actuated means mounted on said governor shaft, a lever journaled in said housing for vertical swinging movement therein, said lever having one arm operatively engaging said centrifugal actuated means and another arm having a trackway adapted to receive the roller on said fuel feed control member, a horizontal rock shaft journaled in said housing and having a crank disposed above the point of connection between said lever and said fuel feed control member, an operating lever on said rock shaft exteriorly of said housing, a coil tension spring, a support for the upper end of said coil tension spring pivotally suspended from said crank, a support for the lower end of said tension spring having a slot-and-pin connection with said second mentioned arm of said lever, a coil compression spring mounted in said housing above said first mentioned arm of said lever and adapted to yieldably resist movement imparted to said lever by said centrifugal means when said tension spring is substantially fully contracted, and means accessible from the outside of said housing for adjusting said compression spring.

7. A speed governor for internal combustion engines including a horizontally reciprocable fuel feed control member, said governor comprising a shaft adapted to operate in unison with said engine, a thrust sleeve slidable axially on said shaft, means for varying the effective length of said thrust sleeve, centrifugally actuated means mounted on said shaft and adapted to shift said thrust sleeve axially thereof when the speed of the shaft increases, a thrust bearing carried by said thrust sleeve, a lever fulcrumed on a horizontal axis and having one arm operatively engaging said thrust sleeve and another adapted to be operatively connected to said fuel control member, a rock shaft disposed with its axis parallel to the pivotal axis of said lever and having a

radially extending arm, a tension spring, a support for the one end of said tension spring suspended from said radial arm, and a support for the other end of said spring having a pivotal connection with said second mentioned arm of said lever.

8. A speed governor for internal combustion engines including a horizontal reciprocable fuel feed control member, said governor comprising a shaft adapted to operate in unison with said engine, a thrust sleeve slidable axially on said shaft, means for varying the effective length of said thrust sleeve, centrifugally actuated means mounted on said shaft and adapted to shift said thrust sleeve axially thereof when the speed of the shaft increases, a thrust bearing carried by said thrust sleeve, a lever fulcrumed on a horizontal axis and having one arm operatively engaging said thrust sleeve and another adapted to be operatively connected to said fuel control member, a rock shaft disposed with its axis parallel to the pivotal axis of said lever and having a radially extending arm, a tension spring, a support for the one end of said tension spring suspended from said radial arm, a support for the other end of said spring having a slot-and-pin connection with said second mentioned arm of said lever, a lever secured to said rock shaft for operating the same, and adjustable stops for limiting the swinging movement of said lever.

9. A speed governor for internal combustion engines including a horizontal reciprocable fuel feed control member, said governor comprising a shaft adapted to operate in unison with said engine, said governor comprising a thrust sleeve slidable axially on said shaft, means for varying the effective length of said thrust sleeve, centrifugally actuated means mounted on said shaft and adapted to shift said thrust sleeve axially thereof when the speed of the shaft increases, a thrust bearing carried by said thrust sleeve, a lever fulcrumed on a horizontal axis and having one arm operatively engaging said thrust sleeve and another adapted to be operatively connected to said fuel control member, a rock shaft disposed with its axis parallel to the pivotal axis of said lever and having a radially extending arm, a tension spring, a support for the one end of said tension spring suspended from said radial arm, a support for the other end of said spring having a slot-and-pin connection with said second mentioned arm of said lever, a lever secured to said rock shaft for operating the same, adjustable stops for limiting the swinging movement of said lever, and a compression spring cooperating with said first mentioned arm of said lever and adapted to yieldably resist the swinging movement imparted thereto by said thrust bearing when said tension spring is substantially fully contracted.

10. A speed governor for internal combustion engines including a reciprocable fuel feed control member, said governor comprising a shaft adapted to operate in unison with said engine, a thrust sleeve slidable axially on said shaft, centrifugally actuated means mounted on said shaft and adapted to shift said thrust sleeve axially thereof when the speed of the shaft increases, a thrust bearing carried by said thrust sleeve, means for varying the effective length of said thrust sleeve comprising a sleeve nut threaded on one end of said thrust sleeve and a lock sleeve having slidable but nonrotary connections with said thrust sleeve and said sleeve nut, a lever fulcrumed on a horizontal axis and

having one arm operatively engaging said thrust sleeve and another arm adapted to be operatively connected to said fuel control member, a rock shaft disposed with its axis parallel to the pivotal axis of said lever and having a crank portion, a tension spring, a support for the one end of said tension spring pivotally connected to said crank, and a support for the other end of said spring having a pivotal connection with said second mentioned arm of said lever.

11. A speed governor for internal combustion engines including a reciprocable fuel feed control member, said governor comprising a shaft adapted to operate in unison with said engine, a thrust sleeve slidable axially on said shaft, centrifugally actuated means mounted on said shaft and adapted to shift said thrust sleeve axially thereof when the speed of the shaft increases, a thrust bearing carried by said thrust sleeve, means for varying the effective length of said thrust sleeve comprising a sleeve nut threaded on one end of said thrust sleeve and a lock sleeve having slidable but nonrotary connections with said thrust sleeve and said sleeve nut, a lever fulcrumed on a horizontal axis and having one arm operatively engaging said thrust sleeve and another arm adapted to be operatively connected to said fuel control member, a rock shaft disposed with its axis parallel to the pivotal axis of said lever and having a crank portion, a tension spring, a support for the one end of said tension spring pivotally connected to said crank, a support for the other end of said spring having a pivotal connection with said second mentioned arm of said lever, a lever secured to said rock shaft for operating the same, and a compression spring cooperating with said first mentioned arm to said lever and adapted to yieldably resist the swinging movement imparted thereto by said thrust bearing when said tension spring is substantially fully contracted.

12. A speed governor for internal combustion engines including a movable fuel feed control member, said governor comprising a horizontal shaft adapted to operate in unison with said engine, a housing having an opening adapted to receive said shaft, a governor shaft mounted in said housing above and at an angle to said first mentioned shaft, a gear mounted in said housing and working in lubricant contained therein and having a connection with said first mentioned shaft, a gear on said governor shaft intermeshing with and driven by said first mentioned gear, roller bearings mounted in said housing for supporting said governor shaft adjacent to the upper and lower ends thereof, centrifugally actuated means mounted on said shaft, a lever journaled in said housing for vertical swinging movement therein, said lever having one arm operatively engaging said centrifugal actuated means and another arm adapted to be operatively connected to said fuel feed control member, a horizontal rock shaft journaled in said housing and having a crank disposed above the point of connection between said lever and said fuel feed control member, and a coil tension spring having one end sustained by said crank and its other end connected to said second mentioned arm of said lever, the bearing for the lower end of said governor shaft being disposed in position to receive oil thrown from said gears, said governor shaft having an axial bore extending therethrough to said upper bearing and an oil passageway between said lower bearing and the lower end of said axial bore, whereby the oil received by said bearing is deliv-

ered by the pumping action thereof through said passageway and said axial bore to said upper bearing from which it is thrown into the upper portion of said housing.

13. A speed governor for internal combustion engines including a movable fuel feed control member, said governor comprising a horizontal shaft adapted to operate in unison with said engine, a housing having an opening for said shaft, a governor shaft mounted in said housing above and at an angle to said first mentioned shaft, a gear mounted in an oil containing lower portion of said housing and driven by said first mentioned shaft, a gear on said governor shaft intermeshing with and driven by said first mentioned gear, roller bearings mounted in said housing for supporting said governor shaft adjacent to the upper and lower ends thereof, centrifugally actuated means mounted on said shaft, a lever journaled in said housing for vertical swinging movement therein, said lever having one arm operatively engaging said centrifugal actuated means and another arm adapted to be operatively connected to said fuel feed control member, a horizontal rock shaft journaled in said housing and having a crank disposed above the point of connection between said lever and said fuel feed control member, a coil tension spring suspended from said crank and pivotally connected at its lower end to said second mentioned arm of said lever, the bearing for the lower end of said governor shaft being disposed in position to receive oil thrown from said gears, said governor shaft having an axial oil passageway extending there-through to said upper bearing, oil impelling means associated with said lower bearing, and a passageway leading from said oil impelling means to the lower end of said axial oil passageway.

14. A speed governor for internal combustion engines including a movable fuel feed control member, said governor comprising a horizontal shaft adapted to operate in unison with said engine and having a shaft coupling member fixed thereto, a housing having an opening therein for said shaft coupling member, a governor shaft mounted in said housing above and at an angle to said first mentioned shaft, a gear mounted in

said housing and having an axially slidable but nonrotatable connection with said shaft coupling member, a gear on said governor shaft intermeshing with and driven by said first mentioned gear, centrifugally actuated means mounted on said governor shaft, a lever journaled in said housing for vertical swinging movement therein, said lever having one arm operatively engaging said centrifugal actuated means and another arm adapted to be operatively connected to said fuel feed control member, a horizontal rock shaft journaled in said housing and having a crank disposed above the point of connection between said lever and said fuel feed control member, and a coil tension spring pivotally suspended from said crank and having a pivotal connection with said second mentioned arm of said lever.

15. A speed governor for internal combustion engines including a horizontally reciprocable fuel feed control member having a roller journaled thereon, said governor comprising a horizontal drive shaft adapted to operate in unison with said engine, a governor shaft located above and at an oblique angle to said drive shaft, a driving connection between said drive shaft and the lower end of said governor shaft, centrifugally actuated means mounted on said governor shaft, a lever pivoted on a horizontal axis disposed above and transversely of said governor shaft, said lever having a pair of spaced arms disposed on one side of its axis and arranged for actuation by said centrifugal means when the speed of said governor shaft increases, a pair of spaced downwardly extending arms disposed on the other side of said axis, and a cross bar rigidly connecting the free ends of said last mentioned arms and having a downwardly opening trackway formed therein for the roller on said fuel feed control member, a manually operable rock shaft disposed parallel to said lever axis and having a crank disposed adjacent to said downwardly extending arms of said lever, and a coil tension spring having its upper end anchored to said crank and its lower end anchored to said cross bar adjacent to said trackway.

HERBERT C. EDWARDS.