Nov. 16, 1965 A. E. HUSE 3,217,700

VARIABLE SPEED GOVERNOR

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FIG. 1.

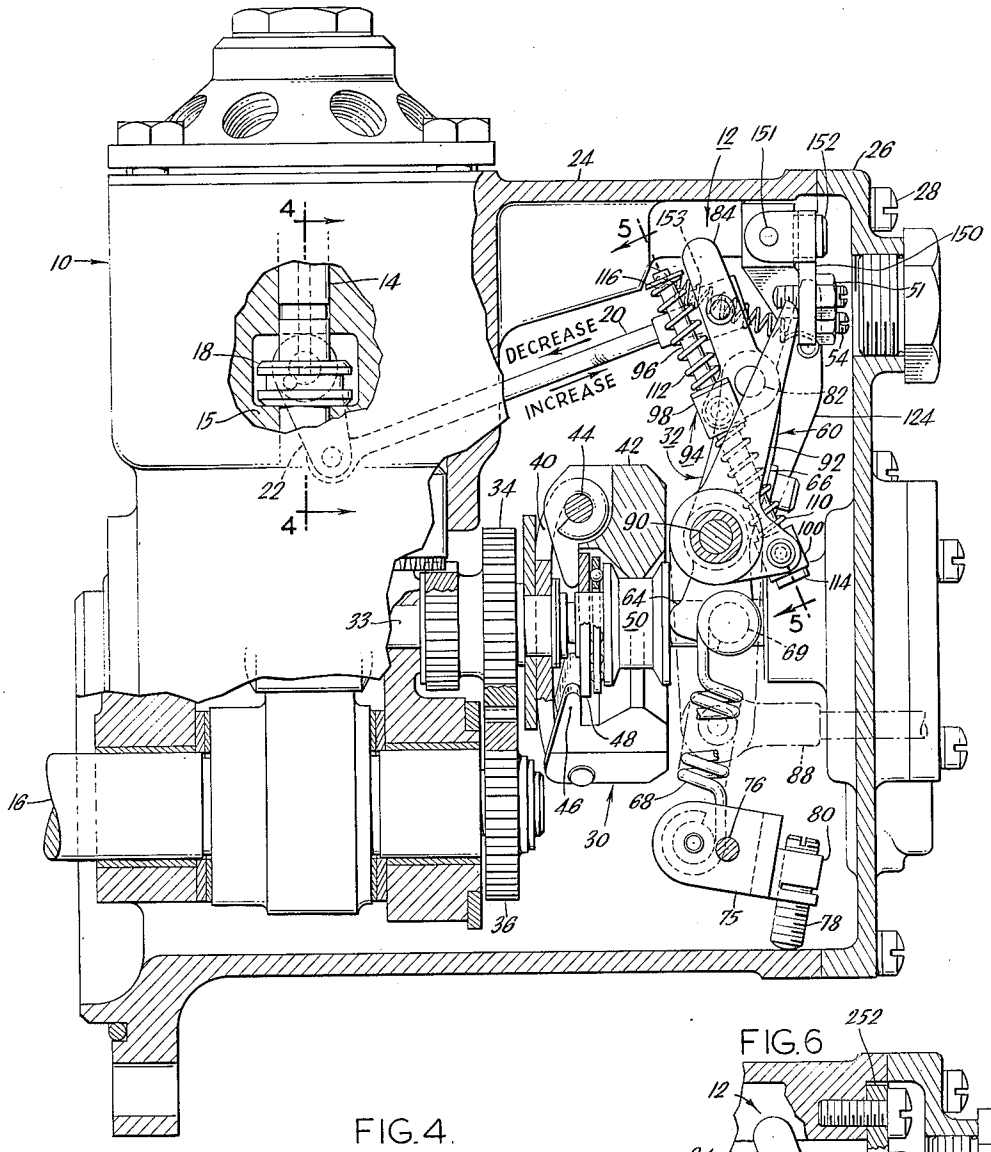


FIG. 4.

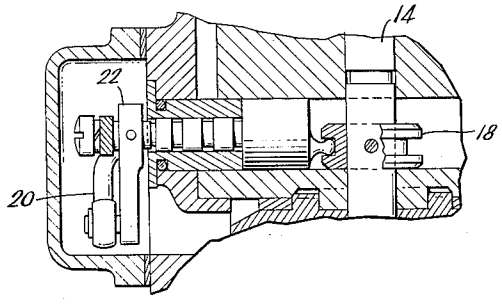
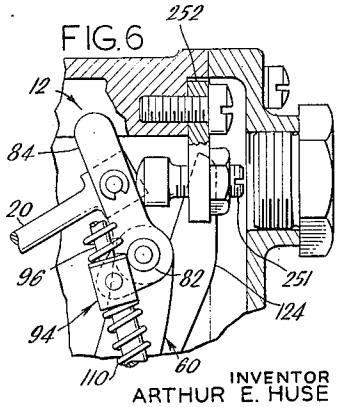


FIG. 6



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FIG. 5.

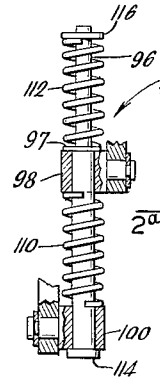


FIG. 5a

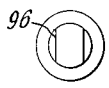


FIG. 5b

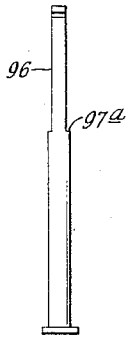


FIG. 2.

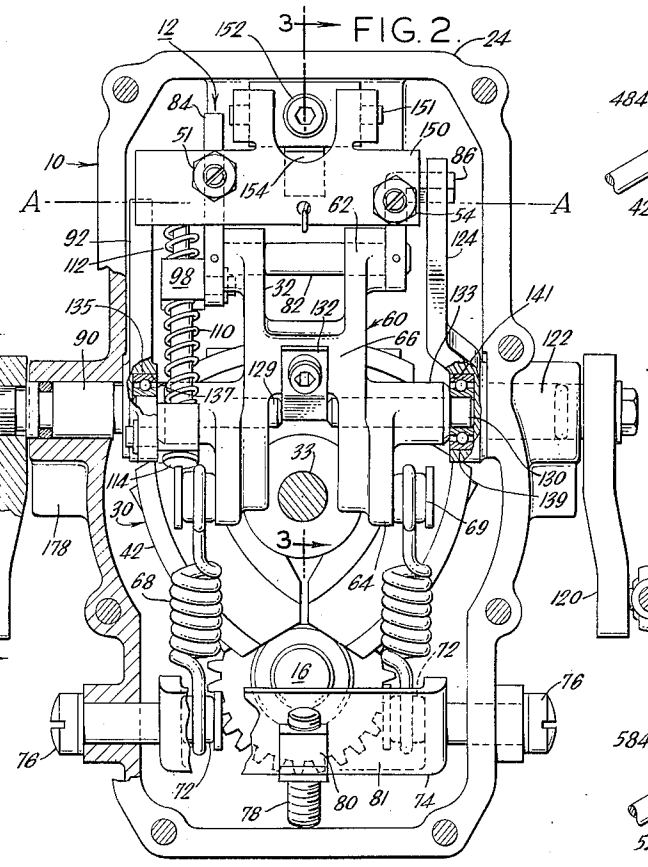


FIG. 3

FIG. 7

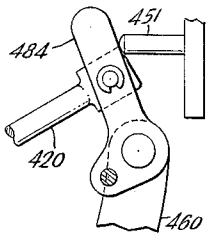


FIG. 9

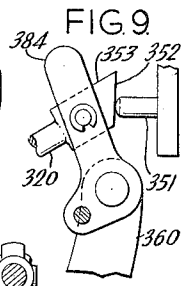


FIG. 8.

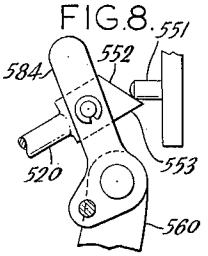


FIG. 2a

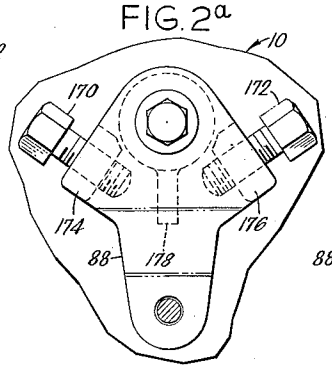
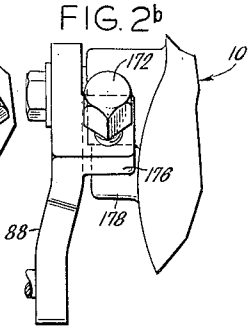


FIG. 2b



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3,217,700

VARIABLE SPEED GOVERNOR

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Filed Feb. 27, 1963, Ser. No. 261,325
8 Claims. (Cl. 123—140)

This invention relates to a speed regulating and torque control governor for controlling fuel supplied by a fuel pump to an internal combustion engine.

An object of the present invention is to provide a torque control governor including a linkage connected to the pump which is adjustable selectively to vary the quantity of fuel delivered by the pump and manual control means actuatable with a minimum force to position the control linkage for a speed change.

Another object of the present invention is to provide a simple, readily adjustable full-load fuel stop and torque control to suit the torque requirements of the engine at speeds below the full-load speed.

Still another object of the present invention is to provide a torque control governor adapted for us with turbocharged engines including automatic means for decreasing fuel delivered from the pump when the quantity of air delivered by the turbosupercharger is low.

A further object of the present invention is to provide a torque control governor including automatic means for obtaining excess fuel delivery from the pump during crank to facilitate engine starting.

A still further object of the present invention is to provide a centrifugal governor which is compact and is of comparatively simplified low-cost construction which may be manufactured economically and which is fully effective for the purposes intended.

These and other objects of the present invention and the various features and details of the construction thereof are hereinafter more fully set forth with reference to the accompanying drawings, wherein:

FIG. 1 is a side elevational view partly in section of a pump and a centrifugal governor in accordance with the present invention for selectively controlling the quantity of fuel delivered by the pump;

FIG. 2 is an end elevational view of the centrifugal governor partly in section so that details thereof may be seen more clearly;

FIG. 2*a* is a fragmentary sectional view of the limit means for the manual operating lever taken on line 2*a*—2*a* of FIG. 1;

FIG. 2*b* is a fragmentary side elevational view of the limit means of FIG. 2*a*;

FIGS. 3 and 4 are enlarged fragmentary sectional views taken on lines 3—3 of FIG. 2 and 4—4 of FIG. 1, respectively;

FIG. 5 is an enlarged sectional view of the centering mechanism for the load lever of the governor taken on line 5—5 of FIG. 1;

FIGS. 5*a* and 5*b* are plan and side elevational views respectively of the rod for the centering mechanism shown in FIG. 5; and

FIG. 6 is an enlarged fragmentary side elevational view showing a modified form of torque control stop screw.

FIG. 7 is a fragmentary view of a modified form of the full load stop or limit screw arrangement of FIG. 1 operable to effect an increased fuel delivery at full load speed when additional load is imposed on the engine to give the engine "lugging" ability;

FIG. 8 is a fragmentary view of an alternate arrangement for achieving "lugging"; and

FIG. 9 is a fragmentary view of an arrangement similar to that of FIG. 8 except that this arrangement is adapted for use with some engines to effect a decrease of fuel delivered by the pump when the engine speed is decreased.

Referring now to the drawings, and particularly to FIG. 1 thereof, there is illustrated a conventional fuel injection type pump **10** and a centrifugal governor **12** in accordance with the present invention for selectively regulating the quantity of fuel delivered by the pump **10**. The pump **10** which is generally of the type shown in Patent No. 2,965,087, reference being made thereto for details, but generally it includes a plunger **14** mounted in a pump housing **15** operatively connected to a cam shaft **16** which is driven by an associated internal combustion engine and which reciprocates and rotates the plunger **14** to distribute fuel to cylinders of an internal combustion engine in their firing order. A control sleeve **18** circumscribes the plunger **14** and is movable axially thereof through the governor **12** which is connected to the sleeve **18** by a control rod **20** and a bell crank mechanism **22** whereby movement of the sleeve **18** upward relative to the plunger **14** effects an increase in the quantity of fuel delivered by the pump **10** and movement of the sleeve **18** downward relative to the plunger **14** decreases the quantity of fuel delivered by the pump.

As illustrated for example in FIG. 1, the governor **12** is housed in a governor housing **24** which in the present instance is formed integrally with the pump housing **15** and which has an end cover **26** removably secured to the open end of the governor housing **24** by bolts **28** to permit access to the governor. The governor **12** includes a speed sensing mechanism **30** and a control linkage **32** connected to the control rod **20** and operatively associated with the speed sensing mechanism. The speed sensing mechanism **30** comprises a governor shaft **33** which is journalled at its inner end in the pump housing **24** and which is rotated by the cam shaft **16** through meshing gears **34** and **36** on the governor shaft and cam shaft respectively, a spider **40** mounted on the governor shaft **33** and a plurality of flyweights **42** pivoted on pins **44** carried in looped ends of arms of the spider **40**. Each of the flyweights has a finger **46** which engages the face of a washer **48** carried at one end of a sleeve **50** mounted for axial movement on the governor shaft **33**.

The control linkage **32** includes a fulcrum lever **60** which is pivotally mounted between the side walls of the governor housing **24** and which as illustrated in FIG. 2, is of generally H-shaped configuration comprising a pair of spaced upper arm members **62**, a pair of spaced lower arm members **64** and a cross bar **66** between the upper and lower arm members. A shaft **82** which is rotatably journalled in the outer free ends of the upper arm members **62**, mounts at one end a load lever **84** and at its opposite end an inverted L-shaped shutoff lever **86**. As illustrated in FIG. 1, one end of the control rod **20** is pivotally connected to the load lever **84** between opposite ends thereof. The lower arm members **64** straddle the governor shaft **33**, the outer ends of the lower arm members **64** being urged in contact with the outer axial end face of the sleeve **50** by means of a pair of coil springs **68**. Each of the coil springs **68** is connected at one end to a pin supported needle bearing **69** on the outer tip of the lower arm member **64** and at its opposite end is secured to another pin supported needle bearing **72** mounted at the outer ends of the leg portions **75** of a U-shaped bracket **74**. The U-shaped bracket **74** is pivotally mounted between the side walls of the governor housing **24** by means of pivot pins **76** which engage approximately mid-way between the ends of the leg portions **75**. An adjusting screw **78** is mounted in an internally threaded block **80** projecting from the cross piece **81** of the U-shaped bracket **74**, the screw **78** engaging the base of the governor housing **24** whereby the bracket **74** may be pivoted selectively thereby to regulate the initial tension in the coil springs **68**. By this arrange-

ment, the biasing force exerted by the lower arm members 64 against the axial end face of the sleeve 50 may be selectively adjusted.

Engine speed may be varied selectively by means of a manually actuated operating lever 88 mounted exteriorly of the housing on the outer end of a stub shaft 90 journalled in the side wall of the governor housing 24, the shaft 90 mounting at its inner end interiorly of the housing, a lever 92. The load lever 84 is connected to the lever 92 for actuation thereby by means of a centering mechanism 94 which includes a shaft 96 and a pair of sleeve-like centering blocks 98 and 100 which are slideably mounted on the shaft 96 for axial movement relative thereto. The block 98 is pivotally connected to a finger-like projection on the inner, lower end of the load lever and the block 100 is pivotally connected to a finger-like projection on the rearward, lower end of the lever 92. The centering mechanism further includes a pair of coil springs 110 and 112 encircling the shaft 96, the coil spring 110 being disposed between the centering blocks 98 and 100 and normally urging the centering block 100 against a retainer 114 at the lower end of the shaft 96 and the spring 112 being disposed between a washer 97 adapted to seat on two flats 97*a* on the shaft 96 and a retainer 116 at the upper end of the shaft 96, the washer 97 providing abutment means for the spring 112. Accordingly, by this arrangement, if it is desired to decrease engine speed, the operating lever 88 is rotated in a clockwise direction as viewed from the left side of FIG. 2 whereby the lever 92 is also rotated in a clockwise direction which through the centering mechanism pivots the load lever 84 to the left with respect to FIG. 1 in a direction to decrease fuel delivered by the pump. This decrease in engine speed moves the sleeve 50 to the left and pivots the fulcrum lever to the right until the forces of the flyweights and springs are in balance. If it is desired to increase engine speed, the movements are reversed, that is, the operating lever 88 is rotated in the opposite direction which effects pivotal movement of the load lever 84 to the right through the centering assembly, that is, in a direction to increase fuel delivered by the pump. It is noted that the load lever 84 is pivoted relative to the fulcrum lever by movement of the operating lever whereby a minimum uniform force is required to position the sleeve 18 for a speed change through the governor linkage.

The load lever 84 may be moved manually in a direction to decrease fuel delivered by the pump to a shut down position by means of a manual shutoff lever 120 mounted exteriorly of the housing on a stub shaft 122 which is journalled in the side wall of the governor housing 24 and which mounts at its inner end a shutoff actuating lever 124 which engages the arm of the L-shaped lever 86. If lever 120 is moved beyond the normal shut off position such that the load lever 84 hits the governor housing, this over-travel without damage is permitted by compression of the spring 112 as shaft 96 moves downward. Accordingly by this arrangement the manual shutoff lever 120 may be moved in a clockwise direction as viewed from the right in FIG. 2 whereby the actuating lever 124 pivots the lever 86 in a direction to move the load lever 84 until fuel delivery from the pump ceases.

In the present instance the fulcrum lever 60 is mounted in the governor housing 24 by means of a pair of stub shafts 129 and 130 which are journalled in bosses 133 projecting from the lower arm members below the cross bar 66, the shaft 129 being journalled at its outer end in a bearing 135 housed in a cup-like recess 137 in the lever 92 and the shaft 130 being journalled at its outer end in a bearing 139 mounted in a cup-like recess 141 in the shutoff actuating lever 124. It is noted that the shafts 129 and 130 are retained in the journalled position shown by means of a plate 132 against which the

inner ends of the shafts 129 and 130 abut as shown in FIG. 2.

In initially setting the centrifugal governor for operation, it is noted that the governor shaft 33 and the centrifugal weight assembly 30 including the spider 40 and flyweights 42 are driven by the cam shaft drive gear 36 at a speed proportional to the engine speed. The centrifugal force developed by the rotating flyweights 42 acts through the flyweight fingers 46 against the thrust washer 48 and sleeve 50 tends to move the sleeve 50 to the right with respect to FIG. 1 and this tendency to move to the right is opposed by the fulcrum lever 60 which bears against the opposite end of the sleeve 50 and normally tends to urge the sleeve 50 to the left by the tension springs 68. The geometrical arrangement of the flyweight 42, fulcrum lever 60 and governor springs 68 is such that the position of the sleeve 50 varies linearly with the speed of the engine. Thus while the angular position of the fulcrum lever 60 and the axial position of the sliding sleeve 50 relative to the governor shaft 33 are both a direct function of engine speed, the position of the load lever 84 which controls the quantity of fuel delivered by the pump is also determined by the manually positioned operating lever 88. Thus at idle, the operating lever 88 is rotated in a clockwise direction as viewed from the left in FIG. 1 to tilt the load lever 84 through the centering block assembly 94 to the left with respect to FIG. 1 whereby the flyweights 42 are practically collapsed and the speed is set by regulating the adjusting screw 78. At full load speed, the operating lever 88 is rotated in a counterclockwise direction, the flyweights 42 are nearly wide open, and this rotation of the operating lever 88 moves the load lever 84 and control rod 20 to the right to obtain full load fuel delivery from the pump. At this setting, an adjustable full load limit screw 51 in the governor housing 24 is adjusted until it just contacts the load lever 84.

In the embodiment of the invention illustrated in FIG. 1, the load limit screw 51 is mounted in a plate 150 which pivots on pins 151 mounted in a bracket 152 depending from the governor housing. The plate 150 is normally held tightly against a lug 154 on the bracket 152 by means of a tension spring 153. The plate 150 is disposed in the path of movement of the lever 92 so that it may be pivoted against the bias of the spring in a counterclockwise direction with respect to FIG. 1. Accordingly, when the operating lever 88 is moved to the idle position, the upper portion of lever 92 pivots the plate 150 backward thereby permitting a further movement of the load lever 84 to the right and in turn permitting an increase in the amount of fuel for starting purposes. In FIG. 6 the screw 251 is mounted in a stationary bracket 252 and this arrangement of course, does not provide for the increased fuel at starting of the engine.

Rotational movement of the operating lever 88 between a low idle position and a full load position is limited by a pair of limit screws 170, 172 which are mounted in lugs 174, 176 projecting inwardly from the operating lever 88 and which are adapted to engage a boss 178 projecting from the side wall of the governor housing 24 to limit rotation of the operating lever 88. The screws 170 and 172 are threaded in the lugs 174 and 176 to permit the range of movement of the operating lever to be adjusted.

In operation, for a given setting of the operating lever 88 the engine is running at a predetermined speed for a given load whereby the sleeve 50 assumes a given position on the shaft 33 corresponding to the engine speed in which the biasing force of the fulcrum lever 60 against the sleeve 50 balances the opposing forces of the governor weights 42. If the engine load decreases, its speed increases whereby the flyweights 42 swing farther outward thereby moving the sleeve 50 to the right and pivoting

the fulcrum lever 60 in a counterclockwise direction with respect to FIG. 1 which moves the load lever 84 to the left thereby decreasing the fuel delivered by the pump. On the other hand, if the engine load increases, its speed decreases and the flyweights 21 swing inward permitting the fulcrum lever 60 to pivot in a clockwise direction thereby moving the load lever 84 to the right toward a position of increased fuel delivery from the pump. In this way the speed of the enigne is maintained within certain limits regardless of the engine load as long as the engine is not overloaded.

In certain applications, for example, in turbocharged engines, it is desirable to decrease the quantity of fuel delivered by the pump when the engine is running at low speeds when the quantity of air delivered by the turbocharger is insufficient to burn the full load fuel quantity. To this end the adjustable limit screw 51 is mounted in a plate 150 in position to engage the load lever 84 slightly above its pivotal connection to the control rod 20 and an adjustable reverse screw 54 is mounted in the plate 150 to engage the L-shaped lever 86 in a plane A—A passing through the load lever 84 between its pivotal connection to the control rod 20 and its pivotal connection to the fulcrum lever 60. Accordingly at full load speed, the load lever 84 contacts the limit screw 51. If additional load is imposed on the engine, the fulcrum lever 60 rotates in a clockwise direction with respect to FIG. 1, and the load lever 84 is pivoted about the screw 51 in an opposite direction to provide increased fuel for more engine torque. As the engine speed continues to drop off, the screw 54 engages the L-shaped lever 86. With additional rotation of the fulcrum lever 60 clockwise, the load lever movement is reversed by pivoting about screw 54 to move the control rod to the left with respect to FIG. 1 to decrease the quantity of fuel delivered by the pump. Accordingly this arrangement provides for decreased fuel delivery for turbocharged engines at low speeds where the quantity of air delivered by the turbosupercharger is low.

A modified arrangement providing for movement of the load lever 84 in a direction to decrease quantity of fuel delivered to some engines when the engine is at full load speed an additional load is imposed, is illustrated in FIG. 9. In this arrangement the adjusting screw 351 is adapted to engage a tapered end face 352 of a linkage block 353 pivotally connecting the control rod 320 to the load lever 384. The end face 352 as shown slants toward the pivot end of the load lever 384 so that at full load speed the screw 351 engages the lower end of the end face 352. If additional load is imposed on the engine, the speed drops and the fulcrum lever 360 rotates in a clockwise direction tending also to rotate the load lever 384 in a counterclockwise direction whereby, due to the downward inclination of the end face 352, the control rod 320 moves to the left to decrease the quantity of fuel delivered by the pump.

In other applications, it is desirable to increase quantity of fuel delivered by the pump to the engine when the engine is running at full load speed and additional load is imposed on the engine to thereby give the engine the desired "lugging" ability as its speed drops. To this end as illustrated for example in FIG. 7, the adjusting screw 451 is located relative to the load lever 484 so that it engages the load lever 484 at a point between its pivotal connection to the control rod 420 and its outer free end remote from the end pivotally connected to the fulcrum lever 460. Accordingly, assuming that the engine is running at full load speed whereby the flyweights 42 are partially extended and the load lever 484 just abuts the adjusting screw 451, if additional load is imposed on the engine, its speed starts to drop and the flyweights 42 collapse thereby causing sleeve 50 to move to the left whereby a clockwise rotation of the fulcrum lever 460 is effected. This in turn causes the upper end of the fulcrum lever 460 and the load lever 484 to move vertically and to the right whereby the limit screw 451 pivots the load lever 484 in a counterclockwise direction with respect to FIG. 1 to move the control rod 420 to the right in a direction to increase the quantity of fuel delivered by the pump. It is noted that during pivotal movement of the load lever 484, the lower spring of the centering mechanism is compressed to permit a change in the distance between pivotal connections of the centering mechanism 94 to lever 92 and load lever 484.

An alternate arrangement for effecting increased fuel delivery when the engine is running at full load speed and additional load is imposed on the engine is shown in FIG. 8. As shown therein, the limit screw 551 is adapted to engage a linkage block 553 pivotally connecting the load lever 584, to the control rod 520, the end of the linkage block being tapered upwardly as at 552 toward the free end of the load lever as shown. Accordingly, as the fulcrum lever 560 pivots in a clockwise direction when the engine is running at full load speed and additional load is imposed, the adjusting screw 551 rides upwardly on the tapered surface thereby to move the control rod to the right as seen in FIG. 1 in a direction to increase the quantity of fuel delivered by the pump.

While particular embodiments of the invention have been illustrated and described herein, it is not intended to limit the invention and changes and modifications may be made therein within the scope of the following claims.

I claim:

1. In a governor for selectively controlling fuel delivered by a pump to an engine, a governor housing, a control linkage mounted in said housing including a pivotally mounted load lever operatively connected to the pump whereby movement of the load lever in one direction effects increased fuel delivery from the pump and movement in a direction opposite said one direction effects decreased delivery from the pump, an operating lever connected to the load lever operable between a low idle position and a full load position, a stop member pivotally mounted in the housing in the path of movement of said load lever and normally disposed in a predetermined position, means for actuating said stop member from said predetermined position when the operating lever is in the low idle position thereby permitting movement of said load lever in a direction to increase fuel to provide for additional fuel delivery for starting purposes.

2. A governor as claimed in claim 1 including a plate pivotally mounted in said housing carrying said stop member, spring biasing means normally biasing said plate to said predetermined position and wherein said means for actuating said stop member comprises an inner lever connected to said operating lever adapted to engage said plate.

3. In a governor for selectively controlling fuel delivered by a pump to an engine, a governor housing, a control linkage including a fulcrum lever pivotally mounted in said housing for movement along a predetermined path in response to engine speed for a given load thereon, a load lever pivotally mounted to the fulcrum lever and operatively connected to the pump whereby movement of the load lever in one direction effects increased fuel delivery from the pump and movement in a direction opposite said one direction effects decreased fuel delivery from the pump, an operating lever connected to said load lever operable between a low idle position and a full load position, a first adjustable member mounted in said housing operable to engage said load lever when said operating lever is in the full load position, a second adjustable member mounted in the housing operable to move said load lever in said opposite direction to decrease fuel delivery from the pump when the operating lever is in said full load position and additional load is imposed on the engine.

4. In a governor for selectively controlling fuel delivered by a pump to an engine, a governor housing, a

control linkage including a fulcrum lever pivotally mounted in said housing for movement in a predetermined path in response to engine speed for a given load thereon, a load lever pivotally mounted to the fulcrum lever and operatively connected to the pump whereby movement of the load lever in one direction effects increased fuel delivery from the pump and movement in a direction opposite said one direction effects decreased fuel delivery from the pump, an operating lever connected to said load lever operable between a low idle position and a full load position, an adjustable member mounted in said housing operable to engage said load lever when said operating lever is in the full load position and disposed relative to said load lever to permit movement thereof in a direction to increase fuel delivery by the pump when the operating lever is in said full load position and additional load is imposed on the engine.

5. In a governor for selectively controlling fuel delivered by a pump to an engine, a governor housing, a control linkage including a fulcrum lever pivotally mounted in said housing for movement along a predetermined path in response to engine speed for a given load thereon, a load lever pivotally mounted to the fulcrum lever and operatively connected to the pump by means including a block having a tapered end face whereby movement of the load lever in one direction effects increased fuel delivery from the pump and movement in a direction opposite said one direction effects decreased delivery from the pump, an operating lever connected to the load lever operable between a low idle position and a full load position, an adjustable stop member mounted in said housing adapted to engage said tapered end face when said operating lever is in the full load position and permit movement of said load lever to vary fuel delivery by the pump when additional load is imposed on the engine.

6. A governor as claimed in claim 5 wherein said end face is tapered toward the free outer end of said load lever whereby said load lever moves in a direction to increase fuel delivered by the pump when the operating lever is in the full load position and additional load is imposed on the engine.

7. A governor as claimed in claim 5 wherein said end face is tapered toward the pivotal connection of said load lever to said fulcrum lever whereby said load lever moves in said opposite direction to decrease fuel delivered by the pump when the operating lever is in the full load position and additional load is imposed on the engine.

8. In a governor for selectively controlling fuel delivered by a pump to an engine, a control linkage including a pivotally mounted load lever operatively connected to the pump whereby movement of the load lever in one direction effects increased fuel delivery from the pump and movement in a direction opposite said one direction effects decreased fuel delivery from the pump, an operating lever and a centering mechanism connecting the load lever to the operating lever whereby rotation of the operating lever in one direction effects through said centering mechanism movement of said load lever to increase fuel delivered by the pump and rotation of said operating lever in the opposite direction effects through said centering mechanism movement of said load lever to decrease fuel delivered by the pump, said centering mechanism comprising an elongated rod, first and second blocks mounted for limited sliding movement on said rod, said first block pivotally connected to said load lever and said second block pivotally connected to said operating lever, abutment means mounted for limited movement axially of said rod, first spring biasing means engaging said abutment means and adapted to press said abutment means against the free face of said first block during overtravel of said first block and load lever while overspeeding.

References Cited by the Examiner

UNITED STATES PATENTS

1,935,507	11/1933	Kuttner	123—140
2,294,469	9/1942	Loeffler	123—140
2,571,571	10/1951	Hanners et al.	123—140 X

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