Aug. 11, 1942. F. J. TIPPEN 2,292,805

GOVERNING GEAR OF ENGINES AND OTHER MACHINES

Filed April 29, 1940 3 Sheets-Sheet 1

FIG. 1.

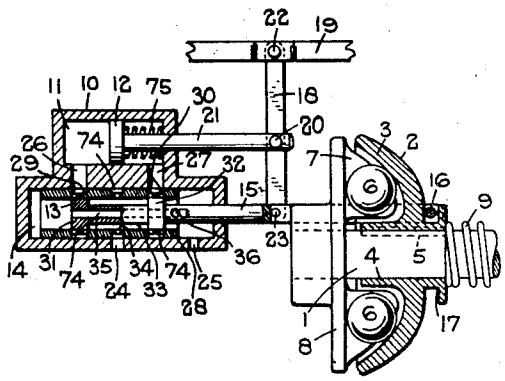
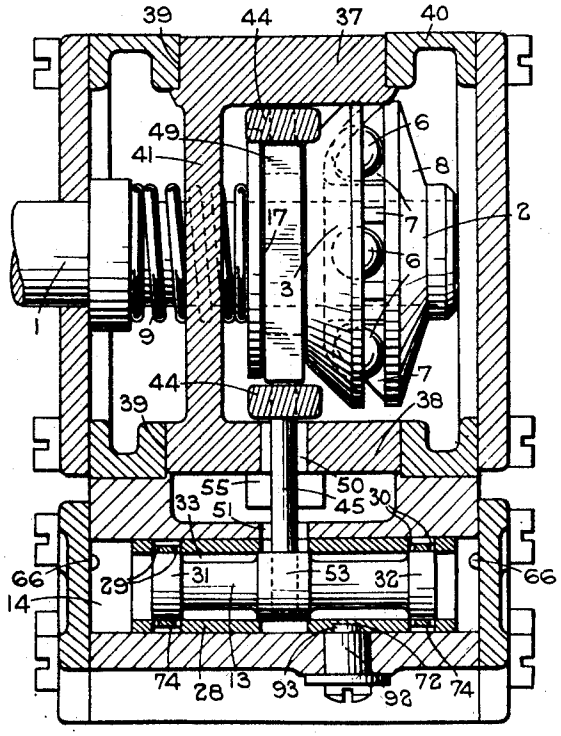


FIG. 4.



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GOVERNING GEAR OF ENGINES AND OTHER MACHINES

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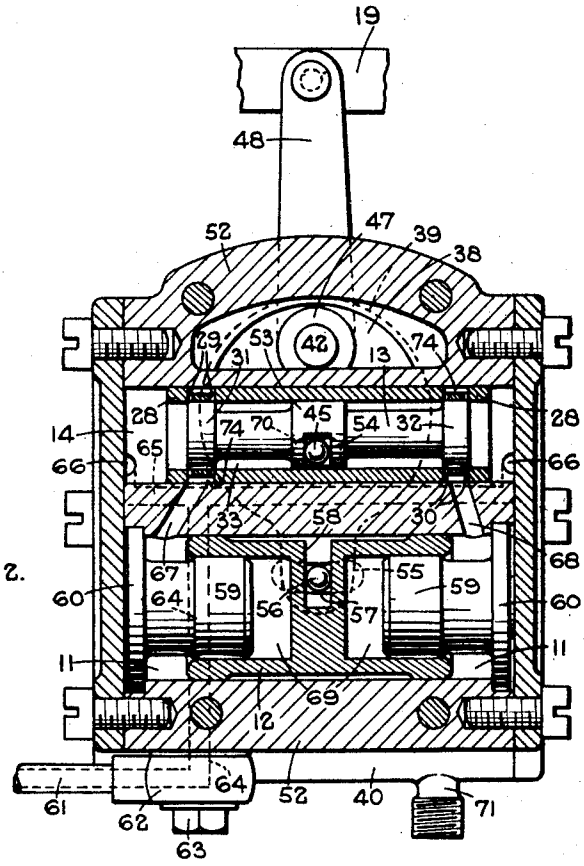


FIG. 2.

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GOVERNING GEAR OF ENGINES AND OTHER MACHINES

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FIG. 3.

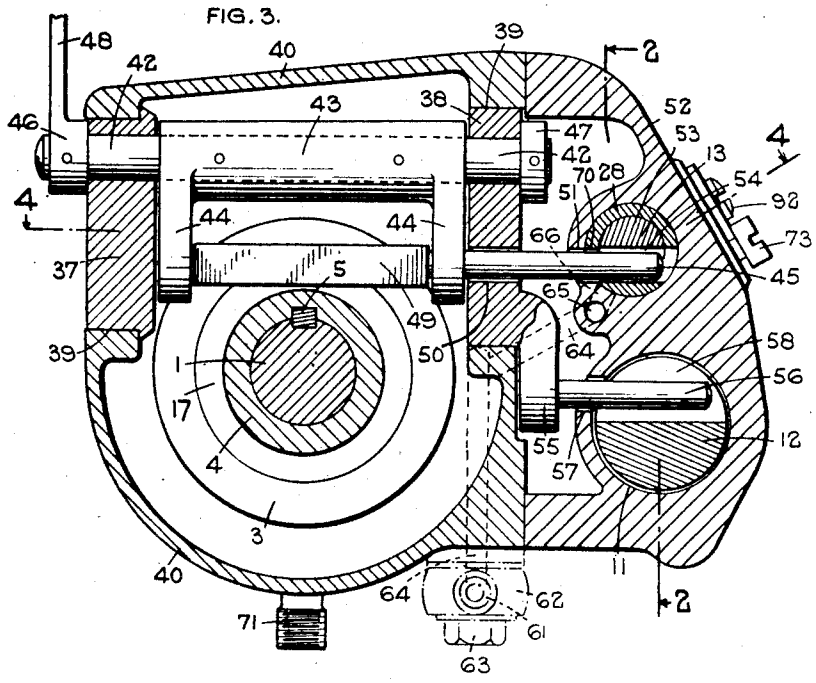
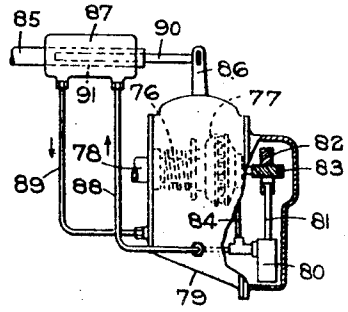


FIG. 5.



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UNITED STATES PATENT OFFICE

2,292,805

GOVERNING GEAR OF ENGINES AND OTHER MACHINES

Frank John Tippen, Coventry, England

Application April 29, 1940, Serial No. 332,263
In Great Britain May 26, 1939

9 Claims. (Cl. 264—3)

It is well known that, when a centrifugal governor is positively connected to the regulating means of an engine or machine, the speed of the latter will only remain constant so long as the load thereon is unchanged, any alteration of such load resulting in the engine or machine running at a new constant speed which is slightly different from the original speed.

The present invention relates to governing gear of the type which includes correcting mechanism adapted to eliminate or modify the aforesaid speed variation, such mechanism operating in response to any movement of the governor consequent upon a change in its rotational speed and being arranged to displace the fulcrum of a floating rocking lever through the medium of which said governor actuates the regulating means of the engine or machine.

In one previously proposed construction of the above type, the speed correcting mechanism comprises a hydraulic motor under the control of a pilot valve which is operated by the governor, the piston rod of the hydraulic motor moving the fulcrum of the rocking lever when the pilot valve is displaced from its normal position and continuing its overriding adjustment of the governing gear until the speed of the governor has been so modified as to restore the pilot valve to the normal position.

The present invention has for its chief object to provide an improved governing gear of the type aforesaid.

Referring to the drawings.

Figure 1 is a part-sectional side elevation of the governing gear illustrated in a diagrammatic manner,

Figure 2 is a section on the line 2—2 of Figure 3.

Figure 3 is an end elevation of the practical embodiment of the invention shown in Figure 2, and

Figure 4 is a section on the line 4—4 of Figure 3.

Figure 5 is a diagrammatic side elevation of a further modification.

In applying the invention to the governing gear of a compression ignition engine, the rotational speed of the engine may be regulated in known manner by varying the quantity of fuel delivered by the fuel pump at each working stroke of its plunger or plungers.

This is effected, in the case of one well known construction of pump, by longitudinal movement of a rack bar which rotates the, or each, plunger of the pump in its cylinder, the plunger being formed with a suitably shaped recess whereby the contents of the cylinder are allowed to escape at a point on the delivery stroke which varies in accordance with the angular position of the plunger.

The fuel pump (not shown in the drawings) may be coupled to a horizontal shaft 1 which runs alongside the engine and is driven by chain or other gearing from the cam shaft thereof.

The governor 2 is mounted on the shaft 1 and may be of any construction which will give a sufficiently sensitive operation.

Preferably the governor 2 comprises a cup member 3 with a central hub 4 which is slidably keyed at 5 to the shaft, this cup member 3 co-operating with a plurality of balls 6, each of which is free to move longitudinally of a radial groove 7 in a carrier member 8 fixed to the shaft 1.

The bases of these radial grooves 7 are preferably flat and lie in a common plane perpendicular to the shaft axis, each ball 6 being of such a diameter that, when in its radially innermost position, it engages simultaneously with the interior of the cup member 3 and the base of its own particular groove 7.

When the shaft 1 rotates, the outward movement of the balls 6 due to centrifugal force causes axial displacement of the cup member 3, which latter may have its inner surface formed (as in Figure 1) to such a curvature that, for equal increments of speed, the forces acting on the member 3 in a direction parallel to the shaft 1 increase at a constant rate.

This enables the necessary loading of the governor to be provided by a coiled compression spring 9 disposed coaxial with the shaft 1 and acting on the back of the cup member 3.

Mounted adjacent the governor 2 is a speed correcting unit, indicated generally at 10, which includes a cylinder 11 containing a piston 12 and illustrated for convenience as having its axis parallel to that of the shaft 1.

Movement of the piston 12 in either direction is controlled by admitting pressure fluid from any suitable source (for example, oil from the engine lubrication system) to the appropriate end of the cylinder 11, under the control of a pilot valve 13 working in a valve chest 14 which is also incorporated in the unit 10. The cylinder 11 and valve chest 14 are each closed at both ends

The valve 13 is directly connected in any suitable manner to the governor cup member 3, so that an axial movement of the latter on the shaft

1 causes an equal movement of the valve 13 in the valve chest 14.

In the schematic arrangement shown in Figure 1, the valve 13 has associated therewith a coaxial rod or stem 15 which passes through one end of the valve chest 14 and is provided with a pin 16 engaging a circumferential groove 17 in the hub of the cup member 3. Alternatively, the end of the valve rod 15 may have a pin-and-slot connection to a fork which is pivotally mounted and provided with trunnions engaging the groove 17.

The valve 13 is also connected directly to one arm of a rocking lever 18 whose other arm acts (for example, through the rod 19) on the fuel pump control member or its equivalent. In the case of a petrol engine, the rod 19 would, of course, be connected to the carburetter throttle.

The rocking lever 18 is fulcrummed at 20 on a piston rod 21 associated with the piston 12 and extending through the adjacent end of the cylinder, the arms of the lever 18 being pivoted at 22, 23 to the control rod 19 and valve rod 15, respectively.

The valve chest 14 is provided with supply and discharge ports 24, 25 for the pressure fluid, and when the engine oil is made use of, these ports may be connected by pipes to the pressure lubrication system.

At positions spaced longitudinally thereof, the valve chest 14 is also provided with inlet ports 26, 27, which place it in communication with opposite ends of the cylinder 11.

The valve 13 may engage the interior of the valve chest 14 directly, but, as accurate location of the ports is essential to the effective operation of the unit 10, it is preferred to insert in the valve chest a liner sleeve 28 of somewhat shorter length, such sleeve being formed at the appropriate positions with ports 29, 30 adapted, respectively, to place the interior of the valve chest in communication with the two spaced inlet ports 26, 27, to the cylinder 11. Instead of providing a single port 29, 30 in each case, there may be a plurality of ports (or pairs of ports) spaced angularly around the sleeve 28. The ports 29, 30 aforesaid may be formed in the sleeve 28 without difficulty in their exact designed positions.

In the schematic arrangement shown in Figure 1, the valve 13 is of the equilibrium type, with two spaced heads 31, 32 which engage the interior of the sleeve 28 and a central portion of smaller diameter, there being provided around their central portion of the valve an annular space 33 which communicates at all positions of the valve with the supply port 24 by way of a port (or ring of ports) 34 in the sleeve 28.

The valve rod or stem 15 is also of smaller diameter than the heads 31, 32, the spacing and axial lengths of the latter being such that, in the normal or mid-position of the valve 13, they just cover the inlet ports 26, 27 to the cylinder 11; that is to say, the valve has no lap.

The action of the speed correcting unit 10 is as follows:

Assuming that the load on the engine has been increased, causing its rotational speed to fall, the inward movement of the governor balls 6 will allow an axial displacement of the cup member 3 under the action of the spring 9 and this, being transmitted through the rod 15 or other mechanical connection to the valve 13, will move the latter longitudinally of the valve chest 14 (i. e. towards the left-hand side of the drawing) so that the rocking lever 18 swings clockwise about its fulcrum 20.

It will be obvious that, if this fulcrum 20 were to remain stationary, the rod 19 would be displaced towards the right by an amount exactly proportionate to the governor movement, but with the arrangement under consideration the action of the governor 2 on the rod 19 is modified by the speed correcting unit 10 in a manner hereinafter described.

The movement of the valve 13 to the left causes the left-hand 31 thereof to place the supply port or ports 34 in communication, by way of the annular space 33 aforesaid, with the sleeve port or ports 29 and associated inlet port 26, which latter opens into the end of the cylinder 11 remote from the rocking lever 18.

Admission of oil to the cylinder 11 in this manner displaces the piston 12 towards the right, oil trapped in that end of the cylinder being exhausted through the second inlet port 27.

The movement of the valve 13 to the left has caused the right-hand head 32 thereof to uncover the sleeve port or ports 30, so that the oil exhausted from the cylinder 11 can escape into the right-hand end of the valve chest 14 in which is placed the discharge port 25, this latter being clear of the end of the sleeve 28.

The piston movement aforesaid influences the primary system (comprising the governor 2 and the rocking lever 18) by swinging the latter in a clockwise direction about its pivotal connection 23 to the valve rod 15, the movement of the piston 12 not being an exact reproduction of the valve movement, but continuing until the fuel pump delivery has been sufficiently increased to compensate exactly for the greater load on the engine.

The direct connection of the rods 15, 19 through the rocking lever 18 causes any movement of the governor cup member 3 to be positively and instantly transmitted to the regulating means or member of the engine, the subsequent displacement of the fulcrum 20 by the piston 12 constituting an overriding adjustment which takes place relatively slowly as the valve 13 admits oil to the cylinder 11.

When the speed correcting unit 10 comes into operation the resultant displacement of the rod 19 is magnified due to the fact that the fulcrum 20 of the lever 18 is moving in the opposite direction to the pivotal connection 23 between the latter and the valve rod 15, the fuel supply to the engine being thus increased to an extent sufficient to restore the engine to its original speed instead of to a slightly lower speed. By the time such speed has been attained, the movement of the valve rod 15 to the left under the action of the governor 2 has restored the valve 13 to its original normal position so that the supply of oil to the piston 12 is cut off.

In the event of the load being decreased, so that the engine accelerates, the outward movement of the governor balls 6 displaces the cup member 3 towards the right, so as to compress the spring 9, and the valve 13 has a corresponding movement imparted thereto.

This causes the right-hand piston portion 32 of the latter to uncover the sleeve port or ports 30, so that oil can pass through the latter from the annular space 33 to the inlet port 27 associated with the right-hand end of the cylinder 11.

The oil admitted as aforesaid displaces the piston 12 towards the left-hand end of the cylinder 11, which latter exhausts by way of the

inlet port 26 and sleeve port or ports 29 to the adjacent end of the valve chest 14. Thence the displaced oil is directed in any suitable manner to the discharge port 25, which it may reach by flowing through an axial bore 35 in the valve 13 and its rod 15, and out into the valve chest 14 through a transverse hole or exhaust port 36 in the rod 15.

The above-mentioned movement of the piston 12 to the left actuates the regulating member of the fuel pump in a manner to reduce the delivery from the latter and is continued until the engine speed has been brought down to its original value, by which time the movement of the valve 13 to the left has terminated the oil supply to the cylinder 11.

The practical embodiment of the invention illustrated in Figures 2 to 4 retains the essential components of the preceding construction, but in a modified form calculated to produce on assembly a very compact mechanism.

It will be noted that in this construction the cylinder 11 of the speed correcting mechanism is disposed below the valve chest 14, these members being parallel to one another as in Figure 1 but disposed alongside the governor shaft 1.

The governor 2 closely resembles the corresponding component already described, but in this case that part of the internal surface of the cup member 3 on which the balls 6 act is of conical form instead of being transversely curved. This facilitates manufacture of the cup member 3 and has proved entirely satisfactory in connection with governors designed to operate approximately at one particular speed, although of course, in a case where the purpose of the engine necessitates periodical variation of the governed speed over a fairly wide range, the internally curved form of cup member above mentioned is desirable.

A pair of spaced eccentrics 37, 38 are mounted for rotation about a common axis disposed at right angles to and above the governor shaft 1, these eccentrics being journalled in circular openings 39 in the side walls of a casing 40 and being retained in phase with one another by an integral connecting web 41, so that they may be regarded as parts of a single eccentric.

A spindle 42 on which the eccentrics 37, 38 are freely rotatable extends parallel to the common axis thereof, and intermediate the two eccentrics the spindle 42 has fixed upon it a fork 43 whose limbs 44 are apertured to receive a pin 45 extending parallel to the spindle 42.

Endwise location of the spindle 42 is effected by means of collars 46, 47 fixed thereon and engaging the outer faces of the eccentrics 37, 38, respectively, the collar 46 having an integral arm 48 which is connected (for example, through the rod 19) to the fuel pump control member or its equivalent. This arm 48 and the fork limbs 44 form, in conjunction, a floating rocking lever.

The pin 45 is formed or provided, between the fork limbs 44, with a flat-sided shoe 49 which engages a circumferential groove 17 in the hub of the governor cup member 3, one end of the pin 45 projecting beyond the adjacent fork limb and passing through a slot 50 in the eccentric 38.

This end of the pin 45 extends through an opening 51 in the wall of the valve chest 14, which latter and the cylinder 11 are formed integral with or carried by a housing 52 secured to the side of the casing 40.

The valve 13 is of generally similar form to that shown in Figure 1, but, instead of a rod or stem, it is formed with a central enlargement 53 in which is a transverse slot 54 engaged directly by the end of the pin 45.

The adjacent eccentric 38 is provided, below the slot 50 therein, with a short radial arm 55 carrying a peg 56 which engages the piston 12 through a slot 57 in the wall of the cylinder 11.

The piston 12 is of cup-like form at each end and has a central solid portion with a transverse slot 58 in which the peg 56 engages.

The cup-like ends of the piston 12 closely fit the interior of the cylinder 11 and engage over aligned inwardly extending plugs 59 carried by the cylinder end plates 60.

A pipe 61 leading from the engine lubrication system or other source of pressure fluid is provided with a banjo union 62 which is secured to the casing 40 by a hollow bolt 63 of known form at the lower end of a duct 64. This duct 64 leads through the casing 40 and housing 52 to a passage 65 which extends alongside the valve chest 14 and communicates with the latter by way of ports 66 at the ends thereof.

The valve chest 14 is provided with a liner sleeve 28 as in the preceding construction and the spaced ports (or rings of ports) 29, 30 in this sleeve are connected by passages 67, 68 respectively, to the adjacent ends of the cylinder 11.

It will be seen from Figure 2 that, when the various components of this modified construction are in their normal positions (which may be the positions they occupy when the engine is running light at the desired speed), the axes of the eccentrics 37, 38, spindle 42, pin 45, peg 56 and the pivotal connection between the arm 48 and the rod 19 lie in a common plane which is vertical in the example illustrated.

Assuming that the load on the engine is increased, the speed will tend to fall and the movement of the governor cup member 3 to the right (Figures 2 and 4) will cause the fork 43 to be oscillated in an anti-clockwise direction with the spindle 42.

This moves both the end of the arm 48 and also the pin 45 out of the above-mentioned vertical plane (hereinafter termed the "datum plane"), the movement of the arm 48 to the left influencing the rod 19 in a manner to increase the fuel supply to the engine, whilst the movement of the pin 45 to the right causes the head 31 of the valve 13 to uncover the sleeve port 29 so that oil can pass from the left-hand end of the valve chest 14 through the passage 67 to the adjacent end of the cylinder 11.

This oil enters the annular space between the cylinder wall and the adjacent end plug 59, which latter has sufficient clearance in the cup-like end of the piston 12 to allow a restricted flow of oil into the interior space 69 of the cup.

As a result of this, the piston 12 moves to the right, oil trapped in that end of the cylinder 11 escaping slowly past the plug 59 and through the passage 68 to the sleeve ports 30. These latter have been uncovered by the movement of the valve 13 to the right, so that the oil is free to enter the central portion of the sleeve 28 and can escape therefrom into the interior of the housing 52 by way of a slot 70 in the sleeve 28 which registers with the slot 51 in the wall of the valve chest 14. A pipe 71 is provided to return such oil from the housing 52 to the engine sump.

It will be appreciated that the cup-like ends

of the piston 12 and the inwardly-extending plugs 59 co-operate to form dashpots, so that the piston movement is substantially dead-beat.

Owing to the connection of the piston 12 to the eccentric 38 through the arm 55, the piston movement in question influences the primary system (comprising the governor 2, fork limbs 44 and arm 48) by causing an angular movement of the eccentrics 37, 38 in an anti-clockwise direction about their common axis. The spindle 42 which carries the regulating arm 48 (and forms the fulcrum of the floating rocking lever constituted by this arm and the fork 43) is displaced to the left, the fork 43 momentarily swinging about the pin 45 as a fulcrum so that the end of the arm 48 moves still further to the left.

In this way, the fuel supply is increased to an extent greater than that brought about by the initial movement of the governor 2, so that the engine is promptly brought back to its exact original speed instead of taking up a slightly lower speed.

While the eccentrics 37, 38 are turning upon their common axis as above described, the increased speed of the engine is moving the cup member 3 (and hence the valve 13) to the left, until finally the valve is restored to its original normal position, the oil supply to the cylinder 11 being then terminated, so that the mechanism comes to rest with the axes of the spindle 42, pin 45, peg 56 and the pivotal connection to the rod 19 all disposed in a common plane which is inclined to the vertical datum plane through the axis of the eccentrics 37, 38.

The mode of operation of the device when the load on the engine is diminished will be obvious from the foregoing without further description.

The action of the governing gear above described is extremely stable, as no attempt is made to obtain isochronism in the governor 2 itself, such condition being produced by the overriding action of the speed correcting mechanism.

In the case of a marine engine, it is desirable to be able to regulate over a substantial range the speed to which the engine is governed, and this may be effected in known manner by varying the load which is imposed on the governor cup member 3 by the spring 9.

It is preferred, however, to make the adjustment by varying, for any given radius of the path traversed by the governor balls 6, the position of the valve 13 relatively to its normal position, and for this purpose, in either of the constructions above described, the ported sleeve 28 may be made slidable in the valve chest 14 so that it can be adjusted axially of the latter by any suitable means.

In any case, whatever the duty of the engine or machine to which the governing gear is applied, it is desirable for the liner sleeve 28 to be movable over a small range longitudinally of the valve chest 14 so as to provide an initial fine adjustment whereby errors in manufacture may be compensated for. In the construction last described, this adjustment may be effected by means of a rotary head 92 mounted in the wall of the housing 52 and having an eccentric pin 93 which engages a groove 72 in the sleeve 28. The head 92 is turned until the engine runs at the desired speed when light, and may then be locked in its adjusted position by means of a clamping screw 73.

In order that communication may be maintained between the cylinder 11 and the sleeve ports 29, 30, 34 throughout the full range of adjustment of the sleeve 28, the exterior of the latter is formed with spaced circumferential grooves 74 in the bases of which the various ports are formed, and the width of such grooves is such that, in any position of the sleeve 28, they register with the associated ports in the valve chest walls.

It will be observed that, in the two constructions of governing gear above described, the valve 13 of the speed correcting mechanism receives the same axial displacement as the governor cup member 3.

The cup member 3, after any variation in the load on the engine, continues to move until the valve 13 has regained its original normal position cutting off the supply of oil to the cylinder 11, and it will be obvious that, if the distance through which the valve 13 moves is unequal to the extent of movement of the cup member 3, the valve will regain its normal position whilst the cup member 3 is still in a position other than that which is occupied at the designed speed.

Thus, if these two components are so connected that the axial displacement of the valve 13 exceeds that of the cup member 3 (for example, if the governor 2 in Figure 1 is arranged to act on the lever 18 at a point between the fulcrum 20 of the latter and its connection 23 to the valve rod 15, or if the pin 45 shown in Figures 2 to 4 has its projecting end cranked downwardly so as to provide an effective leverage greater than that afforded by the fork limbs 44), it follows that after any variation in the load on the engine the governing gear will effect an alteration in the fuel supply which is more than sufficient to compensate for the increase or decrease in the load.

That is to say, the governing gear may be designed so that the engine is accelerated when the load is increased and is brought to a lower speed when the load is reduced, the governor thus having a rising characteristic (as opposed to the horizontal characteristic obtained with the construction illustrated).

The provision of a rising characteristic as aforesaid is a desirable feature when the governing-gear is applied to compression ignition or other engines used in connection with electric lighting units, as the slight acceleration of the engine which follows an increase of load compensates for the increased voltage drop in the wiring at the higher load and maintains the lights at their original brilliance.

In the case of an engine the operation of the speed correction mechanism by means of oil from the pressure lubrication system, as above described, is particularly convenient, because it makes possible a simple form of safety control whereby the engine is stopped in the event of the oil pressure failing. For example, in the construction shown in Figure 1, a spring 75 may be arranged to act on the piston 12 or on some other part of the mechanism in such a manner that relaxation of the oil pressure on the piston 12 will allow the spring 75 to move the regulating means or member to the "stop" position. With such an arrangement, the differential fluid pressure on the piston 12, when the governing gear is in operation, is preferably sufficient to maintain the piston at a position substantially midway of the length of the cylinder 11.

Although the governing gear forming the subject of this invention is primarily intended for use with internal combustion engines, it is equally applicable in connection with steam, hot-

air and other fluid pressure engines, hydraulic machinery, and in fact any apparatus where accurate maintenance of a predetermined rotational speed is desirable.

When applying the present invention to an engine or machine which does not in itself possess a source of pressure fluid capable of operating the speed correction mechanism of the governing gear, or where, when such source exists, its utilization for the purpose in question is not practicable or convenient, the governing gear may be provided with its own pump and fluid supply.

In the modified construction illustrated in Figure 5, enclosed governing gear (which may be similar to that shown in Figures 2 to 4) is indicated schematically at **76**, **77** being the governor and **78** the governor shaft.

The lower part of the casing **79** forms a sump in which is disposed a pump **80**, preferably of gear or vane type, the pump spindle **81** being driven from the shaft **78** through the skew gears **82**, **83**. Oil or other fluid is drawn from the sump and delivered through a pipe **84** to the speed correcting mechanism (for example, by way of a chamber having a spring-loaded relief valve), afterwards returning to the sump for re-circulation.

It will be understood that with the constructions of governing gear shown in Figures 1 to 4, the power available for operating the regulating means or member of the engine does not exceed the axial thrust exerted by the balls **6** on the governor cup member **3**.

In view of this, it may be desirable to provide, in cases where a substantial effort is required to operate the speed regulating gear, some means of supplementing the governor effort.

Figure 5 illustrates, in addition to the self-contained pump aforesaid, a convenient method of obtaining increased power from the governing gear. In this case, the speed regulating rod or member **85** is connected to the arm **86** of the unit **76**, not directly, but through the medium of servo mechanism (indicated at **87**), which may be of the fluid-pressure type and operated by oil or other fluid from the pump **80**. Suitable delivery and return pipes for the pressure fluid are shown at **88** and **89** respectively. When the unit **76** is operated by oil from a pressure lubrication system, the servo mechanism **87** may be supplied from the same source.

A convenient form of servo mechanism for use in this connection includes a valve **90** which reciprocates internally of a hollow piston rod **91**. The valve **90** may be acted upon directly by the arm **86** of the unit **76**, and the piston rod **91**, which may constitute or be connected to the end of the speed-regulating member **85**, reproduces exactly, and with any desired increase of power, the movements of the valve **90**.

In all the above constructions, the regulating means or member associated with the engine may be provided with a manual control for use when starting, such control being adapted to override the governing gear.

What I claim then is:

1. Governor mechanism for the speed regulating means of an engine or machine comprising a speed governor adapted to be driven by said engine or machine, a rocking lever having one arm acted upon by said speed governor and the other arm adapted to act upon the speed regulating means, a pair of discs spaced longitudinally of and rotatable about a common fixed axis, a spindle forming the fulcrum of said rocking lever and supported at its ends by said discs in spaced parallel relationship with said axis, and correcting means for modifying the speed governor regulation of said engine or machine for the purpose described, said correcting means comprising a motor for rotating said discs, and control means for said motor operated by movement of the first-mentioned arm of said rocking lever.

2. Governor mechanism for the speed regulating means of an engine or machine comprising a speed governor adapted to be driven by said engine or machine, a rocking lever having one arm acted upon by said speed governor and the other arm adapted to act upon the speed regulating means, a pair of discs spaced longitudinally of and rotatable about a common fixed axis, a web integrally connecting said discs, a spindle forming the fulcrum of said rocking lever and supported at its ends by said discs in spaced parallel relationship with said axis, and correcting means for modifying the speed governor regulation of said engine or machine for the purpose described, said correcting means comprising a motor for rotating said discs and control means for said motor operated by movement of the first-mentioned arm of said rocking lever.

3. Governor mechanism for the speed regulating means of an engine or machine comprising a speed governor adapted to be driven by said engine or machine, a rocking lever having one arm formed as a fork, and provided with two crankpins one of which connects the limbs of said fork, the other arm of said rocking lever being adapted to act upon the speed regulating means, a pair of discs spaced longitudinally of and rotatable about a common fixed axis, a spindle forming the fulcrum of said rocking lever and supported at its ends by said discs in spaced parallel relationship with said axis, and correcting means for modifying the speed governor regulation of said engine or machine for the purpose described, said correcting means comprising a motor for rotating said discs and control means for said motor acted upon by the second crankpin on the forked arm of said rocking lever.

4. Governor mechanism for the speed regulating means of an engine or machine comprising a speed governor adapted to be driven by said engine or machine, a rocking lever having two crankpins on one arm thereof, one of said crankpins being acted upon by said speed governor, the other arm of said rocking lever being adapted to act upon the speed regulating means, a pair of discs spaced longitudinally of and rotatable about a common fixed axis, a spindle forming the fulcrum of said rocking lever and supported at its ends by said discs in spaced parallel relationship with said axis, the second of said crankpins extending through an opening in the adjacent disc, and correcting means for modifying the speed governor regulation of said engine or machine for the purpose described, said correcting means comprising a motor for rotating said discs and control means for said motor acted upon by the second crankpin on the forked arm of said rocking lever.

5. Governor mechanism for the speed regulating means of an engine or machine comprising a speed governor adapted to be driven by said engine or machine, a rocking lever having one arm acted upon by said speed governor and the other arm adapted to act upon the speed

regulating means, and correcting means for modifying the speed governor regulation of said engine or machine for the purpose described, said correcting means comprising a motor for moving the fulcrum of said rocking lever, a pilot valve for controlling the supply of actuating fluid to said motor, a valve chest in which said pilot valve works, a liner sleeve in said valve chest, a rotary head mounted in the wall of said valve chest, and an eccentric pin on said rotary head engaging a groove in said liner sleeve, whereby angular movement of said rotary head adjusts said liner sleeve longitudinally of said valve chest.

6. Governor mechanism for the speed regulating means of an engine or machine comprising a speed governor adapted to be driven by said engine or machine, a rocking lever having one arm acted upon by said speed governor and the other arm adapted to act upon the speed regulating means, and correcting means for modifying the speed governor regulation of said engine or machine for the purpose described, said correcting means including a cylinder, a fluid-actuated piston in said cylinder for moving the fulcrum of said rocking lever, cup-like portions at the ends of said piston, fixed plugs engaging telescopically with said cup-like portions and co-operating therewith to produce a dash-pot effect on movement of said piston in either direction, and valve means operated by movement of the first-mentioned arm of said rocking lever for controlling the supply of actuating fluid to said cylinder.

7. Governor mechanism for the speed regulating means of an engine or machine having a pressure lubrication system comprising a speed governor, a rocking lever having one arm acted upon by said speed governor and the other arm adapted to act upon the speed regulating means, and correcting means for modifying the speed governor regulation of said engine or machine for the purpose described, said correcting means including a cylinder, a piston in said cylinder for moving the fulcrum of said rocking lever, said piston being actuated by oil from said pressure lubrication system, valve means operated by movement of the first-mentioned arm of said rocking lever for controlling the supply of actuating fluid to said cylinder, and a spring adapted, in the event of a failure in said lubrication system, to move said rocking lever in a manner to stop said engine.

8. Governor mechanism for the speed regulating means of an engine or machine comprising a speed governor adapted to be driven by said engine or machine, a rocking lever having one arm acted upon by said speed governor and the other arm adapted to act upon said speed regulating means, a disc rotatable about a fixed axis and having said rocking lever fulcrummed eccentrically thereon, and correcting means for modifying the speed governor regulation of said engine or machine for the purpose described, said correcting means including a cylinder, a fluid actuated piston in said cylinder for rotating said disc so as to move the fulcrum of said rocking lever, cup-like portions at the ends of said piston, fixed plugs engaging telescopically with said cup-like portions and co-operating therewith to produce a dashpot effect on the movement of said piston in either direction, and valve means operated by movement of the first-mentioned arm of the said rocking lever for controlling the supply of actuating fluid of said cylinder.

9. Governor mechanism for the speed regulating means of an engine or machine comprising a speed governor adapted to be driven by said engine or machine, a rocking lever having one arm acted upon by said speed governor and the other arm adapted to act upon said speed regulating means, a disc rotatable about a fixed axis and having said rocking lever fulcrummed eccentrically thereon, an actuating arm on said disc at the side of said axis remote from the fulcrum of said rocking lever, and correcting means for modifying the speed governor regulation of said engine or machine for the purpose described, said correcting means comprising a motor adapted to act on said actuating arm in a manner to rotate said disc, control means for said motor operated by movement of the first mentioned arm of said rocking lever, a pilot valve for controlling the supply of actuating fluid to said motor, a valve chest in which said pilot valve works, a liner sleeve in said valve chest, and means mounted in the wall of said valve chest for adjusting the position of said liner sleeve longitudinally in said valve chest.

FRANK JOHN TIPPEN.