TORQUE RESPONSIVE INTERNAL COMBUSTION ENGINE GOVERNOR

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FIG. 1

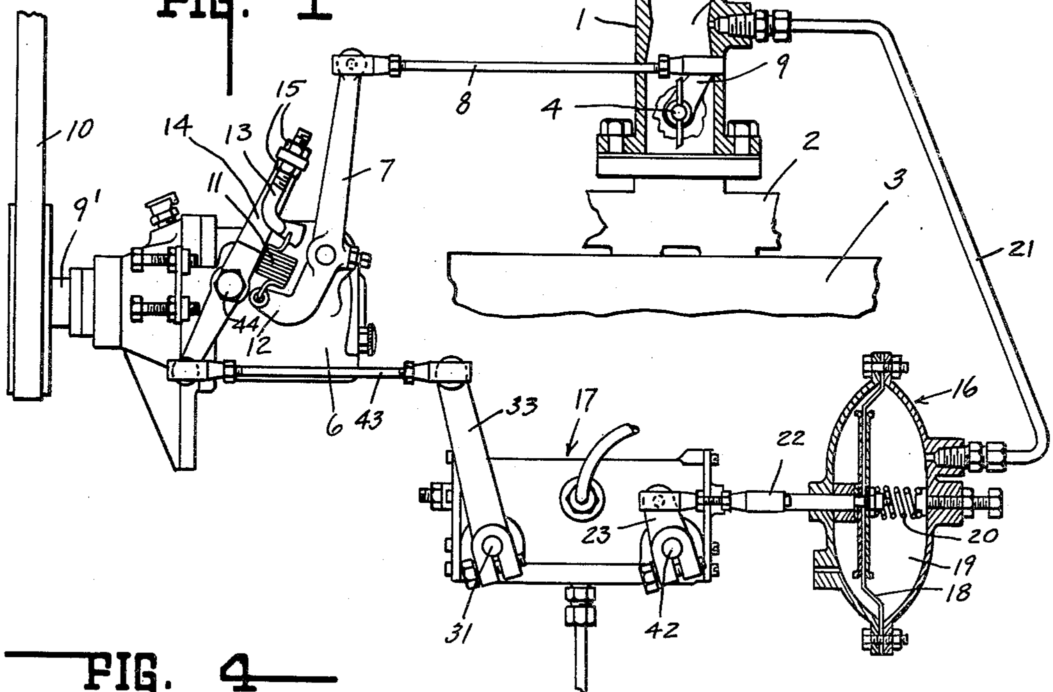

FIG. 4

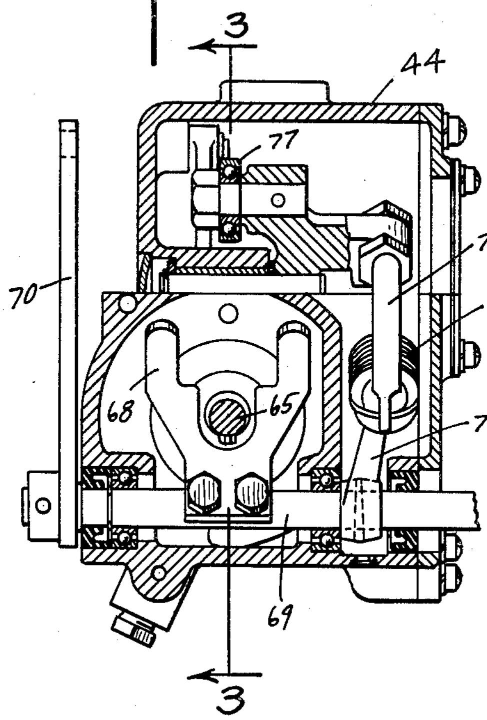

FIG. 6

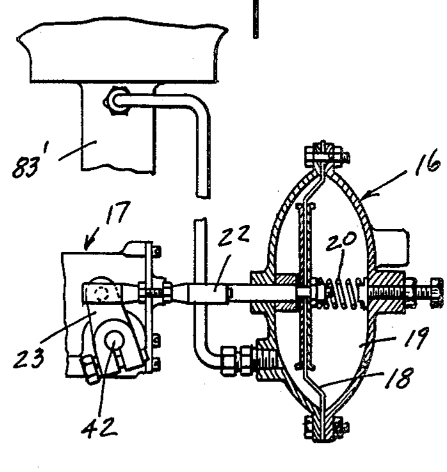

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FIG. 2

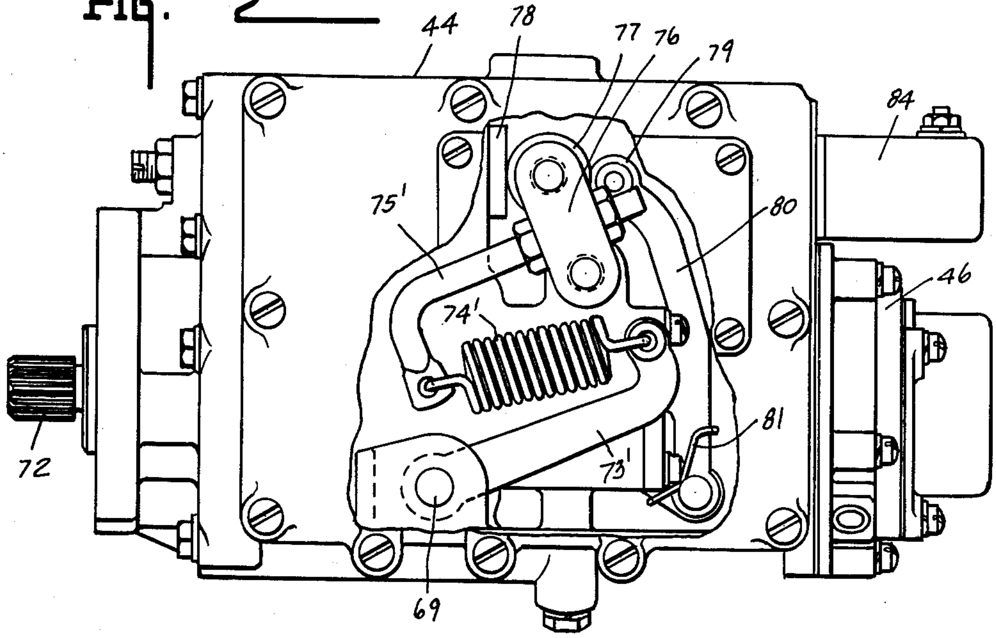

FIG. 3

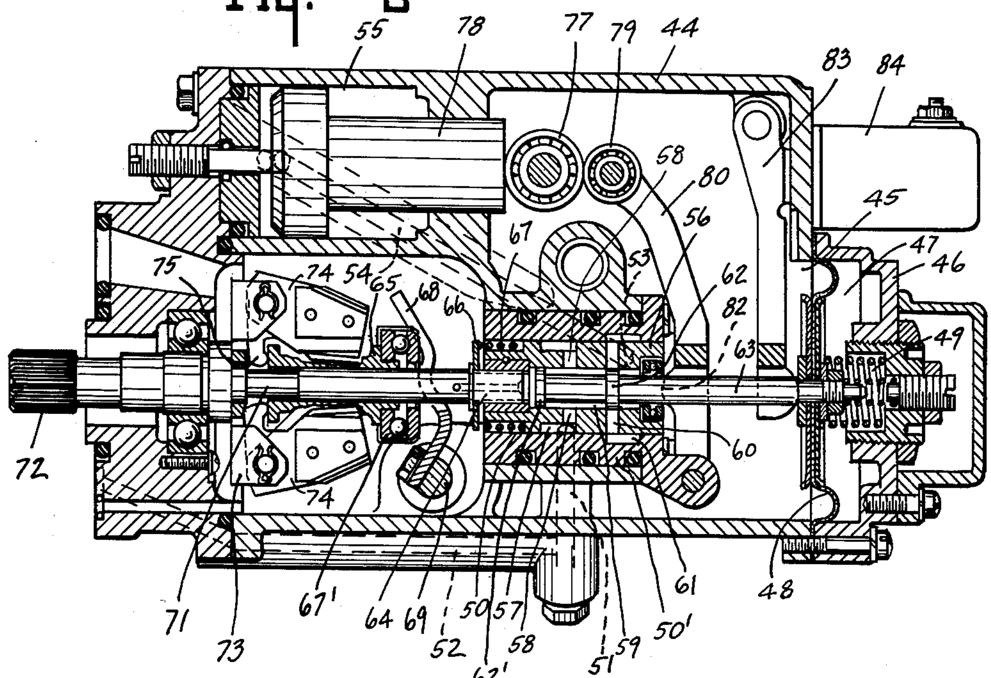

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FIG. 5

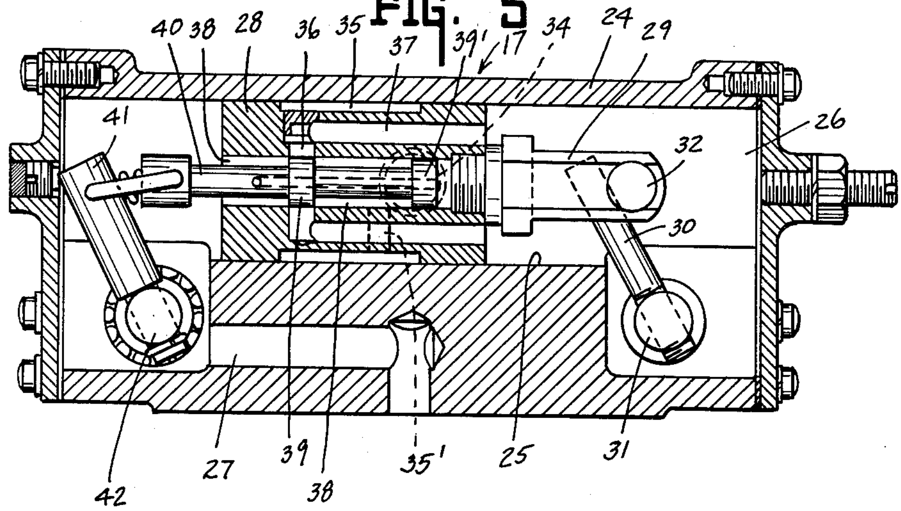
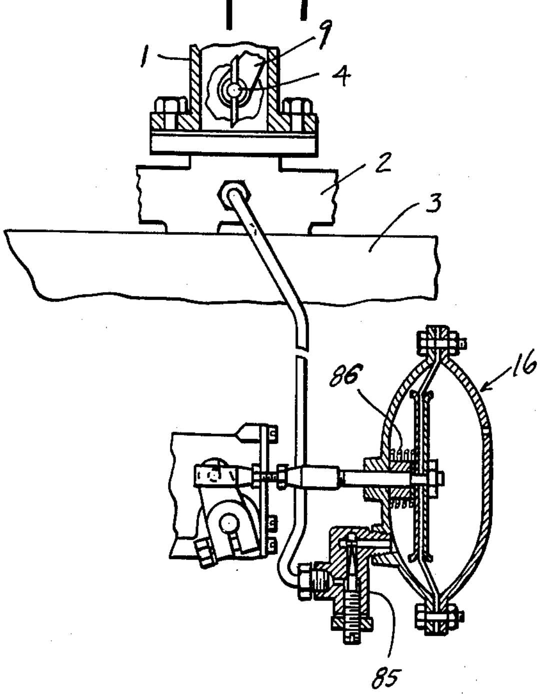


FIG. 7



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TORQUE RESPONSIVE INTERNAL COMBUSTION ENGINE GOVERNOR

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Application July 28, 1951, Serial No. 239,073

24 Claims. (Cl. 123—103)

The present invention relates to governing means for automatically controlling the speed of an internal combustion engine. It has for one of its objects that of providing a governing means for automatically controlling the speed of an engine in such a manner that under normal conditions at no load and light loads the engine will operate at comparatively low speeds, and accordingly will deliver low horsepower output, while as additional power demands are impressed upon the engine, the engine speed is increased to meet these increased power demands and vice versa.

Another object of the invention is to provide a governing means for internal combustion engines the speed adjustment of which is automatically changed through the medium of a load sensing means to effect an increase in the speed of the engine as the load demands are increased and vice versa.

Another object of the invention is to provide a speed responsive governor controlling the delivery of fuel to an internal combustion engine, which control will increase the fuel delivery to the engine for effecting an increased speed in the operation of the engine upon the imposition of additional load on the engine and vice versa.

Still another object of the invention is to provide, in a governing means for internal combustion engines which comprises a reactive control device, a load sensing means and a non-reacting linkage coupled between the governing means and the load sensing means, whereby the load sensing means is free to sense change of load on the engine independently of any reaction from the reactive means, thereby to effect an increase in the speed of the engine as the load demands increase.

Other objects and advantages of the invention will appear more fully hereinafter in the accompanying specification and claims.

For the purpose of disclosing the invention I have illustrated certain embodiments thereof in the accompanying drawings in which:

Fig. 1 is a schematic drawing of an apparatus embodying my invention.

Fig. 2 is a side elevation of a governing device embodying my invention.

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 4.

Fig. 4 is a transverse section of the governor illustrated in Fig. 2.

Fig. 5 is a longitudinal sectional view of the servomotor illustrated in Fig. 1.

Fig. 6 is an illustration of the modification of the apparatus illustrated in Fig. 1, wherein the load sensing device is connected to the exhaust manifold of the engine, and

Fig. 7 is an illustration of a modification wherein the load sensing device is connected to the intake manifold of the engine.

In the apparatus illustrated in Fig. 1, I provide a carburetor **1** delivering fuel supply to the intake manifold **2** of an internal combustion engine **3**. This carburetor is provided with a fuel flow control valve **4**, and on the air intake side of the carburetor it is provided with a venturi **5**.

The position of the control valve **4** is controlled through the medium of a centrifugally operated governor **6** having a control lever **7** connected by a suitable linkage **8** with a crank arm **9** on the shaft of the fuel control valve **4**. This centrifugally operated governor may be of a well known type wherein there is provided centrifugally operated weights responsive to the speed of the engine driven shaft and operable as the weights move outwardly under centrifugal force to move the control lever **7** in a direction to close the fuel control valve **4**. The centrifugally operated governor is of the type illustrated in Fig. 3, which structure will be more fully described hereinafter. The governor shaft **9'** is driven by a suitable belt connection **10** or other suitable connection with the engine, the speed of which is to be controlled and is accordingly driven at a speed comparable with the speed of the engine.

The centrifugal force caused by rotating the governor weights is suitably transmitted to the control shaft to which control lever **7** is fastened, and is resisted by a resilient means **11** which is connected to an extension **12** of control lever **7**. The other end of resilient means **11** is connected to an adjustable arm **13** mounted on the governor speed change lever **14**. The adjustable arm **13** is adjustably fastened by means of jam nuts **15**. The speed setting of the governor **6** may be increased by positioning the governor speed change lever **14** in positions counter-clockwise to that shown, and vice versa.

Under normal no load conditions the governor **6** controls the speed of the engine in a normal manner, that is the governor control lever **7** positions the carburetor lever and throttle valve **4** in such a manner as to maintain no load speed as determined by the governor speed setting.

When load is applied to the engine the governor reacts in the normal manner, that is the governor weights respond to a slight drop in speed and reposition control lever **7** and the throttle valve **4** toward open position in such a manner as to maintain governed speed as determined by the governor calibration.

In order that the speed setting of the governor may be changed in such a manner that when torque load is applied to the engine **3**, the fuel feed to the engine will be increased to such an extent that the speed of the engine will be increased, I provide a load sensing means which in the present instance includes a load sensing device **16**, a servomotor **17** responding to the movement of the load sensing device. The load sensing device in the present instance comprises a diaphragm **18** mounted within a chamber **19** and operating against a coiled spring **20**. The chamber **19** is connected by a conduit **21** to the venturi **5** on the atmospheric side of the throttle valve. Atmospheric pressure is present on the side opposite to chamber **19** of the diaphragm. The diaphragm in turn is connected by suitable linkage **22** with the pilot valve lever **23** of the servomotor **17**. It is the purpose of the servomotor to provide the necessary power to increase the speed setting of the speed change lever, without interfering with the sensing force; and to provide a non-compressible means to hold the speed change lever in position. It does this by the action of the power lever **33** on the governor speed change lever **14** through linkage **43**. A non-compressible means for holding the speed change lever in position is particularly advantageous because the resilient means **11** is reactive in that tension is transmitted in a backward direction through lever **14**. If lever **14** were connected directly to the load sensing device **16**, the reactive force of resilient means **11** would constitute another added load on diaphragm **18** and also on spring **20**. Therefore, resilient means **11** and spring **20** would necessarily have to be designed to cooperate properly with one another. Since the tensile characteristics of the spring are unpredictable within reasonable tolerances, it would be difficult to reproduce in manufacturing production one speed responsive governor after another having characteristics identical with one another within reasonable tolerances. The provision of the servomotor which comprises a non-compressible means creates an independent relationship whereby load sensing means **16** operates entirely independently of the reactive spring **11**. This servomotor comprises, as illustrated in Fig. 5, a suitable housing **24** having formed therein a cylinder **25** communicating at one end with a trapped oil chamber **26**, and at its opposite end with a passage **27** leading to an oil sump from which oil may be taken and delivered by a suitable pressure to the servomotor structure. Operating within the cylinder **25** is a power piston **28** connected at one end through a bifurcated arm structure **29** with an arm **30** mounted on a shaft **31** through the medium of a pin **32**, which pin is adapted to engage for movement in one direction with the arm **30**. Shaft **31** in turn is provided with a power lever **33** exteriorly of the casing.

The cylinder **25** is provided with a pressure oil inlet, **34**, connected to a suitable pump. The power piston **28** has an annular groove **35** which communicates with the oil inlet **34** at all times. The power piston **28** also has a passage **35'** between the annular groove **35** and the central bore or cylinder **38** for the pilot valve **40**. The pilot valve **40** has two lands **39** and **39'** with pressure oil between them, and is actuated by the external pilot valve lever **23** through shaft **42**, lever **41**, and connecting linkage. The power piston **28** also has ports **36** and passages **37** that provide communication between the pilot valve cylinder **38** and the trapped oil chamber **26**. When the unit is at rest as shown in Fig. 5 the left land **39** of pilot valve **40** covers port **36**. External forces on power lever **33** transmitted to the power piston **28** through shaft **31**, lever **30**, and pin **32** cause a trapped oil pressure in chamber **26**. Movement of the pilot valve **40** to the right (Fig. 5) causes land **39** to uncover port **36** and establish communication between trapped oil chamber **26** and sump through passages **37**, **38** and **27**. The external force on power lever **33** causes the power piston **28** to move to the right until power piston port **36** is moved to coincide with pilot valve land **39** closing the passage and stopping movement. Conversely when the pilot valve **40** is moved to the left (Fig. 5) the trapped oil chamber **26** is connected, through port **36** and passage **37**, with the pressure oil present between the pilot valve lands **39** and **39'**. Oil pressure causes the power piston **28** to move to the left overcoming external forces on power piston lever **33** until port **36** of the power piston **28** is moved to coincide with pilot valve land **39**, closing the passage and stopping movement.

The power piston lever **33**, Fig. 1, is connected by linkage **43** with the lower end of the governor speed change lever **14**, which, it will be noted, is pivoted at **44** on the governor casing intermediate of its ends. Accordingly, as the piston **28** is positioned to the left, Fig. 5, under the influence of oil pressure, the power lever **33** is positioned to the right, Fig. 1, and in a direction to position the governor speed change lever **14** in a direction to increase the tension of the spring **11** on the extension **12** of the control arm **7**, which increased tension tends to oppose the movement of the governor weights in a direction to close the throttle valve. Hence the governor weights must be rotated at a higher speed to overcome the greater force from the spring. It is to be noted that the greater force exerted by spring **11** has no reactive effect on load sensing means **16**, whereby the load sensing means may operate independently of the greater reactive force of spring **11**.

In the operation of the device as so far described, when the engine starts with no load, the engine driven governor **6** controls the engine in a normal manner. That

is, the governor control lever **7** positions the carburetor lever **9** and throttle valve **4** in such a manner as to maintain the low, no load speed as determined by the governor speed setting. Under these conditions, the pressure at the venturi outlet **5** approaches atmospheric, and the vacuum or pressure difference is insufficient to cause the diaphragm **18** to move against the force of the spring **20**. Therefore, normal no load governing conditions exist.

However, when a torque load is applied to the engine, the governor **6** responds to a slight speed drop and moves the carburetor lever toward the right opening the throttle valve **4** enough to maintain engine speed. When the throttle valve is thus opened, the vacuum at the venturi **5** is increased due to increased flow of fuel gases, and this increased pressure difference acts upon the diaphragm **18** to move the same to the right, Fig. 1, against the pressure of the spring **20**.

This movement is transmitted to the pilot valve **40**, through the linkage **22**, the pilot valve lever **23**, the pilot valve lever shaft **42**, lever **41** and inside link. The movement of pilot valve **40** to the left (Fig. 5) causes pilot valve land **39** to uncover port **36** thereby connecting pressure oil present between the pilot valve lands **39** and **39'** at all times, to the trapped oil chamber **26**.

Therefore, pressure is exerted on the right hand side of the power piston **28**, Fig. 5, to move the power piston **28** to the left thus moving the arm **30**, which in turn moves the power piston lever **33** to the right. Fig. 1, moving the governor speed change lever **14** and thereby increasing the tension of the spring **11** and the speed setting of the governor. This movement of the piston will eventually bring the ports **36** into alignment with the pilot valve land **39**, thereby shutting off the admission of further fluid under pressure behind the piston **28** and correspondingly the piston will come to rest in its new position.

The increased tension of the governor spring **11** causes the control arm **7** to move to the right and move throttle valve **4** toward open enough to cause the engine to accelerate to the higher speed as determined by the new setting of the governor. While the engine operates at the highest speed, it will be evident that the reactive force in spring **11** is increased, but this increased reactive force is not reflected back to load sensing device **16** due to the non-compressible character of servomotor **17**. Hence, the reactive force can have no effect on the operating characteristics of the load sensing means **16**.

When load is applied to the engine the action of the speed responsive governor causes the primary sensing at the diaphragm. The action of the power piston lever **33** on the governor speed change lever **14** causes a further opening of the throttle valve **4** which causes a secondary sensing. To attain stable operation, the proper sized orifice must be provided in the line from venturi to diaphragm to correspond to the volume of the chamber, and the acceleration rate of the engine-system. When these conditions have been satisfied, the engine speed settles out at a higher speed determined by the load applied and the calibration and setting of the diaphragm springs.

Conversely, when the engine is operating under load at a higher speed and the load is decreased, the governor **6** responds to a slight increase in engine speed and moves the carburetor lever closing the throttle valve **4** enough to maintain the engine speed. When the throttle valve **4** is moved toward the closed position the vacuum at the venturi **5** is decreased due to the decreased flow of gases, and the diaphragm **18** is moved to the left (Fig. 1) by the action of spring **20**. This movement is transmitted to the pilot valve **40** (Fig. 5) through the levers and links, moving it to the right opening port **36** to sump. This permits the escape of the trapped oil in chamber **26** and permits the movement of the power piston **28**, under the influence of the governor forces through speed change lever **14** on power lever **33**, to the right. This movement of the speed change lever reduces the speed setting of the governor, and the movement of the power piston **28** to the right (Fig. 5) causes the closing of the port **36** by its coincidence with pilot valve land **39**. The engine speed is consequently reduced to a speed determined by the new setting of the governor speed change lever. From the foregoing description it will be apparent that whether the engine load increases or decreases and whether the engine speed increases or decreases, the reactive force exerted by spring **11** can have no effect on the operating characteristics of load sensing device **16** due to the fact that servomotor **17** does not reflect the reactive force of spring **11** or changes therein.

In Figs. 2, 3 and 4 I have illustrated an embodiment of the control means, which is schematically illustrated in Fig. 1. In the structure illustrated in Figs. 2, 3 and 4 there is provided a housing **44** having an opening **45** at one end closed by a closure cap **46**, which provides a chamber **47** in which is mounted a flexible diaphragm **48** operating against biasing springs **49**. The chamber **47** is adapted to be placed in communication through suitable conduits with the venturi **5** in the manner illustrated in Fig. 1. The side of diaphragm **48** opposite to chamber **47** is open to atmospheric pressure. Within this housing there is provided a cylinder **50** formed in a liner **50'** having an intake passage **51** communicating with an intake passage **52** connected with the source of supplying oil under pressure. This cylinder also is provided with a discharge passage **53** communicating by the way of a conduit **54** with a second cylinder **55** formed in the casing **44**, the purpose of which will appear more fully hereinafter. Mounted within this cylinder **50** formed in a liner **50'** is a sleeve valve **56** having an annular groove **57** communicating with pilot valve bore **59** in the sleeve valve through passages **58**. The annular groove **57** and the passages **58**, as well as the pilot valve bore **59**, communicate with the inlet passage **51**.

The sleeve valve **56** is also provided with radial ports **60** communicating with an annular groove **61** in the inner walls of the cylinder **50**, and also with the pilot valve bore **59** in the center of the sleeve valve **56**. Operating within the pilot valve bore **59** is a pilot valve **63** connected by a suitable linkage with the diaphragm **48** and adapted under predetermined conditions to control the ports **60** in the sleeve valve **56** by the pilot valve land **62**.

Pressure oil is present between the pilot valve lands **62** and **62'** at all times the oil pump is running.

The left end of sleeve valve **56** is fitted with an internally splined adapter which receives the splined end **64** of the governor drive shaft **71** making sleeve valve **56** rotatable with the governor drive shaft **71**, but permitting axial movement of sleeve valve **56** in cylinder **50**. To drive shaft **71** is mounted a collar **66** which retains a spring **67** the purpose of which is to urge the sleeve valve **56** to the right, against the sleeve valve lever **80**, through the bearing and contact areas **82**.

The lower left part of Figure 3 embodies a conventional centrifugally actuated mechanical type speed responsive governor. The unit is designed to mount on an accessory housing of the engine to be controlled. Governor drive shaft **71** is driven from the engine by a driving means **72** which is rotated proportionate to engine speed. The governor drive shaft **71** has a weight carrier **73** fastened thereto and rotatable therewith. Governor weights **74** are mounted to the weight carrier **73** to be rotatable with the carrier, and also rotatable about the weight carrier pins on the carrier **73**. Centrifugal force developed by rotating the governor weights **74** is transmitted to the thrust sleeve **65**, slidably mounted on the governor shaft **71**, by means of weight noses **75**. By means of thrust bearing **67'** mounted on thrust sleeve **65** the force from the weights is transmitted to governor yoke **68** which is fastened to rotatable control shaft **69**. Also fastened to control shaft **69** are spring lever **73'** (Fig. 2) and control lever **70** (Fig. 4). Centrifugal force from governor weights **74** is resisted by resilient means **74'** which, at its right end (Fig. 2), is mounted to the governor spring lever **73'**, and at its left end to the governor speed change lever **76** by means of adjusting screw **75'**. Adjustment of governor is accomplished by means of adjusting screw **75'** and jam nuts. Speed setting of the governor is accomplished by moving the governor speed change lever **76**. A clockwise movement increases the tension on the governor spring, and vice versa. The force from the governor spring **74'** keeps the governor weights **74** in a closed position, at which position the engine throttle valve is open, until the engine speed reaches a value at which the centrifugal force from the governor weights becomes great enough to move the control lever to a position in the direction of closed throttle as determined by the load on the engine and the calibration and speed setting of the governor. Outward movement of the weights moves the control lever in the direction of closed throttle, and vice versa. The system comes to rest when the forces from the weights and spring balance. Consequently, a slight increase in speed of governed engine due to a decreased load will result in movement in the direction of closed throttle by the governor; conversely a slight decrease in speed due to an increased load will result in movement in the direction of opened throttle by the governor.

Above the speed responsive governor a power piston **78** operating in the cylinder **55** is moved to the right, Fig. 3, under the pressure admitted thereon through the passage **54**; and when the power piston **78** is moved to the right, it moves speed change lever **76** correspondingly to the right through roller **77** mounted on speed change lever **76**, thereby increasing the tension on the spring **74'** and thus increasing the force against which the governor weights are adapted to operate to move the arm **70** toward a closed throttle position.

In addition, when power piston **78** moves to the right to increase the speed setting of the governor, it carries sleeve valve lever **80** with it through roller **77** on speed change lever **76**, and roller **79** on sleeve valve lever **80**. This permits sleeve valve **56** to be positioned to the right by spring **67** proportionate to the position of power piston **78**. Conversely when the power piston **78** is moved to the left from a high speed setting, spring **81** urges sleeve valve lever **80** to follow, compressing spring **67** through sleeve valve lever contact areas **82**, a thrust bearing, and the sleeve valve **56**.

The lever arm **83** and the solenoid **84** are for a manual control setting under certain conditions, of the governor mechanism, but detailled description thereof is believed to be unnecessary except to say that by adjusting the lever arm **83** through the influence of a solenoid control member **84**, manual adjustment of the control may be effected through effecting pressure on the diaphragm **48** in opposition to the biasing spring **49**.

The apparatus disclosed in Fig. 3 operates in substantially the same manner as that disclosed in Fig. 1. When the engine is started with no load, the engine driven centrifugal governor controls the engine in a normal manner. That is, the governor control lever **70** positions the carburetor shaft and the throttle valve **4**, Fig. 1, in such a manner as to maintain the low no load speed as determined by governor setting.

However, when torque load is applied to the engine, the governor weights tend to move inwardly in a direction to operate the throttle control lever **70** to move the throttle valve **4** further toward the open position. When the throttle valve is opened, the vacuum at the venturi **5** is increased, thereby increasing pressure difference applied to diaphragm **48**. Under these conditions, diaphragm **48** then moves to the right moving the pilot valve **63** to the right, Fig. 3, admitting pressure oil from the inlet passage **51** through the bore **59** and ports **60** to the conduit or passageway **54**, and thus to the cylinder **55** behind the power piston **78**. This moves the piston **78** to the right, Figs. 2 and 3, thereby positioning the governor speed change lever **76** to the right, thus increasing the tension of spring **74'** on spring lever **73'**, which force is transmitted to the governor weights **74** through governor yoke **68** on the centrifugal governor. The control lever **70** is moved in the direction of open throttle. The engine speed is thereby increased to a value determined by the new speed setting of the governor.

It is to be noted that when the power piston **78** moves to the right, Figs. 2 and 3, the sleeve valve lever **80** is likewise moved to the right, thereby unloading contact areas **82** from the thrust bearing of the sleeve valve **56** and permitting the sleeve valve, under the influence of the spring **67**, to move to the right until finally the ports **60** coincide with the pilot valve lands **62**, shutting off further pressure to the cylinder **55** and thus maintaining the parts in their newly adjusted position.

When the power output of the engine begins to exceed the demand for power, as an instance of a decrease in loading, the governor control lever **70**, moved by the spreading of the governor weights **74**, due to slight increase in speed, moves the throttle valve in the direction toward closed position. This movement causes a reduction in the vacuum at the venturi due to the reduced flow of gas, resulting in a reduction in the pressure difference on the diaphragm **48**. Under these conditions the biasing springs **49** move pilot valve **63** to the left, Fig. 3, placing the ports **60** in communication with the right hand side of the bore **59** of the sleeve valve thereby permitting the escape of the fluid under trapped pressure in the cylinder **55** to sump, thus permitting piston **78** to be moved to the left, Fig. 3, by the force of the governor spring reducing the tension on the spring **74'**, thereby reducing the speed setting of the governor. The engine speed is then reduced to a value determined by the new setting of the governor. With the movement of the piston **78** to the left, the sleeve valve lever **80** will move to the left under the influence of the spring **81**, moving the sleeve valve **56** to the left until the ports **60** again coincide with the pilot valve land **62**, closing the passage and stopping movement.

In Fig. 6 I have illustrated a modification wherein the load sensing device **16** illustrated in Fig. 1 is connected to the exhaust manifold **83'**, and under these conditions exhaust back pressure is applied to the left hand side of the diaphragm **18**, to move the same to the right with increased pressure, instead of venturi vacuum being applied to the right hand side as illustrated in Fig. 1. Exhaust back pressure is a function of the flow of exhaust gases which is proportional to the engine horsepower output. The functioning of the governor system with this sensing medium is based on the utilization of any means to indicate flow of exhaust gases, such as back pressure, pressure drop through a venturi tube, static pressure in a Pitot tube, etc. In other respects the operation of the device is the same; and, of course, the same connections are made as in the structure illustrated in Figs. 2, 3 and 4.

In Fig. 7 I have illustrated a modification wherein the load sensing device **16** illustrated in Fig. 1 is connected to the intake manifold **2**, downstream from the carburetor throttle valve **4**. Under these conditions the manifold vacuum is applied to the left side of the diaphragm through a restrictor **85**. The right side of the diaphragm is open to atmospheric pressure. At no load and light loads, the vacuum is high and moves the diaphragm to the left against the spring **86** positioning the speed change lever **14** at low speed settings. However, when the governor responds to an increase in load the vacuum is decreased permitting the spring to move diaphragm to the right thus increasing the speed setting of the governor speed change lever through the hydraulic servomotor.

Manifold vacuum varies inversely as the throttle valve is opened and is roughly indicative of the engine torque. Due to the great pressure difference between no load and full load vacuum (approximately 18–20" Hg) a highly restricted system is necessary to obtain stable operation.

In other respects the operation of the device is the same, and, of course, the same connections are made as in the structure illustrated in Figs. 2, 3 and 4.

The invention claimed is:

1. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; and load sensing means continuously responsive to varying load imposed on the engine and including a continuously responsive non-reactive linkage coupled to said reactive means for effecting an increased opening of said fuel controlling means substantially directly proportional with the increase of load on the engine, and a decreased opening of said fuel controlling means upon a decrease of load imposed on said engine.

2. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; and load sensing means responsive to the fuel flow to the engine and including a continuously responsive non-reactive linkage coupled to said reactive means for effecting an increased opening of said fuel controlling means substantially directly proportional with the increase of fuel flow to the engine under increased load imposed upon the engine, and a closing of said fuel controlling means under a decrease in load imposed on the engine.

3. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; and load sensing means responsive to the exhaust flow of the engine and including a continuously responsive non-reactive linkage coupled to said reactive means for effecting an increased opening of said fuel controlling means substantially directly proportional with the increase of exhaust flow from the engine under increased load imposed upon the engine and a closing of said fuel controlling means under a decrease in load imposed on the engine.

4. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; and load sensing means responsive to the intake manifold pressure of the engine and including a continuously responsive non-reactive linkage coupled to said reactive means for effecting an increased opening of said fuel controlling means substantially directly proportional with the increase of the intake manifold pressure of the engine under increased load imposed upon the engine, and closing said fuel controlling means under a decrease in load imposed upon the engine.

5. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; and load sensing means responsive to load imposed on the engine and including a continuously responsive non-reactive linkage coupled to said reactive means for effecting an increased speed setting of the speed responsive means substantially directly proportional with the increase of load imposed upon the engine, and a decreased speed setting of the speed responsive means upon decrease of load imposed upon the engine.

6. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; and load sensing means responsive to the fuel flow to the engine and including a continuously responsive non-reactive linkage coupled to said reactive means for effecting an increased speed setting of the speed responsive means substantially directly proportional with the increase of fuel flow to the engine, after increase of load imposed on said engine, and a decreased speed setting of the

speed responsive means upon decrease in fuel flow upon a decrease in load imposed on the engine.

7. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing operation of said fuel controlling means; and load sensing means responsive to the exhaust flow from the engine and including a continuously responsive non-reactive linkage coupled to said reactive means for effecting an increased speed setting of the speed responsive means substantially directly proportional with the increase of exhaust flow from the engine upon increase in load imposed on the engine, and a decreased speed setting of the speed responsive means upon a decrease in exhaust flow upon a decrease in load imposed upon the engine.

8. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; and load sensing means responsive to the intake manifold pressure of the engine and including a continuously responsive non-reactive linkage coupled to said reactive means for effecting an increased speed setting of the speed responsive means substantially directly proportional with the increase of the intake manifold pressure of the engine upon increase in load imposed on the engine, and a decrease of intake manifold pressure upon decrease in the load imposed on the engine.

9. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; speed responsive means governing the operation of said fuel controlling means; adjustable reactive resilient means opposing the force of said speed responsive means; and load sensing means responsive to load imposed on the engine and including a continuously responsive non-reactive linkage coupled to said adjustable means for effecting an increased force on said speed responsive means through said adjustable resilient means substantially directly proportional with the increase of load upon the engine, and a decreased force with a decreased load upon the engine.

10. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; speed responsive means governing the operation of said fuel controlling means; adjustable reactive resilient means opposing the force of said speed responsive means; and load sensing means responsive to the fuel flow to the engine and including a continuously responsive non-reactive linkage coupled to said adjustable means for effecting an increased force on said speed responsive means through said adjustable resilient means substantially directly proportional with the increase of fuel flow to the engine under increased load imposed upon the engine, and decreasing the force on said speed responsive device with decrease of fuel flow under decrease in load imposed upon the engine.

11. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; speed responsive means governing the operation of said fuel controlling means; adjustable reactive resilient means opposing the force of said speed responsive means; and load sensing means responsive to the exhaust flow of the engine and including a continuously responsive non-reactive linkage coupled to said adjustable means for effecting an increased force on said speed responsive means through said adjustable resilient means substantially directly proportional with the increase of exhaust flow from said engine under an increased load imposed upon the engine, and a decreased force with the decrease of exhaust flow under a decrease in load upon the engine.

12. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; speed responsive means governing the operation of said fuel controlling means; adjustable reactive resilient means opposing the force of said speed responsive means; and load sensing means responsive to the intake manifold pressure of the engine and including a continuously responsive non-reactive linkage coupled to said adjustable means for effecting an increased force on said speed responsive means through said adjustable resilient means substantially directly proportional with the increase of the intake manifold pressure of the engine, under an increased load imposed on the engine, and a decreased force under the decrease in manifold pressure upon a decrease in the load imposed on the engine.

13. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; a non-reactive, continuously responsive servomotor means controlling the action of said speed responsive means; and load sensing means responsive to load imposed on the engine controlling the action of said servomotor means independently of the reaction of said reactive means for effecting an increased opening of said fuel controlling means substantially directly proportional with the increase of load imposed on the engine, and to effect a decreased opening of the fuel controlling means with the decrease of load imposed on the engine.

14. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; non-reactive, continuously responsive servomotor means controlling the action of said speed responsive means; load sensing means responsive to the fuel flow to the engine controlling the action of said servomotor means independently of the reaction of said reactive means for effecting an increased opening of said fuel controlling means substantially directly proportional with the increase of fuel flow to said engine, upon an increased loading imposed on the engine, and to effect a decreased opening of the fuel controlling means with the decrease of load imposed on the engine.

15. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; a non-reactive, continuously responsive servomotor means controlling the action of said speed responsive means; load sensing means responsive to the exhaust flow of the engine controlling the action of said servomotor means independently of the reaction of said reactive means to effect an increased opening of said fuel controlling means substantially directly proportional with the increase of exhaust flow from the engine, under an increased load imposed on the engine, and a decreased opening of the fuel controlling means with the decrease of exhaust pressure under a decreased load imposed on the engine.

16. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; a non-reactive, continuously responsive servomotor means controlling the action of said speed responsive means; load sensing means responsive to intake manifold pressure of the engine controlling the action of said servomotor means independently of the reaction of said reactive means to effect an increased opening of said fuel controlling means substantially directly proportional with the increase of the intake manifold pressure of the engine, under an increased load imposed upon the engine, and decreased opening of the fuel controlling means with a decrease in manifold pressure under a decreased loading of the engine.

17. In an internal combustion engine governor, in

combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; a non-reactive, continuously responsive servomotor means controlling the action of said speed responsive means; and load sensing means responsive to the load imposed on the engine controlling the action of said servomotor means independently of the reaction of said reactive means for effecting an increased speed setting of the speed responsive means substantially directly proportional with the increased load upon the engine, and a decreased setting of the speed responsive means with a decrease in load imposed upon the engine.

18. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; a non-reactive, continuously responsive servomotor means controlling the action of said speed responsive means; and load sensing means responsive to the fuel flow to the engine controlling the action of said servomotor means independently of the reaction of said reactive means for effecting an increased speed setting of the speed responsive means substantially directly proportional with an increase of fuel flow to the engine, under an increased load imposed on the engine, and for effecting a decreased speed setting of the speed responsive device under a decreased load imposed on the engine.

19. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; a non-reactive, continuously responsive servomotor means controlling the action of said speed responsive means; and load sensing means responsive to the exhaust flow from the engine controlling the action of said servomotor means independently of the reaction of said reactive means for effecting an increased speed setting of the speed responsive means substantially directly proportional with an increase of exhaust flow from the engine, under an increased load imposed on the engine, and a decreased speed setting of the speed responsive means under a decreased load imposed on the engine.

20. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; reactive speed responsive means governing the operation of said fuel controlling means; a non-reactive, continuously responsive servomotor means controlling the action of said speed responsive means; and load sensing means responsive to the intake manifold pressure of the engine controlling the action of a servomotor means independently of the reaction of said reactive means for effecting an increased speed setting of the speed responsive means substantially directly proportional with an increase of intake manifold pressure of the engine under an increased load imposed upon the engine, and a decreased speed setting of the speed responsive means under a decreased load imposed on the engine.

21. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; speed responsive means governing the operation of said fuel controlling means; adjustable reactive means opposing the force of said speed responsive means; a non-reactive, continuously responsive servomotor means controlling the action of said reactive means and load sensing means responsive to the load imposed on the engine controlling the action of said servomotor means independently of the reaction of said reactive means for

effecting an increased force on said speed responsive means through said adjustable means substantially directly proportional with an increase of the load imposed upon the engine, and a decreased force on said speed responsive means with a decrease of load imposed on the engine.

22. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; speed responsive means governing the operation of said fuel controlling means; adjustable reactive means opposing the force of said speed responsive means; a non-reactive, continuously responsive servomotor means controlling the action of said reactive means and load sensing means responsive to the fuel flow to the engine controlling the action of said servomotor means independently of the reaction of said reactive means for effecting an increased force on said speed responsive means through said adjustable means substantially directly proportional with the increase of fuel flow to said engine, with an increased load imposed on the engine, and a decreased force on said speed responsive means with a decrease of load imposed on the engine.

23. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; speed responsive means governing the operation of said fuel controlling means; adjustable reactive means opposing the force of said speed responsive means; a non-reactive, continuously responsive servomotor means controlling the action of said reactive means and load sensing means responsive to the exhaust flow from the engine controlling the action of said servomotor means independently of the reaction of said reactive means for effecting an increased force on said speed responsive means through said adjustable means substantially directly proportional with the increase of exhaust flow from said engine, with an increased load imposed on the engine, and decreasing the force on said speed responsive means with the decrease in exhaust flow from the engine with a decrease in load imposed on the engine.

24. In an internal combustion engine governor, in combination; means for controlling the admission of fuel to the engine; speed responsive means governing the operation of said fuel controlling means; adjustable reactive means opposing the force of said speed responsive means; a non-reactive, continuously responsive servomotor means controlling the action of said reactive means and load sensing means responsive to the intake manifold pressure of the engine controlling the action of said servomotor means independently of the reaction of said reactive means for effecting an increase in force on said speed responsive means through said adjustable means substantially directly proportional with the increase of intake manifold pressure of the engine, upon an increase in load imposed upon the engine, and effecting a decrease in force on said speed responsive device with a decrease in manifold pressure upon a decrease in load imposed on the engine.

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