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GOVERNOR

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3 Sheets-Sheet 2

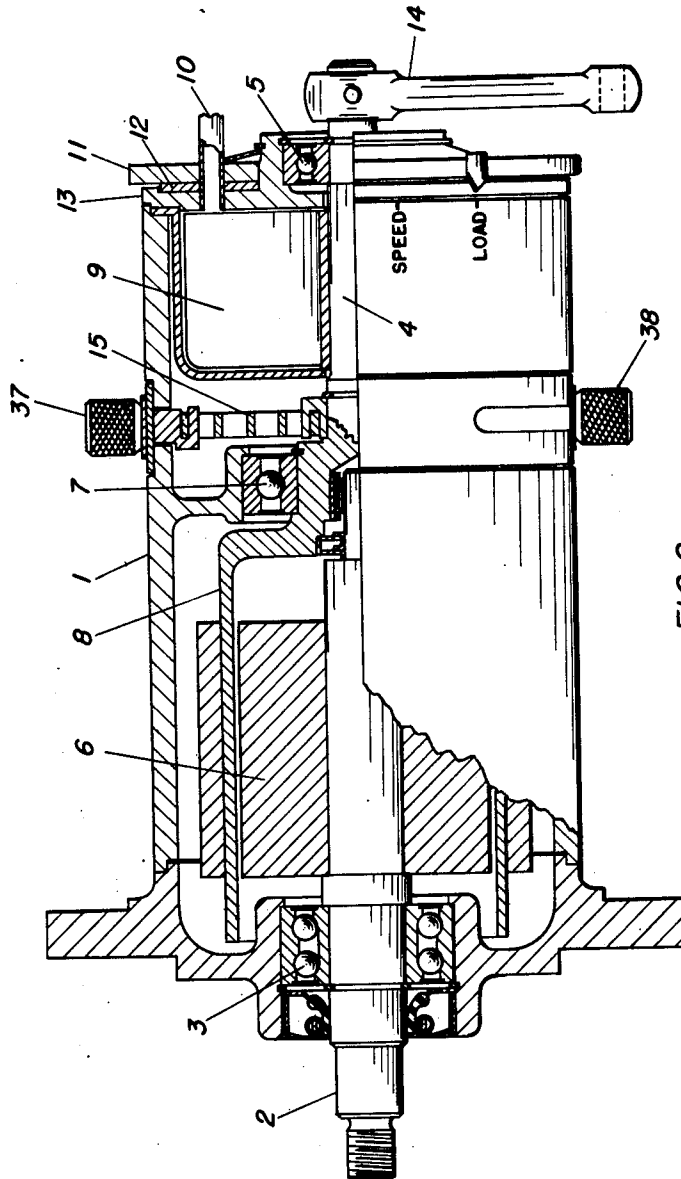


FIG. 2

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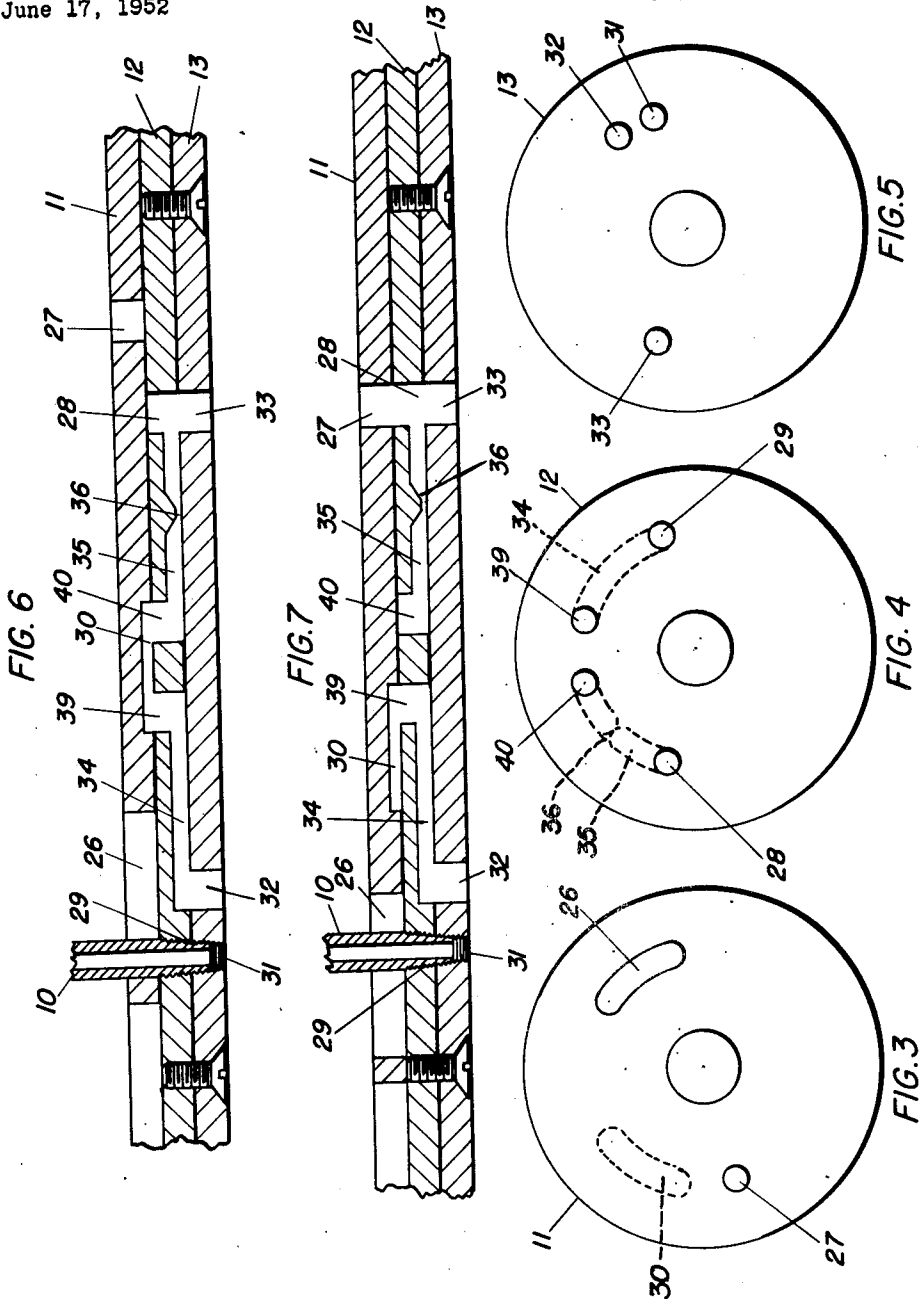
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GOVERNOR

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8 Claims. (Cl. 123-103)

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This invention relates in general to governors and more particularly to improvements in engine throttle control devices for governing engine speed in proportion to engine load and for maintaining nominally constant engine speed over a range of from minimum to maximum engine load.

One of the primary objects of our invention is to provide a single self-contained governor unit that is capable of selective adjustment for controlling the speed of an engine and also for alternately and independently maintaining a nominally constant engine speed throughout a range of from minimum to maximum engine load.

Another object of our invention is to provide a simple self-contained unit, requiring no external electrical connections or auxiliary components, that is selectively manually adjustable to efficiently and accurately perform as a governor, or speed, control for internal combustion engines.

Another object is to provide such a unit that is also selectively manually adjustable to establish and regulate engine speed, between any arbitrary minimum and maximum values, proportional to the magnitude of the load, regardless of the type of load, and also used as a governor for maintaining a nominally constant engine speed throughout a range of from minimum to maximum engine load.

In general, we propose to so construct our self-contained unit that, for proportional load speed governing, the unit senses engine load, which is a function of engine speed and engine manifold pressure, through an air vane torque motor and a magnetic coupling. The magnetic coupling is between the input and output shaft of the unit so as to act as an engine speed sensitive torque motor to add the factor of speed to that of load. These two factors are resiliently biased by spring means to provide proportional load speed control. We provide a simple valve control means for the distribution of engine manifold pressure into the unit so that the torque of the air vane motor will be directly proportional to engine manifold pressure.

For nominal constant speed governing, we employ a magnetic coupling between the input shaft and the output shaft of the unit. This provides torque on the output which is proportional to the speed of rotation of the input shaft. This torque is counteracted by spring biasing of the output shaft in the opposite direction. By simple valve means, the manifold pressure is introduced so as to act upon the vane of the air motor

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so that the torque of the vane is no longer directly proportioned to manifold pressure but is directly proportional to the rate of change of manifold pressure.

With the foregoing and other objects in view the invention resides in the combination of parts and in the details of construction hereinafter set forth in the following specification and appended claims, certain embodiments thereof being illustrated in the accompanying drawings, in which:

Figure 1 is a schematic illustration of the unit showing the essential elements of the unit, including the speed sensing magnetic motor, the air driven load sensing vane motor, biasing spring and throttle linkage, in exploded perspective;

Figure 2 is a view, partly in side elevation and partly in longitudinal section of the governor unit, including the magnetic motor, air vane motor, biasing spring and the manifold pressure valving means including stationary inner and intermediate porting discs and an outer adjustably rotatable outer porting disc;

Figure 3 is a detail view of the outer movable porting disc;

Figure 4 is a similar view of the intermediate stationary porting disc;

Figure 5 is a similar view of the inner stationary porting disc;

Figure 6 is a view in section taken through the porting disc assembly with the outer disc adjusted for nominally constant speed governing;

Figure 7 is a similar view showing the outer disc adjusted for load speed governing;

Figure 8 is a schematic view of the air vane motor when the valve porting disc assembly is adjusted for load speed governing; and

Figure 9 is a similar view showing adjustment for nominally constant speed governing.

Referring more particularly to the drawings, Figure 2 shows the self-contained unit to be contained in a housing 1 supporting the input shaft 2 in bearings 3. Shaft 2 is adapted, by any suitable means, to be driven by the engine crankshaft. The output shaft 4 is mounted for rotation in bearings 5 and 7. Input shaft 2 carries a permanent magnet 6. Cup 8 which surrounds magnet 6, with clearance, to form a magnetic drag cup, is carried by the output shaft 4. Thus, the drag cup forms a magnetic coupling between the input shaft and the output shaft.

Rigidly mounted on output shaft 4 is a vane 9 that is subjected to engine manifold pressure introduced into the housing through a tube 10 extending through an outer rotatably adjustable porting disc 11 and stationary intermediate

inner porting discs 12 and 13. To the outer end of output shaft 4 is an engine throttle operating lever 14.

In Figure 1, of the drawings, we have schematically illustrated the unit. Secured to the output shaft 4 is a coil spring 15, which is viewed in Figure 1, biases the shaft in a clockwise direction, as indicated by arrow 16. Through lever 14, rod 17 and pivoted member 18, this biases the throttle toward open position. As indicated by arrow 19, the input shaft 2 rotates in a counter-clockwise direction.

Referring to Figure 1, with the engine manifold pressure, being less than atmospheric pressure, as it is introduced into the housing, it is applied on the front face of the vane 9 to urge it in a counter-clockwise direction, as indicated by the arrow 19', so that the torque is in a counter-clockwise direction urging the output shaft 4 to move the throttle towards closed position. Likewise, the torque of the drag cup 8 is also in a counterclockwise direction, as indicated by the arrow 20. By means yet to be described, Figure 8 schematically shows the arrangement when the porting disc and valve assembly is adjusted for load speed governing, as viewed from the input shaft end of the unit. Here, the engine manifold pressure is applied through inlet tube 10 to the vane 9, which is rigid with the rotary output shaft 4, the opening to atmosphere being indicated at 20. Thus the torque exerted by vane 9 is directly proportional to the differential between engine manifold pressure and atmospheric pressure and enables the unit to function as a load sensitive torque motor.

Figure 9 schematically shows the setting of the porting disc and valve assembly for purposes of nominal constant speed governing. Here, the air pressure from the engine manifold is introduced through the inlet tube 10 but the outlet 20 to atmosphere shown in Figure 8 is closed to atmosphere.

Under steady state engine manifold pressure conditions, pressure is equalized on opposite faces of vane 9, resulting in no torque being transmitted to output shaft 4. However, upon a change of engine manifold pressure in tube 10, torque is momentarily applied, through vane 9, to output shaft 4 until the pressure in passage 21 becomes equal to the pressure in inlet 10. The magnitude and time duration of this momentarily applied torque is governed by a restriction 23 interposed between passages 22 and 24. With this arrangement, the torque of the air vane motor is directly proportional to the rate of change of engine manifold pressure.

Figures 3 to 7 inclusive, show in greater detail the porting disc assembly which makes it possible to so adjust the outer valve, or porting disc, to bring about the two settings schematically shown in Figures 8 and 9. Figure 3 shows the outer movable porting disc 11 that is manually adjustable with respect to the stationary intermediate porting discs 12 and 13, shown in detail in Figures 4 and 5. Valve disc 11 is shown to have an arcuate slot 26, a circular opening 27 and an annular recess 30. The intermediate stationary disc 12 is shown to have four circular openings 28, 29, 39 and 40. An annular passage 34 extends between openings 29 and 39 and an annular passage 35 extends between openings 28 and 40 and has a midway restriction 36. The inner stationary disc is shown to have circular apertures 31, 32 and 33.

For obtaining adjustment of the porting disc

assembly for nominal constant speed governing, as schematically shown in Figure 9, we adjust the outer movable porting disc 11 to the position shown in Figure 6. It will be seen that the engine manifold pressure introduced through tube 10 to the interior of the casing inwardly of the inner stationary porting disc 13, flows through the tube 10 inasmuch as it extends inwardly through slot 26 of disc 11, and through apertures 29 and 31 of stationary discs 12 and 13. As explained before in connection with the schematic illustration of Figure 9, there is no opening to atmosphere.

In order to accomplish an adjusted setting of the porting disc assembly for load speed governing, as schematically illustrated in Figure 8, we rotatably adjust the outer porting disc 11 until it assumes the position shown in Figure 7. Here, the manifold pressure is introduced through tube 10 to the interior of the housing. The chamber on the other side of the vane is open to atmosphere by reason of the fact that openings 27, 28 and 33 of discs 11, 12 and 13 have been brought into registry.

By means of the manual adjustment knob 37, we may either wind up or unwind the coil spring 15 in order to vary, and adjust, the initial torsional force, or preload, exerted by the bias spring 15 on the output shaft 4. In this manner, the unit will effect the nominally constant speed setting of the governor unit, as described in connection with Figures 6 and 9.

By means of the manual adjustment knob 38, we may clamp the coil spring 15 at selected points throughout its length, so as to vary, and adjust, the effective length of the bias spring 15. In so doing, we modify the speed and load governing characteristics of the governor unit in order to obtain load speed control, as described in connection with Figures 7 and 8.

We claim:

1. A single self-contained governor unit for selectively and independently controlling the speed of rotation of an internal combustion engine in proportion to the load of said engine and for maintaining nominally constant engine speed over a range of from minimum to maximum engine speed, a housing for said unit, said engine having an engine driven shaft, a fuel throttle and a fuel intake manifold, said unit having an input shaft driven by said engine driven shaft and an output shaft for operating said throttle in both directions toward closed and open positions, a magnetic coupling between said input shaft and said output shaft, resilient means for normally biasing said output shaft to rotation in a direction to bias said throttle toward open position, an engine manifold pressure responsive motor including a member carried by said output shaft, means for providing application of manifold pressure to said member of said motor to rotate said motor member and said output shaft, against the action of said biasing means, to normally urge said throttle toward closed position, said means for controlling engine speed in proportion to engine load comprising valving means adjustable to vent to atmosphere on the side of said motor member opposite to the side of application of manifold pressure on said motor member, manually adjustable means, operable in conjunction with said valving means, for adjustably varying the effective length of said resilient biasing means, said selective and independent means for maintaining nominally constant engine speed over a range of from minimum to maximum engine speed comprising said

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valving means that is adapted to be independently manually adjustable to close said vent to atmosphere, a restriction in the passage between the opposite faces of said motor member established by the latter manual adjustment of said valving means and a second and independently manually adjustable means operable in conjunction with said second named valving means adjustment, for varying and adjusting the initial torsional force and preload exerted by said resilient biasing means on said output shaft.

2. A self-contained governor unit for controlling the speed of rotation of an internal combustion engine in proportion to the load of said engine, a housing for said unit, said engine having an engine driven shaft, a fuel throttle and a fuel intake manifold, said unit having an input shaft driven by said engine driven shaft and an output shaft for operating said throttle in both directions toward closed and open positions, a magnetic coupling between said input shaft and said output shaft comprising a permanent magnet carried by said input shaft and a cup surrounding said magnet with annular clearance and carried by said output shaft, a coil spring enveloping said output shaft and having its one end secured to said output shaft and its other end secured to said housing and arranged to normally bias said output shaft to rotation in a direction to bias said throttle toward open position, an air vane motor including an air vane in said housing carried by said output shaft, an inlet tube extending into said housing and connected to said manifold for establishing communication at all times between one side of said air vane and said manifold and for providing means of application of manifold pressure to said air vane to rotate the vane and said output shaft, against the action of said biasing spring, to normally urge said throttle toward closed position, said means for controlling engine speed in proportion to engine load comprising a porting disc assembly, one of which discs is manually rotatably adjustable to vent to atmosphere on the side of said air vane opposite to the side of application of manifold pressure on said air vane and a simultaneously operable manually adjustable means for engaging said biasing spring at selected points throughout its length for adjustably varying the effective length of said biasing spring.

3. A self-contained governor unit for maintaining nominally constant engine speed over a range of from minimum to maximum speed of rotation of an internal combustion engine, for said unit, said engine having an engine driven shaft, a fuel throttle and a fuel intake manifold, said unit having an input shaft driven by said crankshaft and an output shaft for operating said throttle in both directions toward closed and open positions, a magnetic coupling between said input shaft and said output shaft comprising a permanent magnet carried by said input shaft and a cup surrounding said magnet with annular clearance and carried by said output shaft, a coil spring enveloping said output shaft and having its one end secured to said output shaft and its other end secured to said housing and arranged to normally bias said output shaft to rotation in a direction to bias said throttle toward open position, an air vane motor including an air vane in said housing carried by said output shaft, an inlet tube extending into said housing and connected to said manifold for establishing communication at all times between one side of said

air vane and said manifold and for providing means of application of manifold pressure to said air vane to rotate the vane and said output shaft, against the action of said biasing spring, to normally urge said throttle toward closed position, said means for maintaining nominally constant engine speed over a range of from minimum to maximum engine speed comprising said porting disc assembly whose rotatable disc is manually adjustable to close any vent to atmosphere, a restriction in the passage between the opposite faces of said air vane established by said manual adjustment of said rotatable porting disc and a manually adjustable means for selectively winding and unwinding said biasing spring, in conjunction with said porting disc adjustment, for varying and adjusting the initial torsional force and preload exerted by said biasing spring on said output shaft.

4. A single self-contained governor unit for selectively and independently controlling the speed of rotation of an internal combustion engine in proportion to the load of said engine and for maintaining nominally constant engine speed over a range of from minimum to maximum engine speed, a housing for said unit, said engine having an engine driven shaft, a fuel throttle and a fuel intake manifold, said unit having an input shaft driven by said engine driven shaft and an output shaft for operating said throttle in both directions toward closed and open positions, a magnetic coupling between said input shaft and said output shaft, resilient means for normally biasing said output shaft to rotation in a direction to bias said throttle toward open position, an air vane motor including an air vane in said housing carried by said output shaft, an inlet tube extending into said housing and connected to said manifold for establishing communication at all times between one side of said air vane and said manifold and for providing means of application of manifold pressure to said air vane to rotate the vane and said output shaft, against the action of said biasing spring, to normally urge said throttle toward closed position, said means for controlling engine speed in proportion to engine load comprising valving means manually adjustable to vent to atmosphere on the side of said air vane opposite to the side of application of manifold pressure on said air vane, manually adjustable means, operable in conjunction with said valving means, for adjustably varying the effective length of said resilient biasing means, said selective and independent means for maintaining nominally constant engine speed over a range of from minimum to maximum engine speed comprising said valving means that is adapted to be independently manually adjustable to close said vent to atmosphere, a restriction in the passage between the opposite faces of said air vane established by the latter manual adjustment of said valving means and a second and independently manually adjustable means, operable in conjunction with said second named valving means adjustment, for varying and adjusting the initial torsional force and preload exerted by said resilient biasing means on said output shaft.

5. A single self-contained governor unit for selectively and independently controlling the speed of rotation of an internal combustion engine in proportion to the load of said engine and for maintaining nominally constant engine speed over a range of from minimum to maximum engine speed, a housing for said unit, said engine

having an engine driven shaft, a fuel throttle and a fuel intake manifold, said unit having an input shaft driven by said engine driven shaft and an output shaft for operating said throttle in both directions toward closed and open positions, a magnetic coupling between said input shaft and said output shaft, a coil spring enveloping said output shaft and having its one end secured to said output shaft and its other end secured to said housing and arranged to normally bias said output shaft to rotation in a direction to bias said throttle toward open position, an air vane motor including an air vane in said housing carried by said output shaft, an inlet tube extending into said housing and connected to said manifold for establishing communication at all times between one side of said air vane and said manifold and for providing means of application of manifold pressure to said air vane to rotate the vane and said output shaft, against the action of said biasing spring, to normally urge said throttle toward closed position, said means for controlling engine speed in proportion to engine load comprising valving means manually adjustable to vent to atmosphere on the side of said air vane opposite to the side of application of manifold pressure on said air vane, manually adjustable means, operable in conjunction with said valving means, for engaging said biasing spring at selected points throughout its length for adjustably varying the effective length of said biasing spring, said selective and independent means for maintaining nominally constant engine speed over a range of from minimum to maximum engine speed comprising said valving means that is adapted to be independently manually adjustable to close said vent to atmosphere, a restriction in the passage between the opposite faces of said air vane established by the latter manual adjustment of said valving means and a second and independently manually adjustable means, operable in conjunction with said second named porting disc adjustment, for varying and adjusting the initial torsional force and preload exerted by said biasing spring on said output shaft.

6. A single self-contained governor unit for selectively and independently controlling the speed of rotation of an internal combustion engine in proportion to the load of said engine and for maintaining nominally constant engine speed over a range of from minimum to maximum engine speed, a housing for said unit, said engine having an engine driven shaft, a fuel throttle and a fuel intake manifold, said unit having an input shaft driven by said engine driven shaft and an output shaft for operating said throttle in both directions toward closed and open positions, a magnetic coupling between said input shaft and said output shaft comprising a permanent magnet carried by said input shaft and a cup surrounding said magnet with annular clearance and carried by said output shaft, a coil spring enveloping said output shaft and having its one end secured to said output shaft and its other end secured to said housing and arranged to normally bias said output shaft to rotation in a direction to bias said throttle toward open position, an air vane motor including an air vane in said housing carried by said output shaft, an inlet tube extending into said housing and connected to said manifold for establishing communication at all times between one side of said air vane and said manifold and for providing means of application of manifold pressure to said air vane to rotate the vane and said output shaft,

against the action of said biasing spring, to normally urge said throttle toward closed position, said means for controlling engine speed in proportion to engine load comprising valving means manually adjustable to vent to atmosphere on the side of said air vane opposite to the side of application of manifold pressure on said air vane, manually adjustable means, operable in conjunction with said valving means for engaging biasing spring at selected points throughout its length for adjustably varying the effective length of said biasing spring, said selective and independent means for maintaining nominally constant engine speed over a range of from minimum to maximum engine speed comprising said valving means that is adapted to be selectively and independently manually adjustable to close said vent to atmosphere, a restriction in the passage between the opposite faces of said air vane established by the latter manual adjustment of said valving means and a second and independently manually adjustable means, operable in conjunction with said second named porting disc adjustment, for varying and adjusting the initial torsional force and preload exerted by said biasing spring on said output shaft.

7. A single self-contained governor unit for selectively and independently controlling the speed of rotation of an internal combustion engine in proportion to the load of said engine and for maintaining nominally constant engine speed over a range of from minimum to maximum engine speed, a housing for said unit, said engine having an engine driven shaft, a fuel throttle and a fuel intake manifold, said unit having an input shaft driven by said engine driven shaft and an output shaft for operating said throttle in both directions toward closed and open positions, a magnetic coupling between said input shaft and said output shaft, a coil spring enveloping said output shaft and having its one end secured to said output shaft and its other end secured to said housing and arranged to normally bias said output shaft to rotation in a direction to bias said throttle toward open position, an air vane motor including an air vane in said housing carried by said output shaft, an inlet tube extending into said housing and connected to said manifold for establishing communication at all times between one side of said air vane and said manifold and for providing means of application of manifold pressure to said vane to rotate the vane and said output shaft, against the action of said biasing spring, to normally urge said throttle toward closed position, said means for controlling engine speed in proportion to engine load comprising a porting disc assembly, one of which discs is manually rotatably adjustable to vent to atmosphere on the side of said air vane opposite to the side of application of manifold pressure on said air vane, a manually adjustable means, operable in conjunction with said adjustable porting disc, said biasing spring at selected points throughout its length for engaging said biasing spring at selected points throughout its length for adjustably varying the effective length of said biasing spring, said selective and independent means for maintaining nominally constant engine speed over a range of from minimum to maximum engine speed comprising said porting disc assembly whose rotatable disc is selectively and independently manually adjustable to close said vent to atmosphere, a restriction in the passage between the opposite faces of said air vane established by the latter

manual adjustment of said rotatable porting disc and a second and independently manually adjustable means for selectively winding and unwinding said biasing spring in conjunction with said second named porting disc adjustment, for varying and adjusting the initial torsional force and preload exerted by said biasing spring on said output shaft.

8. A single self-contained governor unit for selectively and independently controlling the speed of rotation of an internal combustion engine in proportion to the load of said engine and for maintaining nominally constant engine speed over a range of from minimum to maximum engine speed, a housing for said unit, said engine having an engine driven shaft, a fuel throttle and a fuel intake manifold, said unit having an input shaft driven by said engine driven shaft and an output shaft for operating said throttle in both directions toward closed and open positions, a magnetic coupling between said input shaft and said output shaft comprising a permanent magnet carried by said input shaft and a cup surrounding said magnet with annular clearance and carried by said output shaft, a coil spring enveloping said output shaft and having its one end secured to said output shaft and its other end secured to said housing and arranged to normally bias said output shaft to rotation in a direction to bias said throttle toward open position, an air vane motor including an air vane in said housing carried by said output shaft, an inlet tube extending into said housing and connected to said manifold for establishing communication at all times between one side of said air vane and said manifold and for providing means of application of manifold pressure to said air vane to rotate the vane and said output

shaft, against the action of said biasing spring, to normally urge said throttle toward closed position, said means for controlling engine speed in proportion to engine load comprising a porting disc assembly, one of which discs is manually rotatably adjustable to vent to atmosphere on the side of said air vane opposite to the side of application of manifold pressure on said air vane and a manually adjustable means, operable in conjunction with said adjustable porting disc, for engaging said biasing spring at selected points throughout its length for adjustably varying the effective length of said biasing spring, said selective and independent means for maintaining nominally constant engine speed over a range of from minimum to maximum engine speed comprising said porting disc assembly whose rotatable disc is selectively and independently manually adjustable to close said vent to atmosphere, a restriction in the passage between the opposite faces of said air vane established by the latter manual adjustment of said rotatable porting disc and a second and independently manually adjustable means for selectively winding and unwinding said biasing spring, in conjunction with said second named porting disc adjustment, for varying and adjusting the initial torsional force and preload exerted by said biasing spring on said output shaft.

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