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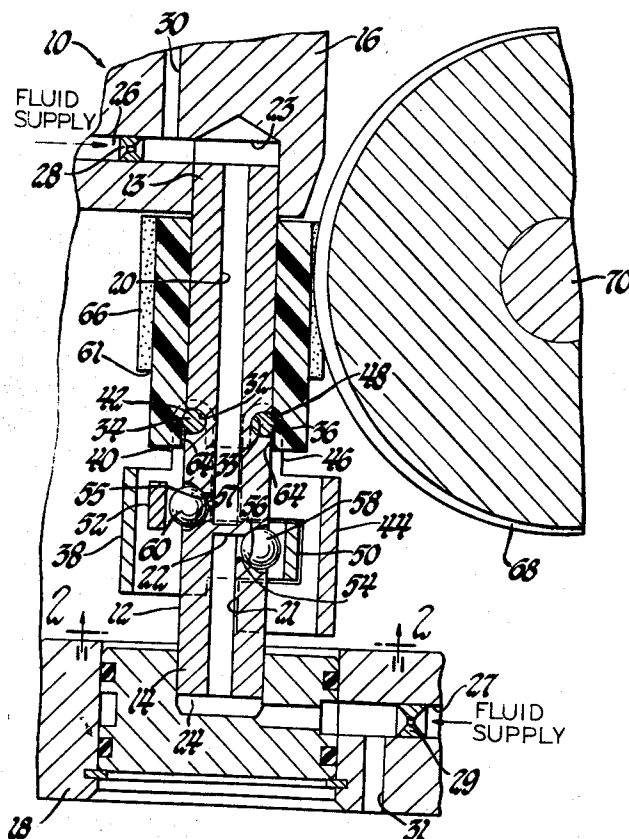
[54] **GOVERNOR**  
**14 Claims, 6 Drawing Figs.**

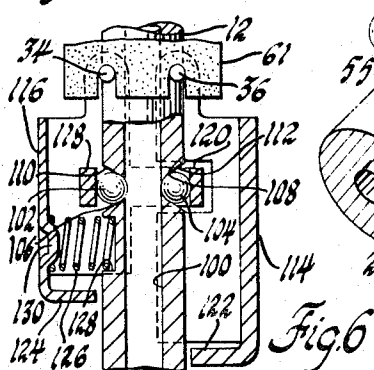
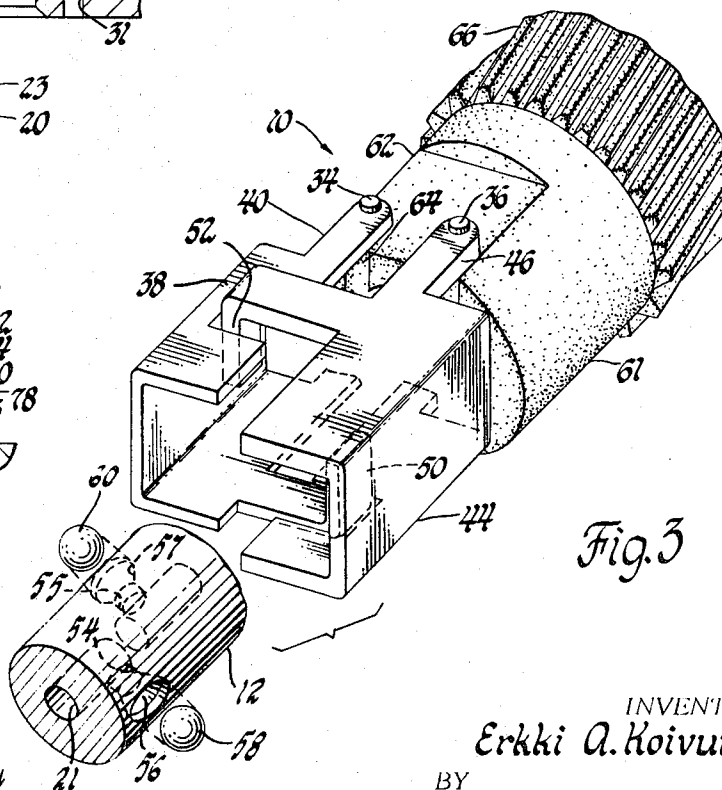
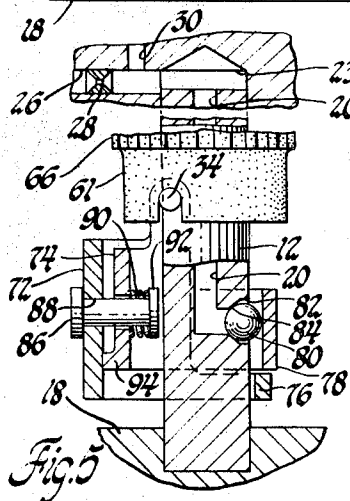
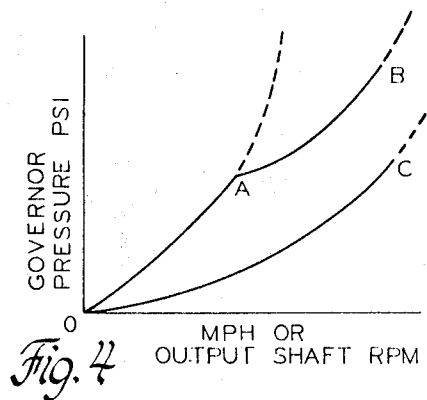
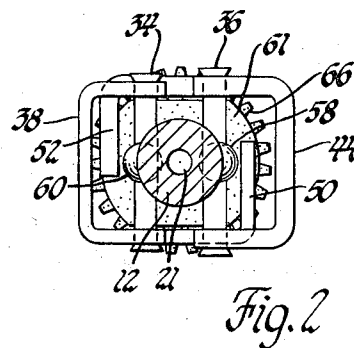
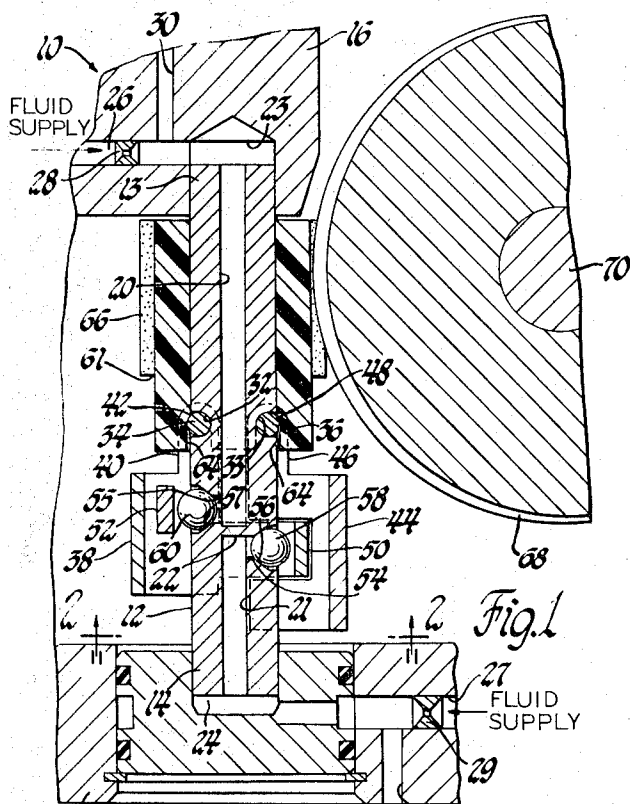
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54, 56; 73/535, 537—540, 544, 550

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**ABSTRACT:** A governor control valve wherein governor outlet pressure is regulated by exhausting fluid from an exhaust port in response to changes in centrifugal force based on vehicular speed changes. The device includes a shaft having a restricted main line pressure inlet, a governor pressure outlet and an exhaust port formed therein and an axial passage therebetween. A cylindrical pin mounted on the shaft supports both a concentric drive gear and one or more weight members suspended from the pin and transmits the torque from the drive gear to the shaft. One embodiment provides two separate governors in one assembly, one with a slow rising pressure curve, the other with a fast rising pressure curve. Another embodiment thereof provides a two-stage governor pressure vs. speed relationship. The first embodiment of the valve assembly consists of dual inlet, outlet and exhaust ports and passages, with a relief valve for each exhaust port, and two weights having different sizes and shapes suspended from two pins for respectively variably controlling the fluid exhaust through the exhaust ports past the relief valves, in response to centrifugal force. The second embodiment of the valve assembly consists of a single inlet and governor pressure outlet arrangement wherein fluid exhaust is controlled by one ball relief valve which is actuated by two different weight members suspended from one pin, the lighter weight member being in direct contact with the valve while the heavier weight member influences the lighter member through a spring until the heavier member contacts a stop.





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## GOVERNOR

This invention relates to automatic transmissions for motor vehicles and more particularly to a governor control valve for same.

In a conventional control system for a vehicle transmission having two or more gear ratios engageable by hydraulically operated brakes and clutches, the automatic selection of the desired drive is in part dependent upon transmission output shaft speed or the driving speed of the vehicle, in order to operate the vehicle efficiently. Two types of governors are currently being used, namely, two-stage governors and two-pressure governors.

A primary object of this invention is to provide an improved governor control valve which provides a two-phase governor pressure curve.

Another object of this invention is to provide an improved governor which provides a two-stage governor pressure curve.

A further object of the invention is to provide a governor control valve which is simple in construction, economical to manufacture and efficient in operation.

A more specific object of the invention is to provide a governor valve which includes a shaft and a pair of relief valves respectively controlled by primary and secondary weight members rotatably supported on the shaft for obtaining the two pressures having different rates of pressure rise.

Another object of the invention is to provide a governor valve having one relief valve controlled by primary and secondary weight members rotatably supported on a shaft and controlling the relief valve to obtain a governor pressure varying in two phases with speed.

Other objects and advantages of the invention will become more apparent when reference is made to the following description and accompanying drawings wherein:

FIG. 1 is a cross-sectional view of a governor control valve assembly embodying the invention;

FIG. 2 is a cross-sectional view taken along the plane of line 2-2 of FIG. 1, as if FIG. 1 were a full round view, and looking in the direction of the arrows;

FIG. 3 is a perspective view of portions of FIG. 1;

FIG. 4 is a graph illustrating a typical curve of governor pressure variation with speed; and

FIGS. 5 and 6 are fragmentary cross-sectional views illustrating modifications of the invention.

Referring now to the drawings in greater detail, FIG. 1 illustrates a governor control valve assembly 10, including a shaft 12 which is rotatably mounted at its ends 13 and 14 in suitable housings 16 and 18, respectively. Axially aligned passages 20 and 21 are formed in the shaft 12, separated by a wall 22. A cavity 23 is formed in the housing 16 adjacent the upper end 13 of the shaft 12 forming a chamber with the axial passage 20, and a transverse opening 24 is formed in the lower end 14 of the shaft 12 forming a chamber with axial passage 21. A regulated fluid pressure supply is connected to inlet passages 26 and 27 formed in the housings 16 and 18. Fluid flows through or downstream of orifices or restrictions 28 and 29 to the first governor pressure chamber, comprising cavity 23 and passage 20 and the second governor pressure chamber provided by the transverse opening 24 and passage 21, respectively. Governor pressure outlets 30 and 31 are also formed in the housings 16 and 18. Recesses or grooves 32 and 33 are formed on the opposite sides of the shaft 12, perpendicular to the axis thereof and intermediate the ends 13 and 14 thereof. The recesses 32 and 33 are suitable for the insertion of pins 34 and 36, as will now be explained.

A substantially U-shaped weight member 38 (FIGS. 2 and 3), having ears or projections 40 formed on each of the top edges of opposing sides thereof is disposed around the shaft 12 and pivotably mounted on the pin 34 through openings 42 formed in the oppositely disposed projections 40.

A second substantially U-shaped weight member 44, having ears or projections 46 formed on opposite upper edges thereof, includes sidewalls longer, thicker and, therefore, heavier than those of the first-mentioned weight member 38. The member 44 is mounted around the shaft 12 on the second

pin 36 adjacent the first weight member 38 by means of openings 48 formed in the projections 46. Once the pins 34 and 36 are slidably mounted in the openings 42 and 48, respectively, the ends of the pins are staked, as illustrated in FIG. 2.

Each of the weight members 38 and 44 has a narrow tab 50 and 52, respectively, extending from one of the side edges thereof into cutout portions of the other weight member and bending inwardly (FIG. 2). The tab 52 on the longer weight member 44 is formed near the upper edges thereof, while the tab 50 on the shorter weight member 38 is formed near the lower edges in FIG. 1, varying the distance each is away from its pivot point, determined by the pins 34 and 36. As may be observed in the drawing, the tabs 50 and 52, being formed in the manner just described, are positioned axially adjacent to one another on opposite sides of the shaft 12. Radially aligned with each of the tabs 50 and 52 are openings 54 and 55, including valve seats 56 and 57, respectively, formed in the wall of the shaft 12. Ball relief valves 58 and 60 are mounted in the openings 54 and 55, respectively, their centers aligned with the midpoint of the tabs 50 and 52. The relief valves 58 and 60 could, of course, be conical or disc-shaped, if desired.

After the weight member 38 and pin 34 subassembly and the weight member 44 and pin 36 subassembly are mounted in the recesses 32 and 33 on the shaft 12, a cylindrical member 61 having exterior parallel cutout portions 62 (FIG. 3) formed adjacent one end thereof and parallel slots or grooves 64 formed through the body thereof perpendicular to the cutout portions 62, is slidably mounted on the shaft 12 such that the slots 64 sit on the pins 34 and 36 and the cutout portions 62 permit pivotal movement of the projections 40 and 46 of the members 38 and 44, respectively, while retaining the members 38 and 44 in their proper suspended positions on the pins 34 and 36. When assembled, the spacing between tabs 50 and 52 and the base of the U-shaped weight members 38 and 44 is such that balls 58 and 60 cannot fall out of seat bores 56 and 57.

Gear teeth 66 are formed on the exterior of the member 61. The member 61 and its associated teeth 66 are formed of any suitable material, such as nylon. The teeth 66 mesh with a conventional speedometer drive gear 68 rotatably connected to a transmission output shaft 70.

## OPERATION

The operation of the governor control valve 10 will now be described and related to the FIG. 4 graph.

Fluid at line pressure is supplied via the inlet 26, the orifice 28 and the chamber 23 to the central passageway 20, while the same line pressure is supplied via the orifice 29, the inlet 27 and the transverse passage 24 to the central passageway 21.

As the transmission output shaft 70 rotates, the associated gear 68 will, in turn, rotate the drive gear 66. As indicated above, the governor shaft 12 and the weights 38 and 44 will be rotated by the gear 66, the torque being transmitted thereto by the pins 34 and 36.

At zero speed of the shaft 12, the tabs 50 and 52 will be suspended at their further most positions from seats 56 and 57. Once pressure is applied to the passages 20 and 21, it will force the valves 58 and 60 outwardly against the tabs 50 and 52, respectively.

At low speeds of the transmission output shaft 70 and, hence, of the governor shaft 12, the weight members 38 and 44 will begin pivoting under the effect of centrifugal force about their respective pins 34 and 36, progressively increasing the biasing force acting on the valves 58 and 60 toward the seats 56 and 57, respectively, influencing the pressure which will be transmitted through the outlets 30 and 31 to a 1-2 shift valve (not shown) and a 2-3 shift valve (not shown), respectively.

Inasmuch as the member 44 is heavier than the member 38, and its tab 52 is axially closer to its pivot pin 36 than the tab 50 of the member 38 is to the pin 34, the member 44 will have a greater bias force at lower speeds and reach its outermost

position under the action of centrifugal force before the member 38 reaches its outer position. Outward movement is, of course, limited by the contact of the relief valves 58 and 60 against their respective seats 56 and 57, at which time fluid exhaust therethrough is stopped. At this time, governor pressure

With increasing speed and increasing bias of member 44, governor pressure vs. speed is represented by the curve "OA" of FIG. 4 and the dotted line extension thereof, and the 1-2 shift valve will be affected thereby. Also with increasing speed and bias by weight 38, there is inward movement of the valve 58 toward the seat 56, caused by the inward movement of the tab 50, to control fluid exhaust so as to produce a governor pressure increasing at a slower rate with speed, as represented by the curve "OC" of FIG. 4, and the 2-3 shift valve will be affected thereby.

FIG. 5 illustrates a modification of the invention, wherein all those elements which are the same as the elements of the FIG. 1 structure bear the same reference numerals. The FIG. 5 embodiment represents a structural modification of the type of governor valve included in U.S. Pat. No. 3,321,056, issued on May 23, 1967, in the name of F. J. Winchell, et al. The variations from the FIG. 1 structure include a primary weight member 72 and a secondary weight member 74, each of which is suspended from the single pin 34. The weight members 72 and 74 include tabs 76 and 78, respectively. The tab 76 of the primary weight member 72 is positioned adjacent the shaft 12, whereas the tab 78 of the secondary weight member 74 is positioned adjacent a ball relief valve 80 mounted in an opening 82 adjacent a valve seat 84 for controlling the exhaust of fluid from the passage 20.

A cylindrical member 86 is fixedly secured to the primary weight member 72 on the side opposite the tab 76. The cylindrical member 86 extends radially inwardly from the primary weight member 72 through an opening 88 formed in the secondary weight member 74, providing means for transferring the effect of centrifugal force on the primary weight member 72 to the secondary weight member 74. A spring 90 is mounted between the secondary weight member 74 and a flange 92 formed on the inner end of the cylindrical member 86. The member 86 is fixed to weight 72 and abuts shaft 12 so ball valve 80 cannot fall out of seat 84 in any rotary position of weight 72. A projection 94 is formed at the lower end of the secondary weight member 74 and extends radially outwardly therefrom toward the primary weight member 72, serving as a stop means under the force of the spring 90.

Insofar as the operation of the FIG. 5 structure is concerned, under the action of centrifugal force, the heavier primary weight member 72 will pivot outwardly about the pin 34 in a clockwise direction in FIG. 5. The lighter secondary weight member 74 will likewise pivot about the pin 34 in a clockwise direction under the action of centrifugal force, and will be additionally influenced by the heavier primary weight member 72 through the spring 90, whose innermost end will move outwardly with the flange 92 of the cylindrical member 86.

The heavy weight member 72 provides a biasing force which increases with speed at a high rate slightly less than curve "OA" of FIG. 4, and the member 86 and spring 90 transmit this force to the light weight member 74, which has a biasing force increasing at a very slow rate like curve "OC" of FIG. 4 so the combined biasing force of the primary and secondary weight members on the valve 80 provides a governor pressure in the line 30 as illustrated by the curve "OA" of FIG. 4. The break point "A" is reached when movement of weight 72, permitted by compression of spring 90, results in the tab 76 of the primary weight member 72 contacting the shaft 12. Once this contact is made, the primary weight member 72 will have its outward movement terminated with increased shaft 12 speed. At this point, the force from the heavier primary weight member 72 being transmitted through the spring 90 to the lighter secondary weight member 74 will no longer increase with increased shaft speed. Increased speed

will now cause the secondary weight member 74 to continue to pivot outwardly, thereby continuing to increase the biasing force to effect the position of ball relief valve 80 relative to the seat 84. The graphical result of this phase is illustrated by curve "AB" of FIG. 4. The resultant governor pressure will be communicated via the single passage 30 to both the 1-2 and the 2-3 shift valves (not shown).

FIG. 6 illustrates another two-stage modification of the invention, wherein all those elements which are the same as the elements of the FIGS. 1 and/or 5 structures bear the same reference numerals. The variations from the FIGS. 1 and 5 structures include a single central passage or chamber 100 having a single restricted inlet and an outlet, such as elements 26, 28 and 30 of FIG. 1, rather than the dual chambers 20 and 21 of FIG. 1, with valves 102 and 104 being mounted adjacent seats 106 and 108 in openings 110 and 112, respectively, both of which communicate with the central chamber 100.

Primary and secondary weight members 114 and 116 are similar to the weight members 44 and 38 of FIG. 1 and include tabs 118 and 120 positioned adjacent the valves 102 and 104, respectively. The weight members 114 and 116 also include bent end portions 122 and 124, respectively, which serve as stops against the shaft 12 to prevent the ball valves 102 and 104 from falling out of the openings 110 and 112 when there is no centrifugal force on the weights 114 and 116.

A spring 126 is mounted between a spring seat 128 formed on the outer surface of the shaft 12 and a seat 130 formed on the weight member 114, urging the tab 120 of the secondary weight 116 against the valve 104. The force of the spring 126 is such that the valve 104 will be held against the seat 108 during low speed operation, resisting the pressure of the oil in the chamber 100, until such time as point "A" is reached on the two-stage curve of FIG. 4. The governor pressure curve "OA" will be determined by the pressure of the fluid in the chamber 100 on the valve 102 and exhausting therepast, forcing the valve 102 in a radially outward direction in opposition to the progressively increasing effect of centrifugal force on the primary weight member 114, and hence, on the valve 102. At a speed and corresponding governor pressure represented by point "A", the effect of centrifugal force on the primary weight member 114 will be such that the valve 102 will be forced closed by the tab 118 against the pressure of the fluid in the chamber 100. At this point, the latter pressure will be sufficient to overcome the combined force of the spring 126 and centrifugal force on the secondary weight member 116. Increased speed thereafter will, of course, cause the tab 120 to force the valve 104 toward the seat 108, thereby progressively increasing governor pressure as represented by the curve "AB" of FIG. 4.

It should be apparent that the curves may be altered to suit other applications simply by changing the relative shapes and weights of the primary and secondary pivotal weight members which control the fluid exhaust valves. If desired, it should also be apparent that springs, and the like, may be incorporated in conjunction with the weight members 38 and 44 to influence the governor pressure.

It should also be apparent that the governor shaft and dual or single pin combination provides a novel means for supporting a drive gear and for simultaneously pivotally suspending both weight members.

It should be further apparent that the dual control valve arrangement described herein need not be limited to automatic transmission applications and could be used in any hydraulic or pneumatic application requiring single, two-phase or two-stage operation.

While but three embodiments of the invention have been disclosed and described, other modifications thereof are possible.

I claim:

1. A governor for supplying a fluid pressure proportional to speed; a rotary member having a chamber therein; a source of fluid under pressure; a restricted inlet passage connecting said source to said chamber; an outlet passage connecting said

chamber to exhaust having a relief valve member therein movable between an open and a closed position for controlling flow from said chamber to exhaust and biased by fluid pressure in said chamber to the open position, and weight means pivotally mounted on said rotary member and being suspended therefrom to a position adjacent said relief valve member to open said relief valve member in all rotary positions of said rotary member, at zero speed in response to gravity and to bias said relief valve to some regulating position between said open and said closed positions proportional to centrifugal force to provide a governor pressure in said chamber varying with the speed of rotation of said rotary member.

2. A governor for supplying a fluid pressure proportional to speed; a rotary member having a chamber therein, said rotary member being mounted for rotation about an axis; a source of fluid under pressure; a restricted inlet passage connecting said source to said chamber; an outlet passage connecting said chamber to exhaust having a relief valve member therein movable between an open and a closed position for controlling flow from said chamber to exhaust and biased by fluid pressure in said chamber to the open position, said outlet passage being substantially normal to said axis and having a valve seat therein, said relief valve member being reciprocally mounted in said inlet passage and having one side engaging said seat in said closed position; and weight means pivotally mounted on said rotary member and connected to said relief valve member to bias said relief valve to some regulating position between said open and said closed positions proportional to centrifugal force to provide a governor pressure in said chamber varying with the speed of rotation of said rotary member, said weight means having its center of mass on the side of said axis substantially opposite said outlet passage and relief valve member and having a portion extending beyond said relief valve member and engaging the other side opposite said one side.

3. The invention defined in claim 1 and said weight means confining said relief valve member in said outlet passage in said closed position, said outlet passage having a seat limiting closing movement of said weight means and relief valve member in said closed position and said weight means and rotary member having stop means to prevent movement of said weight means at said open position.

4. A governor for supplying controlled fluid pressure to a vehicle transmission having an output shaft, an output gear driven thereby, and a source of fluid under pressure, said governor comprising a rotatable shaft having a chamber formed therein, means for communicating said fluid from said source to said chamber, and means operatively connected to said rotatable shaft for varying the pressure of said fluid in said chamber, said last-mentioned means including a pair of exhaust openings formed in said shaft, a pair of valve means for controlling said pair of exhaust openings, a pair of pin means operatively connected to said rotatable shaft for rotation therewith, a weight member pivotally mounted on each of said pin means for controlling the movement of one of said pair of valve means under the action of centrifugal force, biasing means mounted between said rotatable shaft and one of said weight members for urging the respective valve means toward a closed position, and gear means mounted on said pair of pin means around said rotatable shaft for rotating said rotatable shaft and for retaining said weight members in their respective positions on said pair of pin means, said gear means being driven by said output gear.

5. A governor for supplying controlled fluid pressure to a vehicle transmission having an output shaft and an output gear driven thereby, said governor comprising a rotatable shaft, an axial passage formed in said shaft, a source of fluid pressure for said axial passage, pin means mounted on said shaft for rotation therewith, a weight member pivotally mounted on said pin means, a member including gear means mounted on said pin means for retaining said weight member in position on said pin means and for driving said rotatable shaft by means of

said pin means, said gear means being driven by said output gear, and valve means mounted on said shaft and having opening and closing movements thereon for exhausting fluid therethrough and thereby varying said pressure in said axial passage, said opening and closing movements of said valve means being controlled by said weight member under the action of centrifugal force.

6. A governor for supplying controlled fluid pressure to a vehicle transmission having an output shaft, an output gear driven thereby, and a source of fluid under pressure, said governor comprising a rotatable shaft having a chamber formed therein, means for communicating said fluid from said source to said chamber, and means operatively connected to said rotatable shaft for varying the pressure of said fluid in said chamber, said last-mentioned means including an exhaust opening formed in said shaft, valve means for controlling said exhaust opening, pin means operatively connected to said rotatable shaft for rotation therewith, a weight member pivotally mounted on said pin means for controlling the movement of said valve means under the action of centrifugal force, and gear means mounted on said pin means around said rotatable shaft for rotating said rotatable shaft and for retaining said weight member in position on said pin means, said gear means being driven by said output gear.

7. A compound governor for supplying controlled fluid pressure to a vehicle transmission having an output shaft, an output gear driven thereby, and a fluid flow path, said governor comprising a rotatable shaft having two axial passages formed therein, means for communicating said fluid flow path with said two axial passages, and means operatively connected to said rotatable shaft for varying the pressure of said fluid in said fluid flow path in accordance with two different pressure vs. speed curves, said last-mentioned means including first and second exhaust openings formed in said shaft and communicating with said two axial passages, respectively, first and second valve means for controlling said first and second exhaust openings, first and second support members operatively connected to said rotatable shaft for rotation therewith, first and second weight members pivotally mounted on said first and second support members, respectively, for variably controlling the movement of said first and second valve means under the action of centrifugal force, and gear means mounted on said first and second support members around said rotatable shaft for rotating said rotatable shaft and for retaining said first and second weight members in position on said support members, said gear means being driven by said output gear.

8. The governor described in claim 7, wherein said support members are pins mounted in transverse grooves formed in said rotatable shaft.

9. A compound governor for supplying controlled fluid pressure to a vehicle transmission having an output shaft, an output gear driven thereby, and a source of fluid under pressure, said governor comprising a rotatable shaft having a pair of aligned axial passages formed therein, means for communicating said fluid from said source to said aligned axial passages, and means operatively connected to said rotatable shaft for varying the pressure of said fluid in said aligned axial passages in accordance with two different pressure vs. speed curves, said last-mentioned means including first and second exhaust openings formed in said shaft, each communicating with one of said pair of aligned axial passages, first and second relief valve means for controlling said first and second exhaust openings, first and second pin members operatively connected to said rotatable shaft for rotation therewith, first and second weight members pivotally mounted on said first and second pin members, respectively, for variably controlling the movement of said first and second valve means under the action of centrifugal force, and gear means mounted on said first and second pin members around said rotatable shaft for rotating said rotatable shaft and for retaining said first and second weight members in position on said pin members, said gear means being driven by said output gear.

10. The governor described in claim 9, wherein said first and second relief valve means are ball valves.

11. The governor described in claim 9, wherein said first and second pin members are mounted in recesses formed on opposite sides of said rotatable shaft.

12. The governor described in claim 9, wherein said first and second weight members each include three flat sides positioned in their free state parallel to the axis of said rotatable shaft, a pair of projections extending upwardly from the top edges of two opposing sides of each of said three flat sides, an opening formed in each of said projections for suspending said first and second weight members on said pin members, and a tab extending from a side edge of one of each of said three flat sides, said tabs being positioned adjacent said first and second valve means.

13. The governor described in claim 9, wherein said gear means includes a cylindrical body having teeth formed around a portion of the periphery thereof, flat surfaces formed on opposite sides thereof spaced axially apart from said teeth, and a pair of notches formed therethrough perpendicular to said flat surfaces for mounting on said pin members.

14. A governor for supplying controlled fluid pressure to a vehicle transmission having an output shaft, an output gear

driven thereby, and a source of fluid under pressure, said governor comprising a rotatable shaft having a chamber formed therein, means for communicating said fluid from said source to said chamber, and means operatively connected to said rotatable shaft for varying the pressure of said fluid in said chamber, said last-mentioned means including an exhaust opening formed in said shaft, valve means for controlling said exhaust opening, a pin operatively connected to said rotatable shaft for rotation therewith, a pair of speed-responsive weight members pivotally mounted on said pin for controlling the movement of said valve means under the action of centrifugal force, mounting means secured to the heavier of said pair of speed-responsive weight members and extending radially inwardly therefrom, biasing means mounted between the innermost end of said mounting means and the inner side of the lighter of said pair of speed-responsive weight members, a tab on said heavier weight member adjacent said rotatable shaft for at times abutting against said shaft, and a tab on said lighter weight member adjacent said valve means.

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