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HYDRAULIC SPEED GOVERNOR WITH MANUAL CONTROL

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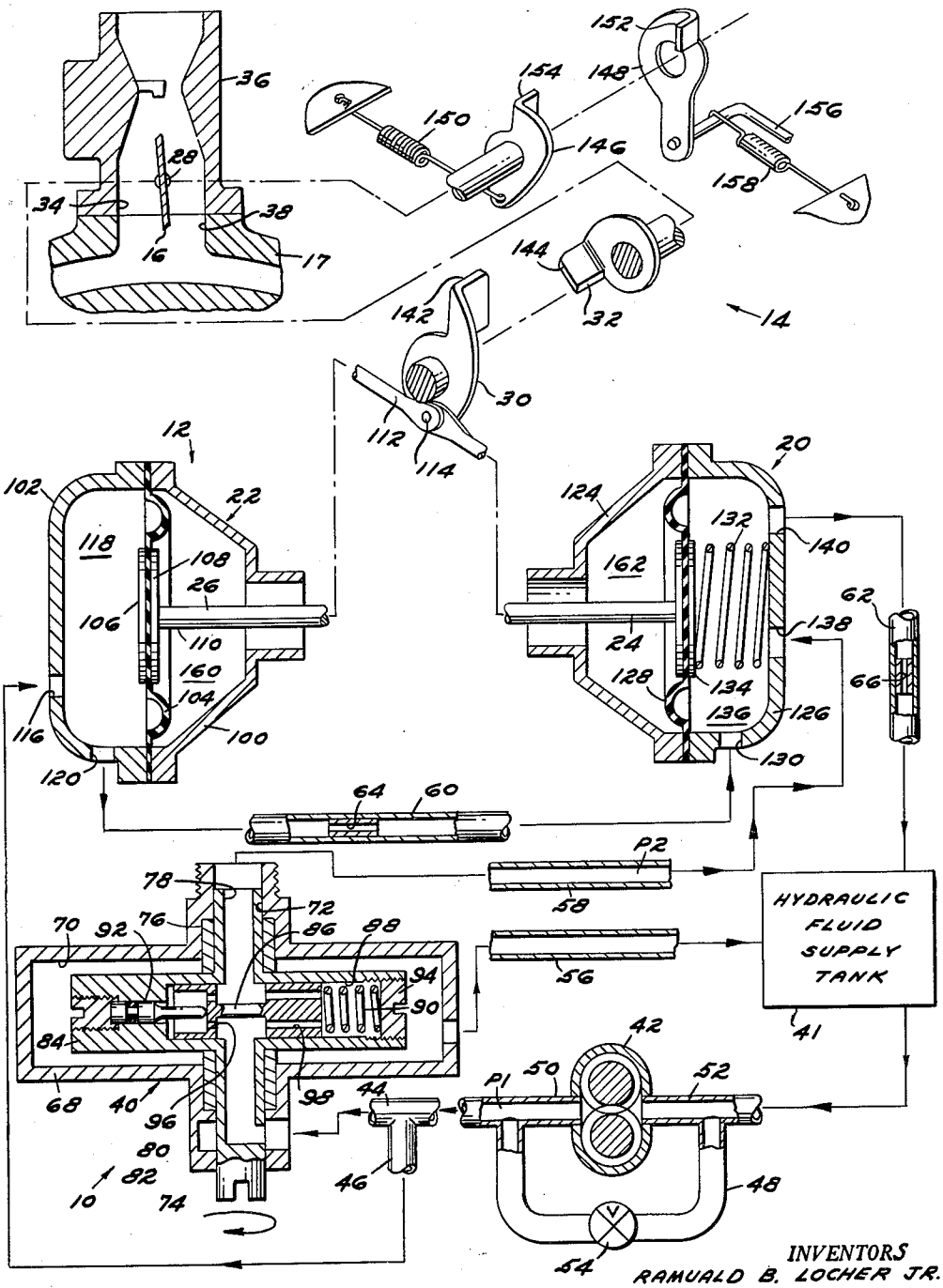


FIG. 1

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FIG. 2

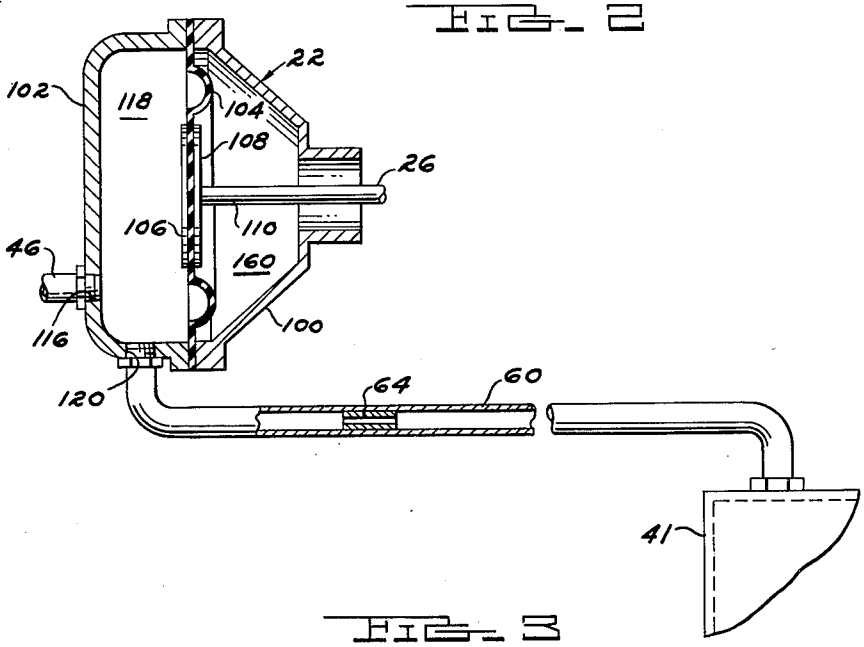
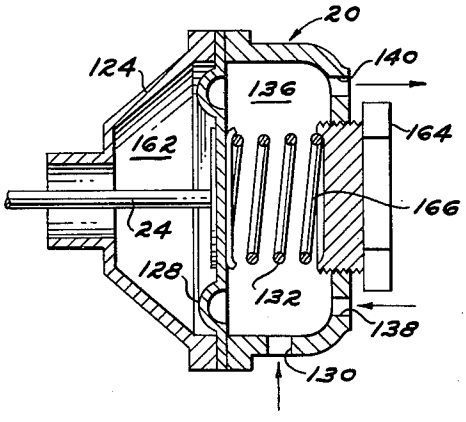


FIG. 3



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HYDRAULIC SPEED GOVERNOR WITH MANUAL CONTROL

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The invention relates to governors and refers more specifically to hydraulically controlled diaphragm actuated mechanism for positioning a speed control member.

Hydraulic governors have been known in the past for use in conjunction with vehicle mounted internal combustion engines and similar devices for regulating the vehicle or engine speed. Prior hydraulic governors have however often been relatively complicated whereby the governors have been expensive and often unreliable.

It is therefore one of the objects of the present invention to provide improved hydraulically controlled diaphragm actuated mechanism for positioning a speed control member.

Another object is to provide a governor comprising hydraulic control means, diaphragm actuating means responsive to the hydraulic control means, and mechanism for positioning a speed control member responsive to the diaphragm actuating means.

Another object is to provide a governor as set forth above wherein the hydraulic control means comprises a speed sensing unit, a hydraulic fluid supply tank, a first circulating circuit for hydraulic fluid from the fluid supply tank through the speed sensing unit to the diaphragm actuating means and back to the fluid supply tank, a second hydraulic fluid circulating circiut from the fluid supply tank to the diaphragm actuating means and back to the fluid supply tank, means for pumping hydraulic fluid from the supply tank through the circulating circuits, means for rotating a portion of the speed sensing unit at a speed proportional to the speed to be governed, and means for restricting the flow of hydraulic fluid through the speed sensing unit in accordance with the speed of rotation of said portion thereof.

Another object is to provide a governor as set forth above wherein the diaphragm actuating means comprises two diaphragm assemblies, each including a pair of housing members having a diaphragm clamper therebetween whereby separate chambers are formed on opposite sides of the diaphragm, a governor actuating rod secured to each of the diaphragms and extending through openings in one of the housing members of each assembly, the chamber formed between the diaphragm and said one diaphragm housing member of each assembly being opened to atmospheric pressure, means for supplying hydraulic fluid under pressure to one of the diaphragm assemblies on the opposite side of the diaphragm thereof from the actuating rod directly from the fluid supply tank, means connecting the chamber on the opposite side of the diaphragm of the other diaphragm assembly to the hydraulic fluid pumped through the speed sensing unit, said other diaphragm assembly including resilient means urging the actuating rod therein toward said one diaphragm assembly, and means connecting each of the chambers on the said opposite side of the diaphragms to the hydraulic fluid supply tank through restrictions.

Another object is to provide diaphragm actuating means as set forth above wherein the chambers on said opposite side of the diaphragms are interconnected through a restriction.

Another object is to provide diaphragm actuating means as set forth above wherein the chamber on the opposite side of the diaphragm of said one diaphragm assembly

is connected directly to the hydraulic fluid supply tank through a restriction.

Another object is to provide a hydraulic governor as set forth above wherein the mechanism for positioning a speed control member comprises a shaft mounting the speed control member for rotation therewith, a drive member rigidly secured to one end of the shaft having an abutment thereon, spring means urging the drive member in a direction to move the speed control member to an open position, a lever pivotally mounted on the one end of the shaft having an abutment thereon engageable with the abutment on the drive member, spring means urging the lever in a direction to cause engagement of said abutments, and means for manually positioning said lever, the last mentioned spring being stronger than the first mentioned spring, a drive member secured to the other end of said shaft for rotation therewith having an abutment thereon, a lever pivotally mounted on said other end of said shaft having an abutment thereon engageable with the abutment on the last mentioned drive member when the lever is pivoted in a direction to close the speed control member, which last mentioned lever is pivotally connected to the actuating rods for movement thereby to limit movement of the speed control member in an opening direction in accordance with the speed sensed by the speed sensing unit.

Another object is to provide a hydraulic governor which is simple in structure, economical to manufacture and efficient in use.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, illustrating a preferred embodiment of the invention, wherein:

FIGURE 1 is a partly diagrammatic, partly schematic illustration of one embodiment of the hydraulic governor of the invention.

FIGURE 2 is a fragmentary diagram of a modification of the hydraulic governor illustrated in FIGURE 1.

FIGURE 3 illustrates a modified diaphragm assembly for use in a hydraulic governor as shown in FIGURE 1.

With particular reference to the figures one embodiment of the present invention will now be disclosed.

As shown in FIGURE 1 the hydraulic governor of the invention comprises the hydraulic control means 10, diaphragm actuating means 12 and the mechanism 14 for positioning the throttle 16 to control the speed of the engine 17. In operation the speed of the engine 17 which it is desired to govern is sensed by the speed sensing unit 40 of the hydraulic control means. The diaphragm assemblies 20 and 22 of the diaphragm actuating means are caused to position the rods 24 and 26 in accordance with the sensed speed and the mechanism 14 is caused to limit the position of the throttle 16 in accordance with the position of the rods 24 and 26 through the lever member 30 and drive member 32 acting on throttle shaft 28.

More specifically the throttle valve 16 is rotatably mounted in the induction passage 34 of a carburetor 36 mounted on the intake manifold 38 of internal combustion engine 17. As shown in FIGURE 1 rotation of the throttle valve 16 in a clockwise direction will open the induction passage 34 of the carburetor 36 and therefore increase the speed of the engine with which the carburetor is associated. Rotation of the throttle valve 16 in a counterclockwise direction will close the throttle valve 16 to reduce the speed of the engine associated therewith.

The hydraulic control means 10 includes a speed sensing unit 40, a hydraulic fluid supply tank 41 and a gear pump 42 for pumping hydraulic fluid from the tank 41 to the speed sensing unit 40 through conduit 44 and to

the diaphragm assembly 22 through conduit 46. The hydraulic fluid, fluid supply tank and pump could in a specific system be motor oil, an engine crankcase and engine oil pump respectively. A bypass conduit 48 is provided between the outlet conduit 50 of the pump 42 and the pump inlet conduit 52 from the hydraulic fluid supply tank 41 in which is positioned a constant pressure relief valve 54 so that the hydraulic fluid delivered to conduits 44 and 46 through conduit 50 from pump 42 is always at a constant predetermined pressure P_1.

Hydraulic conduits 56 and 58 are connected between the speed sensing unit 40 and the hydraulic fluid supply tank 41 and between the hydraulic speed sensing unit 40 and the diaphragm assembly 20 respectively, as illustrated. The conduits 60 and 62 having the restrictions 64 and 66, respectively, therein and extending between the diaphragm assemblies 20 and 22 and between the hydraulic fluid supply tank 41 and the diaphragm assemblies 20, respectively, are also included in the hydraulic control means 10.

The hydraulic speed sensing unit 40 comprises a generally stationary outer housing 68 having a chamber 70 therein and a passage 72 extending therethrough. A shaft 74 rotatable at the speed of the engine to be governed or some function of the speed of the engine is supported within the passage 72 by means of bearings 76. An axial passage 78 through the shaft 74 is in communication at end 80 thereof with an annular passage 82 in housing 68 in which the conduit 44 terminates. Passage 78 is in communication at the other end thereof with the conduit 58. A hollow cross arm 84 is provided on shaft 74 within the chamber 70 and includes therein a valve member 86 positionable within the passage 88 of the cross arm 84 in accordance with the speed of rotation of shaft 74 due to centrifugal force acting thereon. The spring 90 is provided to urge the valve member 86 to the left, as shown in FIGURE 1, into engagement with the adjustable abutment 92.

In operation on rotation of shaft 74 at a speed determined by the adjustment of the abutment 92 and the compression in the spring 90 due to adjustment of abutment 94 centrifugal force acting on the valve member 86 will cause the valve to move to the right, as illustrated in FIGURE 1, in opposition to the bias of the spring 90 to restrict the passage 78 through the shaft 74. The passages 96 and 98 through the valve 86 prevent locking of the valve 86 in a predetermined position due to trapped hydraulic fluid.

Thus it will be seen that after the speed has been reached at which the valve 86 partially closes the passage 78 through the shaft 74 that the pressure in conduit 58 will be at some lower pressure P_2 than the pressure P_1 in the conduit 44. Further this pressure difference will be proportional to the restriction of the passage 78 by the valve 86 and therefore will be proportional to the speed of rotation of shaft 74.

The diaphragm assembly 22 of the diaphragm actuating means 12 comprises the separate housing members 100 and 102 which may be generally circular in transverse cross section and which have the circular diaphragm 104 clamped therebetween. Rod 26 is secured to diaphragm 104 by conventional means such as plates 106 and 108 at end 110 and is pivoted to the lever member 30 at the end 112 by pivot means 114.

Opening 116 is provided in housing member 102 into which conduit 46 is connected so that chamber 118 formed by the housing member 102 and diaphragm 104 has pressure P_1 therein at any time pump 42 is operating. Opening 120 is also provided in the housing 102 into which restricted conduit 60 is connected. As previously indicated restricted conduit 60 connects chamber 118 to chamber 136 to prevent trapping of air in chamber 118.

The diaphragm assembly 20 is similar to the diaphragm assembly 22 as regards the housing members 124 and 126 and the diaphragm 128 and rod 24. The diaphragm

assembly 20 is however also provided with a spring 132 operable between the mounting plate 134 for rod 24 and housing member 126 to urge the rod 24 to the left, as shown in FIGURE 1, at any time the pressure differential across the diaphragm 128 plus the bias of the spring 132 is greater than the pressure differential across the diaphragm 104 and the frictional resistance to movement of the rods 24 and 26 offered by the pivot pin 114 and the pivotally mounted lever 30 to which the pivot pin 114 is secured.

The openings 130, 138 and 140 are provided in the housing member 126 of the diaphragm assembly 20 for connecting the conduits 60, 58 and 62, respectively, into chamber 136.

The mechanical apparatus 14 for positioning the throttle 16 comprises the lever member 30 pivotally mounted on the throttle shaft 28 for rotation by the rods 24 and 26 and drive member 32 rigidly secured to the throttle shaft 28. Lever member 30 as illustrated is provided with the abutment 142 which in operation is engageable with a similar abutment 144 on the drive member 32 on counterclockwise rotation of the lever member 30. Counterclockwise rotation of lever member 30 thus causes rotation of throttle 16 in a closed direction while clockwise rotation of the lever member 30 causes the abutments 142 and 144 to separate and does not effect the positioning of the throttle 16 at speeds below governing speed at which time the throttle is controlled by the drive member 146 and lever 148 at the opposite end of throttle shaft 28.

Drive member 146 is rigidly secured to shaft 28 for rotation therewith and is biased by means of spring 150 in a clockwise direction to cause opening of throttle 16. Lever 148 is pivotally mounted on shaft 28 and is provided with abutment 152 engageable with a similar abutment 154 on drive member 146 on counterclockwise rotation of lever 148. The manual throttle linkage 156 is pivotally secured to lever 148 to position the lever 148 in opposition to the bias of spring 158 to regulate the opening of the throttle 16 by spring 150 at speeds below governing speed. Spring 150 is lighter than spring 158 so that the throttle 16 is biased in a closed direction and must be opened manually through linkage 156. At governing speed the counterclockwise rotation of throttle shaft 28 by drive member 32 engaged with lever 30 causes closing of the throttle 16 in opposition to spring 150 and consequent separation of abutments 154 and 152.

In over-all operation of the governor it will be assumed that the governor governs the speed of the engine 17 through control of the position of the throttle 16 and that initially the engine is operating at a speed below the governed speed thereof. At this time the pump 42 will be operating so that pressure P_1 is present in conduit 50. The shaft 74 is rotated at the speed of the engine, however the valve 86 is in its leftward limiting position as illustrated due to the bias applied thereto by the spring 90. The pressure in conduit 46 and therefore in chamber 118 of diaphragm assembly 22 and the pressure in conduit 44, passage 78, conduit 58, and therefore in chamber 136 of diaphragm assembly 20 is the pressure P_1 in conduit 50.

Since the chambers 160 and 162 on the other side of the diaphragms 104 and 128 from the chambers 118 and 136 respectively are open to atmosphere the rods 24 and 26 are at this time in a leftward limiting position due to the bias of spring 132. Lever 30 is therefore in a fully clockwise position and abutments 142 and 144 are disengaged. No governing action is therefore present at this time.

The speed of the engine is at this time controlled by the manual linkage 156, pivoting lever 148 in a clockwise direction against the bias of spring 158 whereby the weaker spring 150 is permitted to rotate the drive member 146 and the shaft 28 until the abutments 154 and 152 are in engagement. Thus in the usual manner below governed

speed the throttle valve 16 is positioned in accordance with the position of a manually actuated linkage 156.

At the speed at which governing is initiated the centrifugal force developed on rotation of shaft 74 at this speed causes movement of the valve 86 to the right in FIGURE 1 in opposition to the bias applied to valve 86 by spring 90 so that the valve 86 restricts the passage 78. Restriction of the passage 78 produces the lower pressure P_2 in conduit 58 and therefore in chamber 136. Pressure P_1 is still maintained in chamber 118 however since the restriction 64 in conduit 60 connecting chambers 118 and 136 is very small. Thus as the speed of the engine approaches governed speed the pressure differential across the diaphragm 104 is sufficiently larger than the pressure differential across the diaphragm 128 to cause movement of the diaphragms and the rods 24 and 26 connected thereto to the right in FIGURE 1.

As previously indicated movement of the rods 24 and 26 to the right in FIGURE 1 causes counterclockwise rotation of lever member 30 so that the abutments 142 and 144 on the lever member 30 and drive member 32 respectively engage. Engagement of the abutments 142 and 144 will cause counterclockwise movement of throttle 16 through shaft 28 on subsequent counterclockwise rotation of the lever member 30. Such counterclockwise movement of the throttle 16 will of course cause disengagement of the drive member 146 and the lever 148 so that engine speed will now be under the control of the governing mechanism. As the engine speed increases to the governed speed of the engine rotation of the shaft 74 increases and the restriction of passage 78 is more pronounced so that pressure P_2 is related to pressure P_1 to position the rods 24 and 26 and lever member 30 so that the throttle 16 is permitted to open only far enough to sustain the governed engine speed.

The conduit 60, as previously mentioned, is provided only as a means for bleeding any air trapped in chamber 118 back to the hydraulic fluid supply tank 40 and therefore the restriction 64 in the conduit 60 may be extremely small and will have little effect on the pressure differential between chambers 118 and 136 in the above indicated operation. In fact, as is shown in FIGURE 2, the conduit 62 may be connected directly back to the hydraulic fluid supply tank 41 in a modified embodiment of the invention with the operation of the governor being the same as described above. Air which may be trapped in chamber 136 is removed through the outlet conduit 62 having restriction 66 therein connected as shown. Conduit 62 also permits flow of hydraulic fluid through the chamber 136 which is necessary to create the pressure difference between P_1 and P_2.

The governing action after the speed at which governing is initiated is reached may be controlled by varying the force exerted on diaphargm 128 by the spring 132 if desired. Thus as illustrated in FIGURE 3 the diaphragm assembly 20 may be provided with a movable abutment 164 against which end 166 of spring 132 is positioned. The speed at which governing action is initiated may be controlled by the variable abutment 94 against which spring 90 of the speed sensing unit 10 is positioned in conjunction with variable positioning of the adjustable abutment 92.

Thus it will be seen that in accordance with the invention there is provided a simple efficient hydraulically controlled diaphragm actuated mechanical apparatus for positioning a speed control member. While one complete embodiment of the hydraulic governor of the invention has been disclosed and modifications thereof indicated, it will be understood that other modifications thereof are contemplated and are intended to be included within the scope of the invention.

The drawings and the foregoing specification constitute a description of the improved hydraulic speed governor in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What we claim as our invention is:

1. A governor for an internal combustion engine or similar device having a speed control member such as a throttle mounted on a rotatable shaft, comprising first mechanism for positioning the speed control member at speeds above a predetermined speed including a first drive member rigidly secured to one end of the shaft and having an abutment thereon extending axially outwardly of the shaft, and a first lever member pivotally mounted on the one end of the shaft and having an abutment thereon extending axially inwardly of the shaft and overlapping the abutment on the drive member, said abutments being engageable on rotation of said first lever in a direction to cause closing of the throttle, said governor further including second mechanism for positioning the speed control member at speeds below the predetermined speed including a second drive member rigidly secured to the other end of the shaft and having an axially outwardly extending abutment thereon, a second lever member pivotally mounted on the other end of the shaft and having an abutment thereon extending axially inwardly of the shaft and overlapping the abutment on the second drive member, said abutments on the second members being engageable on rotation of said second drive member in a direction to cause opening of the throttle, means pivotally secured to the second lever member for applying a pivotal force thereto, bias means secured to said second lever member urging the second lever member in a direction to engage the abutment thereon with the abutment on the second drive member and cause closing of the speed control member and second bias means weaker than the first bias means urging the second drive member in a direction to open the throttle, diaphragm actuating means operably associated with said first mechanism for pivoting the first lever member in accordance with a difference in hydraulic pressure applied thereacross and hydraulic control means operably associated with said diaphragm actuating means for regulating the hydraulic pressure differential applied to the actuating means in accordance with the speed of the device.

2. Structure as set forth in claim 1 wherein the diaphragm actuating means comprises a pair of separate housings, each including two parts, a diaphragm clamped between the two parts of each housing forming a pressure chamber with one of the two parts and an actuating rod secured to each of the diaphragms at one end and pivotally connected in opposition to each other and to the first lever member at the other end and means for applying the pressure difference between the two pressure chambers.

3. Structure as set forth in claim 2 and further including a restricted conduit connecting the pressure chambers and a restricted conduit extending from one of the pressure chambers to the hydraulic control means.

4. Structure as set forth in claim 2 and further including a separate restricted conduit extending between each of the pressure chambers and the hydraulic control means.

5. Structure as set forth in claim 2 wherein resilient means are provided acting between one of the housings and the diaphragm therein for urging the piston rod connected thereto in a direction to pivot the first lever member to close the throttle valve.

6. Structure as set forth in claim 5 wherein an adjustable plug is provided in the one housing in contact with said resilient means for varying the bias applied to the diaphragm in the one housing by the resilient means.

7. Structure as set forth in claim 2 wherein the hydraulic control means includes a hydraulic fluid supply tank, a centrifugal speed sense including an outer housing and an inner rotor mounted for rotation within the outer housing having an axially extending passage therethrough and centrifugal valve means within said passage for restrict-

ing the passage in accordance with the speed of rotation of the rotor, constant pressure pump means positioned between the hydraulic fluid supply tank and the hydraulic actuating means operable to provide fluid at a substantially constant pressure in the pressure chamber in one of said housings in the hydraulic actuating means and at one end of the axial passage in the rotor in the hydraulic speed sense and means connecting the other end of the axial passage in the rotor in the hydraulic speed sense to the other pressure chamber in the other housing of the hydraulic actuating means whereby a difference in hydraulic pressure is provided in the pressure chambers in accordance with the speed of rotation of said rotor.

8. Structure as set forth in claim 7 and further including means for varying the speed at which the valve means starts to restrict the passage through said rotor.

9. Structure as set forth in claim 8 wherein the means for varying the speed at which the valve means starts to restrict the passage through said rotor comprises an adjustable stop engaged with the valve member, resilient means engaged with said valve member urging it into engagement with the adjustable stop and an adjustable seat for said resilient means.

10. A governor for an internal combustion engine or similar device having a speed control member such as a throttle, comprising mechanism for positioning the speed control member at speeds above a predetermined speed, diaphragm actuating means operably associated with said mechanism for adjusting the mechanism in accordance with a difference between hydraulic pressures applied thereto including a pair of housings, each including two parts and having a diaphragm clamped therebetween forming a pressure chamber between the diaphragm and one part of the housing and a piston rod secured to the diaphragm and connected to the mechanism for positioning the speed control member and hydraulic control means operably associated with said diaphragm actuating means for regulating the hydraulic pressure difference applied to the actuating means in accordance with the speed of the device including a hydraulic fluid supply tank and a restricted exhaust passage extending between one of said pressure chambers of the diaphragm actuating means to the hydraulic fluid supply tank and a restricted conduit connecting the pressure

chambers formed in the housings of the diaphragm actuating means.

11. A governor for an internal combustion engine or similar device having a speed control member such as a throttle, comprising mechanism for positioning the speed control member at speeds above a predetermined speed, diaphragm actuating means operably associated with said mechanism for adjusting the mechanism in accordance with a difference between hydraulic pressures applied thereto including a pair of housings, each including two parts and having a diaphragm clamped therebetween forming a pressure chamber between the diaphragm and one part of the housing and a piston rod secured to the diaphragm and connected to the mechanism for positioning the speed control member and hydraulic control means operably associated with said diaphragm actuating means for regulating the hydraulic pressure differential applied to the actuating means in accordance with the speed of the device including a hydraulic fluid supply tank and a separate restricted exhaust passage extending between each of said pressure chambers of the diaphragm actuating means and the hydraulic fluid supply tank.

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