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2,969,076

ENGINE SPEED CONTROL SYSTEM

Filed June 23, 1958

FIG. 1.

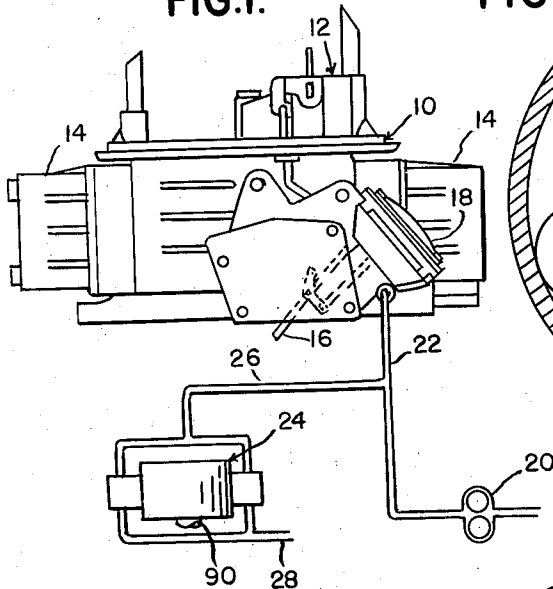


FIG. 6.

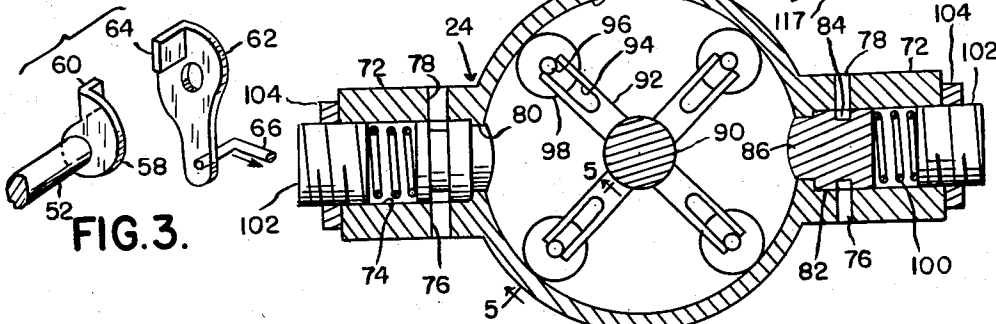
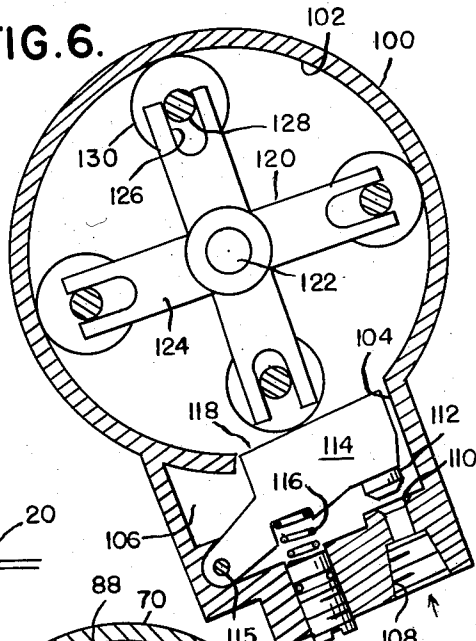


FIG. 3.

FIG. 2.

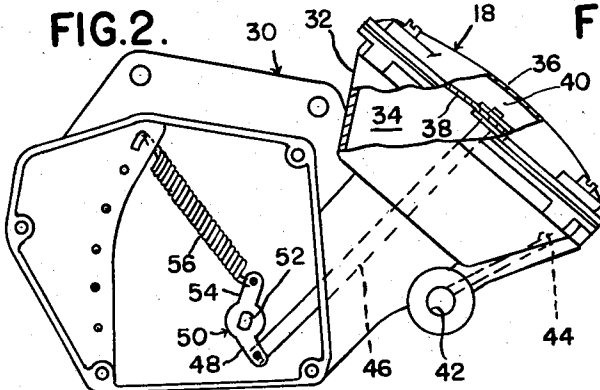


FIG. 4.

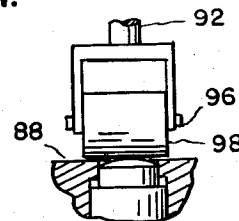


FIG. 5.

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ENGINE SPEED CONTROL SYSTEM

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The present invention relates to an engine speed control system, and more particularly to a speed responsive bypass valve for use in the system.

It is an object of the present invention to provide a speed control system responsive selectively to engine speed or to a condition which is in turn dependent on engine speed such for example as road speed, including a fluid motor, a pump for supplying hydraulic pressure to the motor, and a speed responsive bypass valve for bypassing fluid to render the motor inoperative below a predetermined speed.

More specifically, it is an object of the present invention to provide a speed responsive bypass valve comprising a housing, a centrifugal element rotatable in said housing about an axis and movable radially toward and away from the aforesaid axis, and valve means including a movable valve element having a portion normally projected within the path of movement of said centrifugal element and movable radially of its axis of rotation, yieldable means urging said valve element radially inwardly, said centrifugal element being operable upon attainment of sufficient centrifugal force to overcome said means and to move said valve element radially outwardly toward a closed position.

It is a further object of the present invention to provide a speed responsive bypass valve as described in the preceding paragraph in which a plurality of centrifugal elements are provided in order to impart a multiplicity of closely spaced impulses to said valve element.

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

Figure 1 is a diagrammatic view of a speed control system for an internal combustion engine of a vehicle.

Figure 2 is an enlarged fragmentary view with parts broken away, of the connection between the throttle control motor and the throttle.

Figure 3 is an exploded view showing the connections between the operator controlled throttle actuating member and the throttle shaft.

Figure 4 is a transverse sectional view through the speed responsive bypass valve.

Figure 5 is a section on the line 5—5, Figure 4.

Figure 6 is a sectional view similar to Figure 4 of another embodiment of the invention.

Referring first to Figure 1 there is shown a carburetor 10 for an internal combustion engine of a vehicle. The carburetor as shown is of the dual type having a primary barrel with an inlet 12 and a secondary barrel at the left

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side of the figure. Each of the barrels is provided with its own bowl 14. The present invention relates to the control of the usual throttle plate which is shown in the figure at 16, and the position of this plate is controlled by a hydraulic motor 18 as will subsequently appear.

Hydraulic fluid is supplied to the system by a pump 20 which may be the usual pump for lubricating oil for the engine, or if preferred may be a separate pump with its own supply of hydraulic fluid. Hydraulic fluid under pressure is discharged from the pump 20 and the outlet of the pump is connected by an external passage or conduit 22 with the motor 18. A speed responsive bypass valve device indicated generally at 24 is provided, this valve being connected to the conduit 22 by a conduit 26 which branches and passes to two separate valves as will subsequently appear. Fluid passing through these valves enters branches which unite to form a return conduit 28 through which the fluid returns to the crankcase or a sump from which oil is drawn by the pump 20. In any case, when the bypass valves in the valve device 24 are open pressure is prevented from building up in the motor 18 and the motor is in effect inoperative.

Referring now to Figure 2 there is shown an enlargement of the motor 18 which comprises a casing 30 including a portion 32 defining a chamber 34 which is open at one end. Associated with the chamber 34 is a removable domed cover 36 which is adapted to clamp the edge of a flexible diaphragm 38 to the edge of the casing portion 32. The space indicated at 40 between the flexible diaphragm 38 and the domed cover 36 is thus an expandible chamber having a wall 38 movable in response to changes in actuating pressure within the chamber.

The motor 18 includes a port 42 connected by an internal passage indicated at 44 to the interior of the chamber 40. The port 42 as illustrated in Figure 1, is adapted to be connected to the conduit 22.

The flexible diaphragm 38 has one end of an actuating rod 46 connected thereto, the other end of the rod being connected to an arm 48 of a bell crank lever 50 which is keyed or otherwise secured to a shaft 52 to which the throttle plate 16 is fixedly secured. The bell crank lever 48 has a second arm 54 to which is connected a tension spring 56 urging the throttle shaft 52 in a counterclockwise direction as seen in Figure 2. It will be observed from Figure 1 that the throttle plate 16 is connected to the shaft in such a way that counterclockwise rotation of the shaft results in opening movement of the throttle plate.

Inasmuch as the throttle plate is under the joint control of the vehicle operator and the speed control system disclosed herein, means are required to prevent interference between the manual system and the automatic system. This means includes the structure shown in Figure 3 where the throttle shaft 52 is shown as provided with a fixed member 58 having an offset ear 60. A manual operating lever 62 is pivoted to the shaft 52 and includes an offset ear 64 which is adapted to engage against the rear side of the ear 60 as seen in Figure 3, so as to prevent counterclockwise rotation of the shaft 52 or in other words, to prevent opening movement of the throttle plate under influence of the tension spring 56. The lever 62 has an actuating link 66 connected thereto adapted to be moved in the direction of the arrow upon downward movement of the usual accelerator pedal. It will be understood that this movement of the link 66 causes the ear 64 to tend to move away from the ear 60. However,

the tension spring 56 causes corresponding rotation of the throttle shaft 52 and hence, the ear 60 moves with the ear 64 an amount determined by the amount of depression of the accelerator pedal. When the accelerator pedal is released the ear 64 forces the ear 60 to move in a clockwise direction, thus closing the throttle. This movement is under the influence of the usual spring means associated with the accelerator pedal.

If the accelerator pedal is fully or partially depressed and governed speed is reached, the development of pressure as will subsequently be described, in the chamber 40 causes clockwise rotation of the throttle shaft 52 which rotation results in corresponding movement of the throttle plate. This movement is permitted since at this time the ear 60 merely moves away from the ear 64 and it is thus only necessary for the motor 18 to overcome the tension of the spring 56.

Referring now to Figures 4 and 5 the speed responsive bypass valve comprises a housing 70 having a cylindrical wall provided at opposite sides with tubular extensions 72 each of which forms an internal valve cylinder 74 provided with aligned valve ports 76 and 78. Ports 76 and 78 are respectively connected to the branches of conduits 23 and 26. Valve cylinders 74 are provided at their inner ends with radially inwardly extending short flanges 80 which constitute abutments for valve elements 82.

The valve elements 82 are of the piston type slidable longitudinally in the valve cylinder 74 and are each provided with an intermediate reduced portion 84 adapted to be in alignment with the valve ports 76 and 78 when the valve element 82 is in a limiting position. The inner ends of the valve elements 82 are formed as reduced cam portions 86 which extend past the flanges 80 into the interior of the housing 70 and radially inwardly beyond the inner cylindrical surface 88 of the wall of the housing 70.

Extending into an end of the cylindrical portion of the housing 70 is a rotary drive shaft 90. The drive shaft connects to a drive member which is rotated at a speed dependent on engine speed. If desired, the drive member may rotate at a speed variable directly with engine speed such for example as the distributor drive shaft which rotates at one-half engine speed. Alternatively, the drive means may rotate at a speed which varies directly with the road speed of the vehicle such for example as a shaft at the output end of the transmission. Located within the cylindrical portion of the housing 70 and connected to the shaft 90 is a carrier comprising a plurality of radially extending arms 92 each of which is slotted as indicated at 94 for the reception of the pin 96 of a roller 98. The rollers 98 are centrifugal weights and as the shaft 90 rotates the rollers 98 are forced against the inner cylindrical surface 88 with a force variable in accordance with shaft speed.

The valve elements 82 are urged inwardly to the valve open position shown in Figure 4 by compression springs 100, the effectiveness of which is adjustable by a threaded plug 102 received in the threaded outer end of the valve cylinder 74. The plugs 102 are retained in adjusted position by lock nuts 104.

The cam portions 86 of the valve elements 82 extend radially inwardly beyond the inner surface 88 of the housing 70 and are engaged by each of the rollers 98 as they move past the valve elements. It will be apparent that if the compression of the spring 100 represents a force greater than the centrifugal force of the rollers 98, disregarding the inertial impact of the rollers on the cams, the rollers will be caused to move radially inwardly of the slots 94 as they traverse the cam portions of the valve. However, as the speed of rotation of the shaft 90 increases, so also does the centrifugal force applied by the rollers 98 to the cam portions 86 of the valve elements. Accordingly, at some speed which is predetermined by the adjustment of the spring seat plugs 102, the valve elements 82 move toward closed position.

It will be observed that each of the valve elements 82 is subjected to a series of impulses by the plurality of rollers 98, the frequency and magnitude of the impulses being a direct function of shaft speed. At high shaft speed, the magnitude of the impulses is sufficient to depress the cam portions 86 of the valve elements 82 fully and the frequency of these impulses is sufficiently great so that the valve is effectively maintained in closed position.

It will further be observed that the rollers 98 are arranged in pairs with the rollers of each pair being located diametrically with respect to the axis of the shaft 90. Thus, the forces applied to the rollers and through the rollers to the carrier including the arms 92 by the valve elements 82 are balanced.

Referring now to Figure 6, there is shown a somewhat different embodiment of the invention which however operates in accordance with the principles previously outlined. In this embodiment of the invention the bypass valve comprises a casing 100 the major portion of which is cylindrical and provides a chamber 102 the inner lateral wall of which is cylindrical except for an opening as indicated at 104 leading to a valve chamber 106.

The valve shown in Figure 6 is an air bleed valve and the valve chamber 106 is provided with a tapped opening 108 for connection to a vacuum line extending from a source of partial vacuum such for example as the engine manifold and the throttle adjusting motor 18. It will of course be understood that where the motor 18 is actuated by partial vacuum rather than hydraulic pressure, it is necessary to reverse the direction of the lever arm 48 with reference to the throttle shaft.

The tapped opening 108 communicates with a reduced passage extending to a valve seat 110 which cooperates with a valve element 112 carried by a cam block 114 which in turn is pivoted within the valve chamber as indicated at 115. The cam block 114 is urged outwardly by a compression spring 116, the effectiveness of which is adjustable by means of a threaded spring seat 117. The inner surface 118 of the cam block 114 is located in the opening 104 and extends inwardly beyond the extension of the cylindrical inner surface of the chamber 102. The inner surface 118 of the cam block 114 is shown in Figure 6 as being a flat surface but it may be given a different contour as required for a particular operational characteristic.

Mounted for rotation within the chamber 102 is a frame 120, illustrated as mounted on a rotary shaft 122 and provided with a plurality of radially extending arms 124. Each of the arms 124 at its outer end is provided with a radially elongated slot 126 in which are received axially extending shafts 128 connected to rollers 130. The rollers 130 are of substantial mass and develop forces acting radially outwardly against the inner surface of the chamber 102 due to centrifugal action. As each of the rollers 130 traverses the opening 104, it contacts the surface 118 of the block 114 and urges the block radially outwardly against the action of the compression spring 116. At low speeds, the effectiveness of the spring is sufficient to prevent substantial inward movement of the block and hence, of the bleed valve element 112. However, as the speed increases, so does the centrifugal force developed by the rollers 130 which eventually apply sufficient forces to the block 114 to close the valve 112.

As in the embodiment of the invention previously described, it will be observed that the rollers operate to apply a series of impulses the magnitude and frequency of which varies in accordance with the speed of the engine.

The interior of the casing 100 is vented to atmosphere and hence it is unnecessary to provide seals for the shaft 122.

In operation, air bled past the valve 112 prevents the

manifold vacuum from being effective to move the throttle plate 16 toward closed position. However, as governed speed is approached, the valve element 112 moves towards its seat 110 thus reducing the flow of bleed air and permitting manifold vacuum to become effective within the chamber 40 of the motor 18.

The drawing and the foregoing specification constitute a description of the improved engine speed control system 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 I claim as my invention is:

1. A speed responsive valve device comprising a stationary valve housing having a fluid passage therein, a rotary carrier, a centrifugal weight movable radially of said carrier, a valve element movable radially of said carrier in said valve housing to control said passage, said valve element having a cam portion extending into the path of movement of said weight to apply a force tending to move said weight radially inwardly and to receive an impulse from said weight tending to move said element radially outwardly, and resilient means urging said element inwardly.

2. A speed responsive valve device comprising a housing of circular cross-section, a rotary carrier in said housing, centrifugal weights mounted on said carrier for rotation therewith and movement radially thereof, valve structure comprising a valve port at a side of said housing and a valve element movable radially of said housing to open and close said port, said element having a cam portion extending within said housing in the path of said weights, and a spring urging said element radially inwardly.

3. A speed responsive valve device comprising a housing of circular cross-section, a rotary carrier in said housing, centrifugal weights mounted on said carrier for rotation therewith and movement radially thereof, valve structure comprising a pair of valve ports at opposite sides of said housing and valve elements movable radially of said housing to open and close said ports, said elements having cam portions extending within said housing in the path of said weights, and springs urging said elements radially inwardly.

4. A speed responsive bypass valve device comprising a housing having a cylindrical side wall, a rotary carrier in said housing having an axis of rotation coincident with the axis of said side wall, said carrier comprising a plurality of axially slotted arms, centrifugal weights in the form of rollers having pivot pins slidable in said slots, said rollers being normally engageable under centrifugal action with said side wall, a valve comprising a valve port located at a side of said housing and a valve element movable radially of said housing, said element having a cam portion which in one limiting position of said valve projects inwardly of the side wall into the path of movement of said rollers, and spring means urging said valve element inwardly of said housing.

5. A device as defined in claim 4 in which there are provided a pair of valves diametrically opposite each other on said housing.

6. A device as defined in claim 5 in which said slotted arms are arranged in diametrically extending pairs so that forces applied to said carrier and rollers by said valve elements are balanced.

7. A device as defined in claim 4 in which said valve element is a piston type element movable in a valve cylinder and having a reduced intermediate portion, and said port is located in a side of said valve cylinder.

8. A device as defined in claim 7 in which a pair of valve ports are provided in alignment in said valve cylinder to be connected together when the reduced portion of the valve element is in alignment therewith.

9. A speed responsive valve including a stationary valve housing having a fluid passage therein, and a

movable valve element movable in said housing to control said passage and having a limiting position, resilient means urging said valve element toward its limiting position, and speed responsive means operable to apply a series of separated impulses to said valve element in a direction to move said valve element against said resilient means, the frequency of said impulses being a function of the speed to which said valve is responsive.

10. A speed responsive valve including a stationary valve housing having a fluid passage therein, and a movable valve element movable in said housing to control said passage and having a limiting position, resilient means urging said valve element toward its limiting position, and speed responsive means operable to apply a series of separated impulses to said valve element in a direction to move said valve element against said resilient means, the magnitude of said impulses being a function of the speed to which said valve is responsive.

11. A speed responsive valve including a stationary valve housing having a fluid passage therein, and a movable valve element movable in said housing to control said passage and having a limiting position, resilient means urging said valve element toward its limiting position, and speed responsive means operable to apply a series of separated impulses to said valve element in a direction to move said valve element against said resilient means, the magnitude and frequency of said impulses being a function of the speed to which said valve is responsive.

12. A speed responsive valve comprising a ported sleeve, a valve element movable longitudinally in said sleeve, resilient means urging said valve element towards a limiting position, and speed responsive means operable to apply a series of separated impulses to said valve element in a direction to move said valve element against said resilient means, the magnitude and frequency of said impulses being a function of the speed to which said valve is responsive.

13. A speed responsive valve comprising a valve chamber having a valve seat therein, a valve element pivoted within said chamber and movable toward and away from said valve seat, resilient means acting on said valve element tending to move said valve element to a limiting position, and speed responsive means operable to apply a series of impulses to said valve element in a direction to move said valve element against said resilient means, the magnitude and frequency of said impulses being a function of the speed to which said valve is responsive.

14. A speed responsive valve device comprising a rotary carrier, a plurality of circumferentially separated radially movable centrifugal weights mounted on said carrier, means limiting radial outward movement of said weights, valve structure comprising a stationary valve housing, a valve element movable in said housing radially of said rotary carrier and having a limiting position, resilient means engageable with said movable valve element normally retaining said valve element in said limiting position, said valve element having a portion which when said valve element is in said limiting position extends into the path of movement of said centrifugal weights so as to be engageable thereby, said weights being spaced apart circumferentially by a distance such that only one of said centrifugal weights is engageable with said valve element at one time.

15. A speed responsive valve device comprising a main housing of internal circular cross-section, a rotary carrier in said housing, centrifugal weights mounted on said carrier for rotation therewith and for movement radially thereof, said weights being normally engageable with the internal circular surface of said housing, valve structure comprising a stationary valve housing at one side of said main housing, a valve element movable in said valve housing radially of said rotatable carrier and including a portion extending inwardly of said main housing to a position in which it is engageable by said centrifugal

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weights, and resilient means opposing radial outward movement of said valve element.

16. A speed responsive valve device comprising a main housing of internal circular cross-section, a rotary carrier in said housing, centrifugal weights, guide means extending radially of said carrier connecting said weights to said carrier for movement radially thereof, said weights being normally engageable with the internal circular surface of said housing, valve structure comprising a stationary valve housing at one side of said main housing, a valve element movable in said valve housing radially of said rotatable carrier and including a portion extending inwardly of said main housing to a position in which

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it is engageable by said centrifugal weights, and resilient means opposing radial outward movement of said valve element.

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