Sept. 8, 1942. J. M. WEYDELL 2,295,147

SPEED GOVERNOR

Filed Jan. 12, 1939 2 Sheets-Sheet 1

Fig. 1.

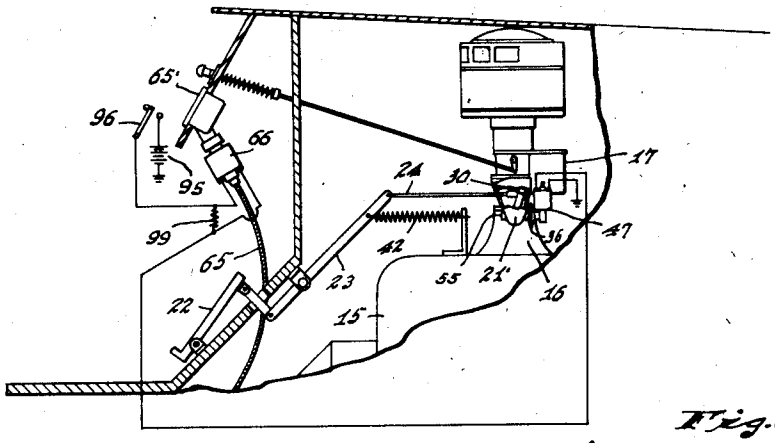


Fig. 5.

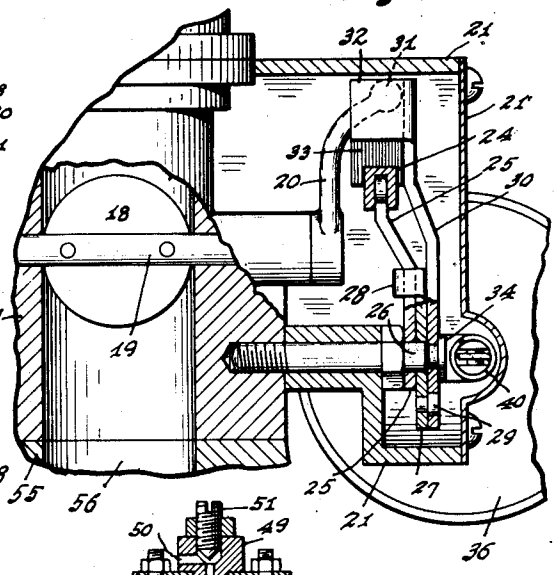


Fig. 8.

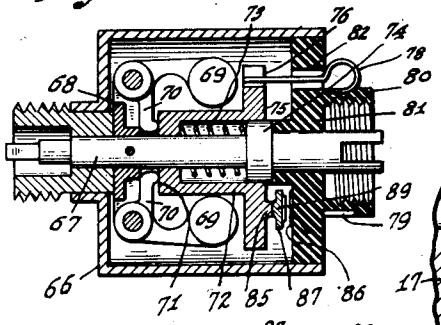


Fig. 9.

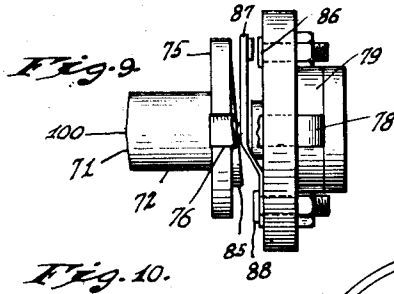


Fig. 10.

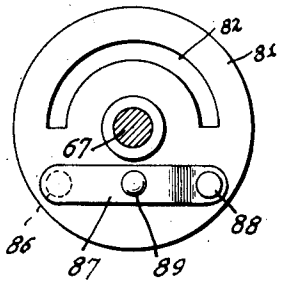
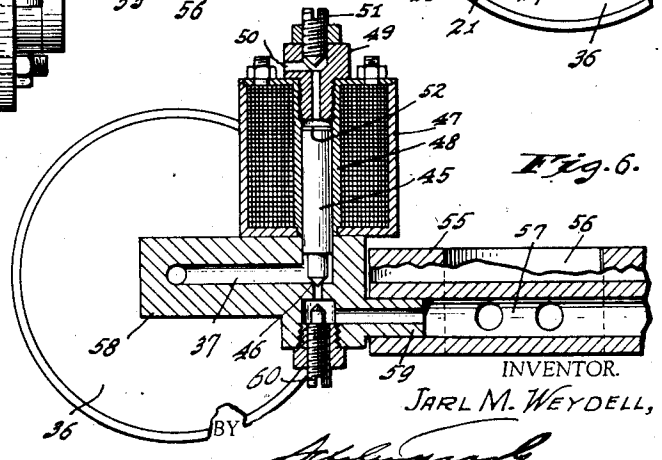


Fig. 6.



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Sept. 8, 1942. J. M. WEYDELL 2,295,147

SPEED GOVERNOR

Filed Jan. 12, 1939 2 Sheets-Sheet 2

Fig. 2.

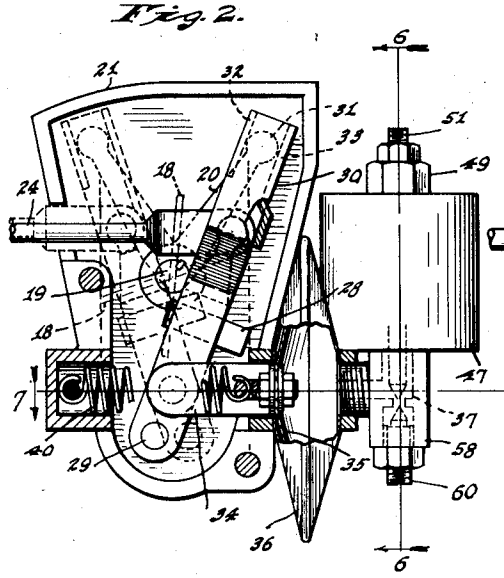


Fig. 3.

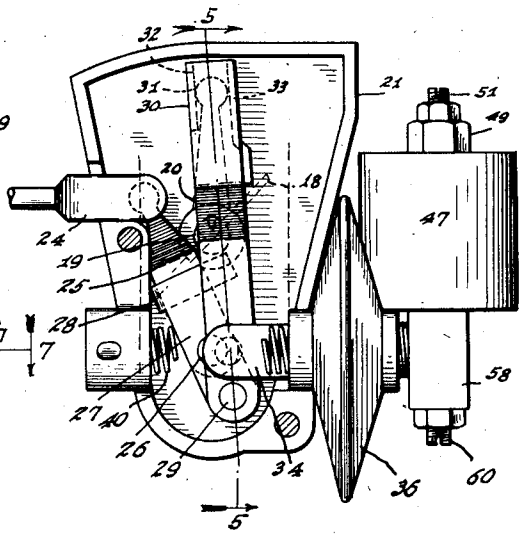


Fig. 4.

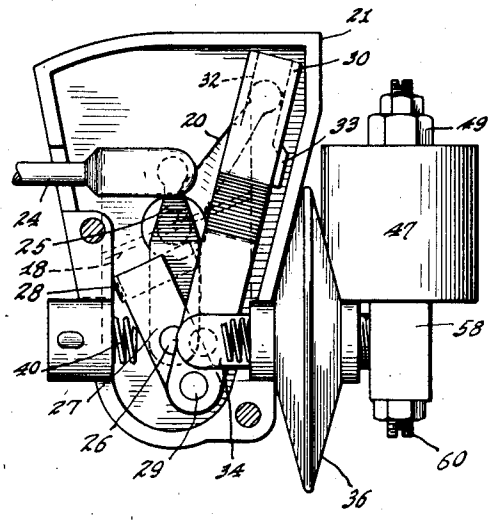
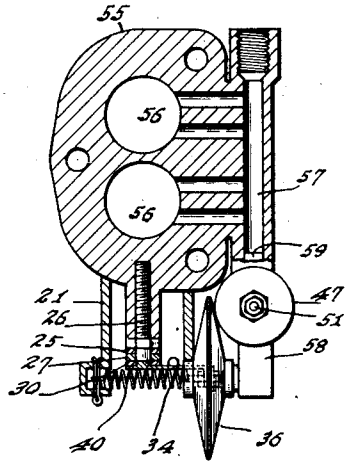


Fig. 7.



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UNITED STATES PATENT OFFICE

2,295,147

SPEED GOVERNOR

Jarl M. Weydell, Indianapolis, Ind., assignor of one-half to Edward E. Stout, Indianapolis, Ind.

Application January 12, 1939, Serial No. 250,509

10 Claims. (Cl. 137—140)

My invention relates to speed governors for throttle-controlled engines such, for example, as internal combustion engines. It is the object of my invention to produce a speed governor which will be sensitive to slight speed variations and which, therefore, will control speed with great accuracy. A further object of my invention is to produce a governor which will perform its governing action gradually so as not to interfere with operation of the engine at the maximum speed which the governor permits. Still another object of my invention is to produce a governor which can readily be incorporated in an automobile.

The precise form taken by my invention will depend to an extent upon the situation in which it is to be used. Some phases of the invention relate to means for controlling a throttle both manually and by speed-responsive mechanism; but in certain of its broader aspects the invention is not limited to situations where a single throttle is both manually and automatically controlled and even includes arrangements where no manual control of any kind is imposed on the speed of the engine.

In carrying out my invention in its preferred form automatic control of the engine-throttle is exercised through the medium of a fluid-pressure motor which moves the throttle in one direction against the action of a spring or other yielding means capable of moving the throttle in the other direction when the fluid-pressure motor is inoperative. The operation of the fluid-pressure motor is controlled by mechanism which is responsive to the speed of the engine and which acts, as the limiting speed of the engine is approached, to render the fluid-pressure motor alternately operative and inoperative and to control the relative durations of periods of operativeness and inoperativeness. Each individual period of operativeness or of inoperativeness, until the limiting speed is actually reached, is insufficient in duration to move the throttle through a material fraction of its entire range of movement; and, as a result, control of the throttle is gradually imposed.

Where manual and automatic control are imposed on the same throttle, I control that throttle jointly by speed-responsive mechanism and a manually operated member, the operative connections being such that each of the control elements exercises its throttle-controlling function without imposing any substantial reaction on the other. Conveniently, I employ a floating lever connected at three spaced points to the throttle, to the speed-responsive device, and to the manually operated member respectively; and I make the latter connection of the lost-motion variety so that the speed-responsive mechanism can operate to close the throttle without compelling movement of the manually operated member. In the specific embodiment of the invention herein described, where my invention is used to control the speed of an internal-combustion engine, automatic throttle-control is exercised by a fluid-pressure motor controlled as above described and comprising a pressure-responsive element adapted to be partially exhausted by connection to the intake manifold under the control of a speed-responsive device.

The accompanying drawings illustrate an embodiment of my invention. Fig. 1 is a fragmental view of an automobile showing my speed-governor in association with the engine; Fig. 2 is an elevation of the governor on an enlarged scale showing the condition existing when the speed-responsive mechanism is inoperative; Fig. 3 is a view similar to Fig. 2, but showing the speed responsive mechanism operating to effect a partial closing of the throttle; Fig. 4 is a view similar to Figs. 2 and 3 but showing the throttle completely closed under the influence of the speed-responsive mechanism; Fig. 5 is a vertical section on the line 5—5 of Fig. 3; Fig. 6 is a vertical section on the line 6—6 of Fig. 2; Fig. 7 is a horizontal section on the line 7—7 of Fig. 2; and Figs. 8 to 10 are detail views.

In Fig. 1 of the drawings, I have indicated an automobile engine 15 the manifold 16 of which has associated with it a carburetor 17 of the down-draft type. The carburetor includes a throttle 18 which controls the supply of mixture to the engine and which is mounted on a shaft 19. The throttle shaft projects through the wall of the mixture conduit of the carburetor and has secured to its outer end a control arm 20. The throttle-control arm 20, together with certain parts of the governing mechanism presently to be described, is enclosed and protected by a casing 21 having a removable cover 21' which, in practice, will be sealed in place.

The manual control for the throttle is indicated in Fig. 1 as an accelerator pedal 22 connected through a lever 23 and rod 24 to a swinging arm 25 which is disposed within the casing 21 and mounted for swinging movement on a pivot 26. Also mounted on the pivot 26 is a second arm 27 which has a lost-motion connection with the arm 25. The nature of this connection is such that the arm 25 can swing the arm 27 in a throttle-opening direction but not in a throttle-

closing direction. Conveniently, the connection is effected by providing the arm 27 with an ear 28 which extends through the plane of the arm 25 on the counterclockwise side of such arm.

The arm 27 extends downwardly beyond the pivot 26 and is there pivotally connected by means of a pin 29 to the lower end of a floating member 30 the upper end of which is connected to the throttle-operating arm 20. Conveniently this connection is effected by providing the arm 20 with a ball-end 31 which is received between spaced ears 32 and 33 on the floating member 30.

At a point intermediate its length, the floating member 30 is pivotally connected to a horizontally movable member 34 whose position is controlled by a power-operated device. Desirably, as indicated above, this device is in the form of a fluid-pressure-responsive element shown here as a diaphragm 35 disposed within a casing 36. The space within the casing 36 and on the opposite side of the diaphragm 35 from the member 34 communicates with a passage 37 which is connected to the mixture-intake conduit of the engine at a point between the engine and the throttle 18. This passage, as will be more fully described later, is provided with a speed-responsive valve which opens the passage when the speed of the vehicle reaches or exceeds a predetermined maximum.

The member 34 is normally held outwardly of the casing 36, or to the left in Figs. 2, 3, and 4, by some yielding means, such as the tension spring 40 shown in the drawings. In this position of the member 34, shown in Fig. 2, its axis of pivotal connection to the floating member 30 may be substantially coincident with the axis of the pivot 26, but this is not esential. With the member 34 held to the left, the throttle 18 is under the control of the accelerator pedal 22. With the accelerator pedal elevated, the parts occupy the full-line positions shown in Fig. 2. Depression of the accelerator pedal draws the rod 24 to the left (Fig. 2) and causes the arm 25 to swing in a counterclockwise direction about the pivot 26. Because of the presence of the ear 28, the arm 27 swings with the arm 25, its lower end moving to cause the floating member 30 to swing in a counterclockwise direction about the axis of its pivotal connection to the member 34. As a result of this swinging movement of the floating member 30, the throttle is moved toward open position. Upon complete depression of the accelerator pedal the parts occupy the dotted-line position shown in Fig. 2.

When pressure is removed from the accelerator pedal 22, a spring 42, which conveniently acts between the lever 23 and some stationary point, raises the accelerator pedal, moves the rod 24 to the right, causes the arm 25 to swing in a clockwise direction, and permits the throttle 18 to close. Closing of the throttle may be insured by making the ear 33 on the upper end of the floating member 30 long enough to be engaged by the adjacent end of the rod 24, as shown in Figs. 2 and 4.

When, under the influence of the speed-responsive mechanism, the passage 37 is connected to the intake manifold, the resultant exhaustion of the casing 36 causes the diaphragm 35 therein to move to the right and to move with it the member 34 in opposition to the spring 40. Movement of the member 34 to the right applies to the arm 27 an effort tending to swing it in a counterclockwise direction about the pivot 26 and to the throttle-control arm 20 an effort tending to close the throttle. As a result of the former effort, the upper end of the arm 27 is brought into engagement with the side wall of the casing 21, as shown in Fig. 4; and thereafter the pivot pin 29 occupies a fixed position and acts as a fulcrum about which the floating member 30 is swung by continued movement of the member 34 to close the throttle. Because the connection between the arm 27 and the lever 25 permits the former to swing in a counterclockwise direction relative to the latter, closing of the throttle as a result of exhaustion of the chamber 36 results in no displacement of the link 34 or of the accelerator pedal 22.

The means for controlling exhaustion of the casing 36 conveniently takes the form of an electro-magnetically operated valve. I have shown in the drawings (Fig. 6) a valve member 45 movable vertically toward and away from a valve seat 46 in the passage 37. The body of the valve member 45 is of magnetic material and is disposed within a solenoid 47, the valve-body being guided for vertical movement by a tubular guide member 48. The upper end of the guide member 48 is closed, as by means of a plug 49 through which there extends a passage 50 connecting the interior of the guide member 48 with atmosphere. An adjustable valve 51 in the passage 50 controls its effective area for a purpose to be described later.

The body of the valve member 45 fits rather loosely within the guide 48 to permit the passage of air. Mounted upon the upper end of the valve member 45 is a valve washer 52 positioned, when the valve member 45 is raised, to engage the lower end of the plug 49 and prevent air flow through the passage 50 therein.

In many automotive vehicles, notably trucks and tractors for semi-trailers, the intake manifold is provided with means for facilitating its connection to one or more vacuum lines leading to brake-operating mechanism or other vacuum-operated devices. Such means usually takes the form of a block 55 interposed between the carburetor 17 and the intake manifold 16 and having one or more mixture-conveying passages 56 extending through it. Extending through the block 55 at one side of the mixture passage 56 is another passage 57 which communicates with the passages 56 and the ends of which are adapted for connection to vacuum lines.

I find it convenient to take advantage of the block 55 in mounting the governor and in connecting the casing 36 to the intake manifold. For this purpose, I may mount the casing 36 on a bracket 58 having at its rear a cylindrical extension 59 adapted to enter one end of the passage 57 in the block 55. The passage 37 is formed in the bracket 58 and extends axially through the projection 59 to communicate with the passage 57, as is clear from Fig. 6. In addition to supporting the casing 36 the bracket 58 may also support the solenoid 47. If desired, the passage 37 may be provided with a valve 60 which controls the rate of exhaustion from the casing 36 when the valve 45 is opened.

Parts of the governor, other than the casing 36 and solenoid 47, may also be mounted on the block 55. To this end, the pivot 26 may be in the form of a screw-threaded stud mounted in the block 55 and extending through a portion of the casing 21, as indicated in Fig. 5.

The speed-responsive mechanism, which controls opening and closing of the valve 45, is conveniently operated by the drive shaft 65 which

drives the conventional speedometer 65'. As is clear from Fig. 8, this speed-responsive mechanism comprises a casing 66 adapted at one end for attachment to the speedometer casing and at the other end for attachment to the sheath with which the usual speedometer drive-shaft is enclosed. Mounted axially within the casing is a shaft 67 adapted at one end for connection to the speedometer mechanism and at the other for attachment to the speedometer drive-shaft.

Within the casing 66 there is mounted on the shaft 67 a cross-member 68 to the ends of which fly-weights 69 are pivoted. Fly-weights 69 are provided with inwardly extending arms 70 engaging the end face 71 of a sleeve 72 which is slidable axially on the shaft 67. Yielding means, such as the compression spring 73 acting between the sleeve 72 and a shoulder 74 on the shaft 67, serves to maintain the face 71 of the sleeve 72 in engagement with the arms 70 and therby to bias the fly-weights 69 toward retracted position.

For the purpose of preventing its rotation, the sleeve 72 is provided with an annular flange 75 notched as indicated at 76 for the reception of a finger 78. The finger 78 is carried by a slip ring 79 yieldingly mounted exteriorly of the casing 66 upon a central cylindrical boss 80 provided on a member 81 which closes the end of the casing 66. The finger 78 extends into the casing through an arcuate slot 82 in the closure 81; and, as a result, the angular position of the sleeve 72 about the axis of the casing 66 can be varied. The split spring ring 79 grips the boss 80 with sufficient force to prevent accidental displacement.

The face of the flange 75 is formed with an arcuate rib 85 the outer face of which is helical, as is clear from Fig. 9. The closure 81 is desirably of insulating material and carries a fixed electrical contact 86 and a movable contact 87, the latter desirably taking the form of a strip of resilient material having one end secured to the closure 81 by a bolt 88 and its opposite end free to move into and out of engagement with the fixed contact 86. Intermediate its ends, the movable contact 87 has an offset portion 89 engaging the arcuate rib 85 on the sleeve 72.

The solenoid 47 is connected to a battery 95 or other source of electrical energy through the contacts 86 and 87, and desirably also through the ignition switch 96 of the automobile. As long as the speed of the vehicle is below that necessary to cause engagement of the contacts 86 and 87, the solenoid 47 is effectively de-energized, the valve member 45 is seated upon the valve seat 46 of its own weight, and the spring 40 holds the member 34 in the position illustrated in Fig. 2. As previously described, the throttle is now under the control of the accelerator pedal, which can move it between closed (full-line) position and open (dotted-line) position.

As the speed of the vehicle increases, the fly-weights 69 move outwardly under the influence of centrifugal force and displace the sleeve 72 to compress the spring 73. When displacement of the sleeve 72 under the influence of the fly-weights has become sufficient to effect engagement of the contacts 86 and 87, the solenoid 47 is energized and raises the valve member 45 to connect the interior of the casing 36 with the intake manifold 16. The resultant exhaustion of the casing 36 moves the member 34 to the right (Fig. 4) and closes the throttle as previously described. By rotating the split collar 79 on the boss 80 the angular position of the sleeve 72 and rib 85 may be varied to control the vehicle speed at which the contact 87 engages the contact 86.

To prevent excessive arcing between the contacts 86 and 87, I find it advantageous to connect across them a resistance 99, such resistance being just sufficient to prevent the solenoid 47 from being effectively energized to raise the valve 45 until the contacts 86 and 87 engage each other.

I find that a more gradual automatic control of throttle position can be effected if the speed-responsive device is arranged to permit vibratory movement of the movable contact 87. With this purpose in view, the free end of the contact 87 may be made relatively heavy so that it will tend to vibrate. If this is done, I find that, without any special provision being made therefor, the contact 87 will vibrate. I prefer, however, to insure such vibration as by making the end face 71 of the sleeve 72 other than plane. As indicated in Fig. 9, the end face 71 can be formed with a diametrically extending ridge 100 which passes beneath the ends of the inwardly extending arms 70 of the fly-weights 69 as the latter rotates. I find that the ridge 100 need be only a few thousandths of an inch in height to accomplish the desired result.

With the speed-responsive device arranged to produce vibratory movement of the movable contact 87, the speed control exercised is gradually imposed. At low vehicle speeds, the rib 85 on the sleeve 72 will be out of engagement with the offset portion 89 on the movable contact 87, and the contacts 86 and 87 will be separated so that no speed-control is exercised. Under these conditions, the sleeve 72 will reciprocate rapidly through a short distance on the shaft 67 as a result of the presence of the ridge 100 in the end face 71. As speed increases, the flange 85 approaches the movable contact 87 until a condition is eventually reached where the rib 85 intermittently engages the contact 87 and forces it, in turn, into intermittent engagement with the fixed contact 86. The resultant intermittent energization of the solenoid 47 causes the valve member 45 to vibrate on and off its valve seat 46. During each interval in which the valve 45 is lifted from its seat 46, air will be exhausted from the casing 36 through the passage 37; but in the intervals between successive liftings of the valve 45, the passage 37 will be closed and some air will be returned to the partially exhausted casing through the passage 50.

The ratio between the amount of air exhausted from the casing while the valve is momentarily lifted to the amount of air returned when the valve is momentarily closed will depend upon the settings of the two valves 51 and 60, upon the force exerted on the diaphragm 35 by the spring 40, and upon the relation between the duration of engagement and the duration of separation of the contacts 86 and 87. As long as this ratio is no greater than unity, the member 34 will be held in its normal position by the spring 40; but as the sleeve 72 moves to the right under the influence of increasing vehicle speed, the duration of each engagement of the contacts 86 and 87 increases and the duration of each separation of such contacts decreases until each increment of air exhausted exceeds each increment of air returned. Thereupon, the member 34 begins to move to the right, and the throttle begins to close. Movement of the member 34 to the right increases the force which the spring 40 exerts on the diaphragm 35 and this, in turn, tends to oppose exhaustion of air from the casing 36 when

the valve 45 is open and to favor return of air to the casing when that valve is closed. As a result, for any given ratio between the respective durations of engagement and separation of the contacts 86 and 87 there is a corresponding position of the throttle. Eventually, the sleeve 72 moves far enough to maintain continuous engagement between the contacts 86 and 87, the valve 45 remains open, and the throttle is completely closed.

When the vehicle speed drops below that necessary to maintain the contacts 86 and 87 in continuous engagement, vibration of the contact 87 and intermittent de-energization of the solenoid 47 will again occur. Under the influence of this intermittent de-energization of the solenoid the valve member 45 will intermittently engage the valve seat 46, and during the periods of such engagement air will enter the passage 50 and flow along the sides of the valve member 45 into the casing 36 to permit the spring 40 to move the member 34 toward its normal position. When vehicle speed drops to a point such that the movable contact 87 vibrates free of the contact 86, the solenoid will remain de-energized, the valve 45—46 will be closed, and the spring 40 will hold the member 34 in its normal position.

The presence of the resistance 99 across the contacts 86 and 87 favors prompt response of the valve 45 to engagement and disengagement of such contacts, since it decreases the extent of current variations, and therefore of inductive lag. By the throttle-controlling means described, a very effective control over vehicle speed is maintained. The imposition of the governing action is gradual; and begins to occur slightly before the maximum vehicle speed is reached and gradually increases in effect as the vehicle speed approaches the maximum, when it becomes complete. This gradual imposition of the governing action eliminates "hunting," or the tendency of vehicle speed to increase and decrease alternately through an appreciable range. I find it readily possible through the use of my apparatus to control vehicle speed within the limits of one-half mile per hour. That is, at the predetermined maximum speed the throttle will be fully closed, at a speed one-half mile per hour below the predetermined speed the throttle will be fully open, and at intermediate speeds the throttle will occupy intermediate positions, such as that illustrated in Fig. 3.

It is to be noted that the first action which occurs when the casing 35 is exhausted is a counterclockwise swinging of the lever 37. In most carburetors, the throttle shaft has associated with it a light torsion spring (not shown) biasing the throttle toward closed position. Frictional resistance to throttle opening, supplemented by the action of such a spring when one is present, prevents rightward movement of the member 34 from closing the throttle until after the arm 27 has been moved to the limit of its counterclockwise movement. With the arm 27 in such position (Figs. 3 and 4), the throttle can not be opened by the accelerator pedal, as the arm 25 is free to swing throughout its entire range of movement without displacing the arm 27 and the pivot 29.

It is to be understood that the specific device described above constitutes but one example of my invention. That invention is not limited to internal-combustion engines, nor to joint manual and automatic control of a single throttle, nor to a device in which the power for operating the speed-responsive device is obtained as the result of the existence of a sub-atmospheric pressure in an intake passage.

I claim as my invention:

1. A speed governor for an internal combustion engine having a throttle valve in its mixture-supply passage, said governor comprising a manually movable member, a pressure-responsive device, a floating member connected at three spaced points to said throttle, said manually movable member, and said pressure-responsive device, a conduit connecting said pressure-responsive device with said mixture-supply passage and joining the latter at a point between said throttle and the engine, a valve in said conduit, and speed-responsive mechanism for operating said valve, the connection between said floating member and said manually movable member being a lost-motion connection permitting said pressure-responsive device to move said floating member to close the throttle without displacing said manually movable member.

2. A speed governor for an engine having a throttle valve in its mixture-supply passage, said governor comprising a manually movable member, a power-operated motor, a floating member connected at three spaced points to said throttle, said manually movable member, and said motor, and speed-responsive mechanism for controlling operation of said motor, the connection between said floating member and said manually movable member being a lost-motion connection permitting said motor to move said floating member to close the throttle without displacing said manually movable member.

3. In a speed-governor for an internal combustion engine having a throttle in its mixture-supply passage, a pressure-responsive device operative when exhausted to move said throttle toward closed position, a conduit for exhausting said pressure-responsive device, said conduit being connected to said passage at a point between said throttle and the engine, a valve normally operative to close said passage and connect said pressure-responsive device to atmosphere, electromagnetic means operative when energized to move said valve to open said passage and close the connection of said pressure-responsive device to atmosphere, a vibratory electrical contact, a second contact disposed to be engaged by said vibratory contact in its vibration, a source of current connected to said electromagnetic means through said contacts, and speed-responsive mechanism for controlling the relative durations of engagement and disengagement of said contacts.

4. In a speed-governor for an engine having a throttle, a pressure-responsive element operative when exhausted to move said throttle toward closed position, means for withdrawing air from said element in increments and for permitting air to return to said element in the intervals between the withdrawal of successive increments, provisions for regulating the rate of air-return during such intervals, and speed-responsive means for controlling the duration and spacing of such intervals.

5. In a speed-governor for an engine having a throttle, a pressure-responsive element operative when exhausted to move said throttle toward closed position, means for withdrawing air from said element in increments and for permitting air to return to said element in the intervals between the withdrawal of successive increments,

and speed-responsive means for controlling the duration and spacing of such intervals.

6. In a speed-governor for an engine having a throttle, a fluid-pressure motor acting when operative to move said throttle toward closed position, yielding means for moving said throttle in the opposite direction when said motor is inoperative, valve means controlling operation of said motor, mechanism actuating said valve means to render said motor alternately operative and inoperative, and a speed-responsive device controlling said mechanism to vary the relation between the duration of each period in which the motor is operative and the duration of each period in which the motor is inoperative.

7. In a speed-governor for an engine having a throttle, a fluid-pressure motor acting when operative to move said throttle in one direction, yielding means for moving said throttle in the opposite direction when said motor is inoperative, valve means controlling operation of said motor, mechanism actuating said valve means to render said motor alternately operative and inoperative, and a speed-responsive device controlling said mechanism to vary the relation between the duration of each period in which the motor is operative and the duration of each period in which the motor is inoperative.

8. In a speed governor, a movable speed-controlling member, a fluid-pressure motor acting when operative to move said speed-controlling member, yielding means for moving said speed-controlling member in the opposite direction when said motor is inoperative, valve means controlling operation of said motor, mechanism actuating said valve means to render said motor alternately operative and inoperative, and a speed-responsive device controlling said mechanism to vary the relation between the duration of each period in which the motor is operative and the duration of each period in which the motor is inoperative.

9. In a speed governor, a movable speed-controlling member, a motor acting when operative to move said member in one direction, means for moving said member in the opposite direction when said motor is inoperative, mechanism for rendering said motor alternately operative and inoperative, and a speed-responsive device controlling said mechanism to vary the relation between the duration of each period in which the motor is operative and the duration of each period in which the motor is inoperative.

10. In a speed-governor for an engine having a throttle, a lever for operating said throttle, a movable fulcrum for said lever, a fixed abutment for limiting movement of said fulcrum in one direction, a movable abutment for limiting movement of said fulcrum in the opposite direction, speed-responsive means for swinging said lever about said fulcrum to control said throttle, and manually operated means for moving said movable abutment.

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