

Nov. 29, 1938.

G. E. HOWARD

2,138,100

SPEED REGULATOR

Filed Jan. 20, 1938

3 Sheets-Sheet 1

Fig. 1.

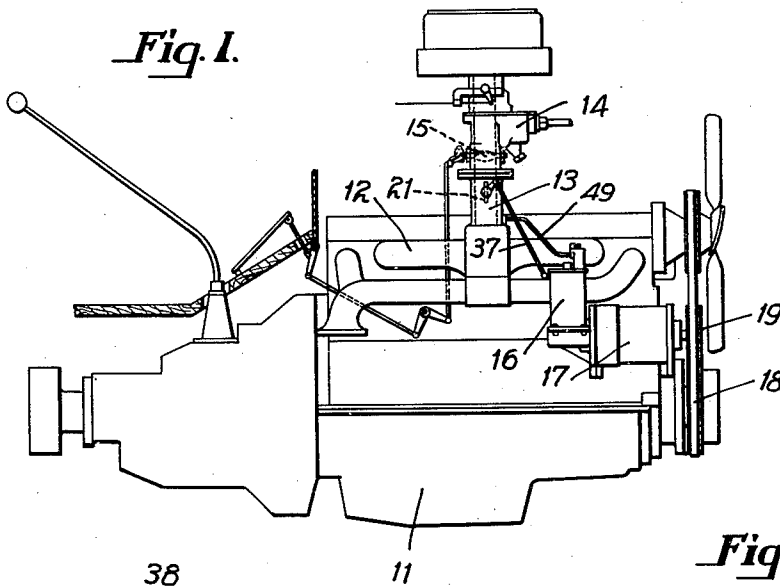


Fig. 3.

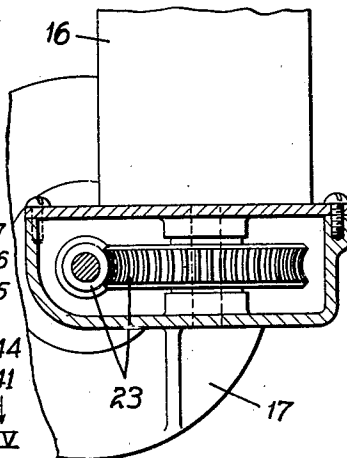
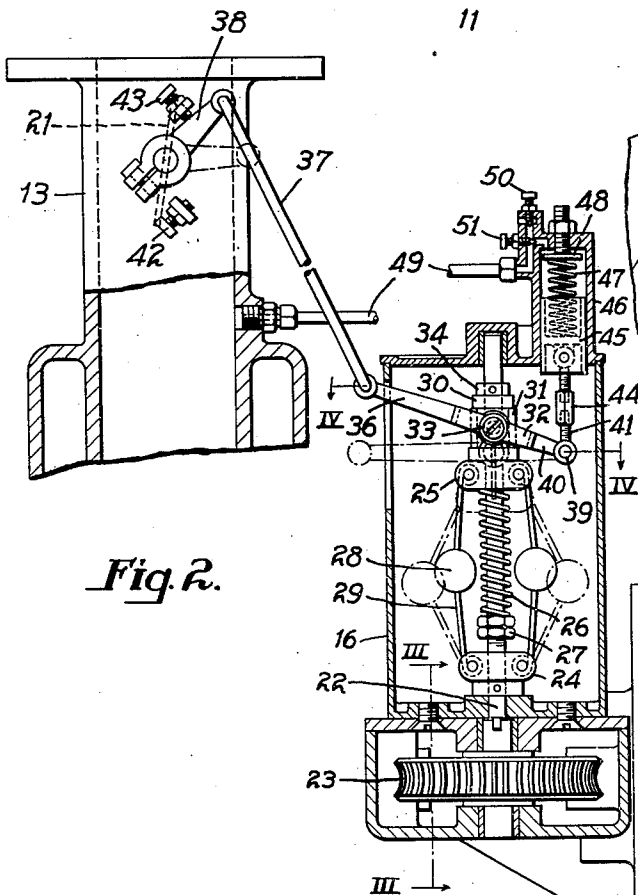


Fig. 2.



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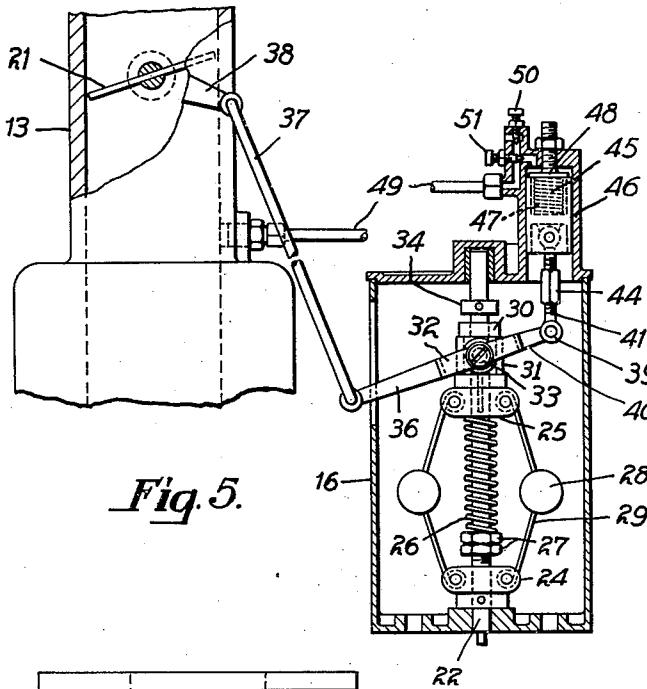


Fig. 5.

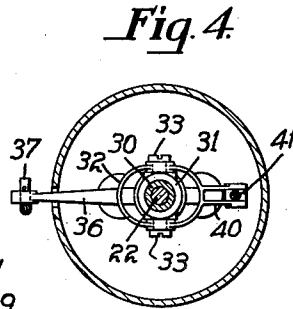


Fig. 4.

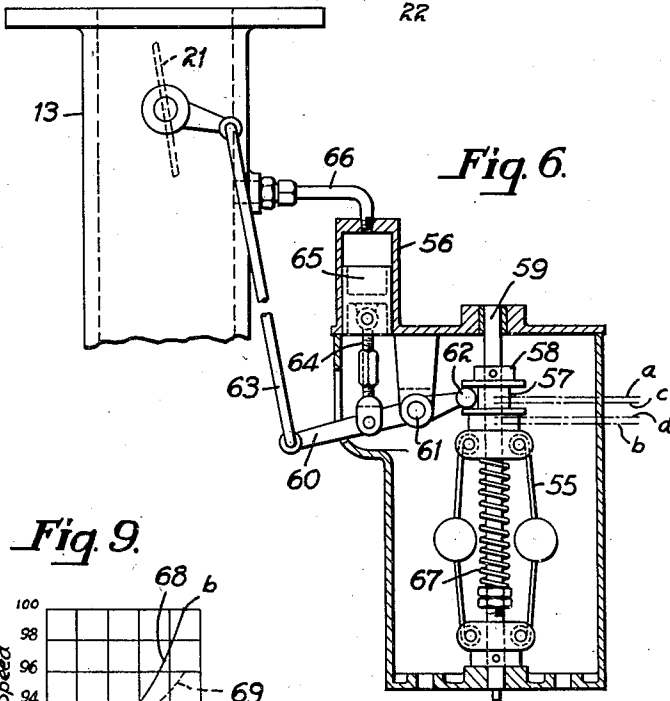


Fig. 6.

Fig. 7.

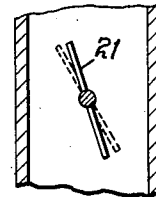


Fig. 8.

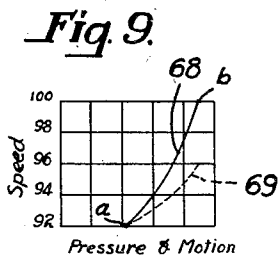
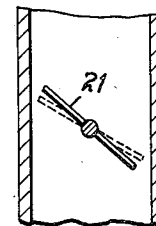


Fig. 9.

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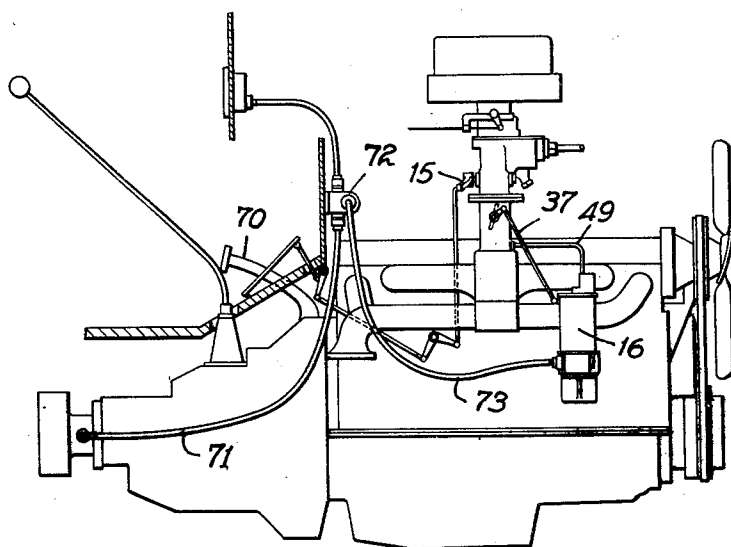


Fig. 10.

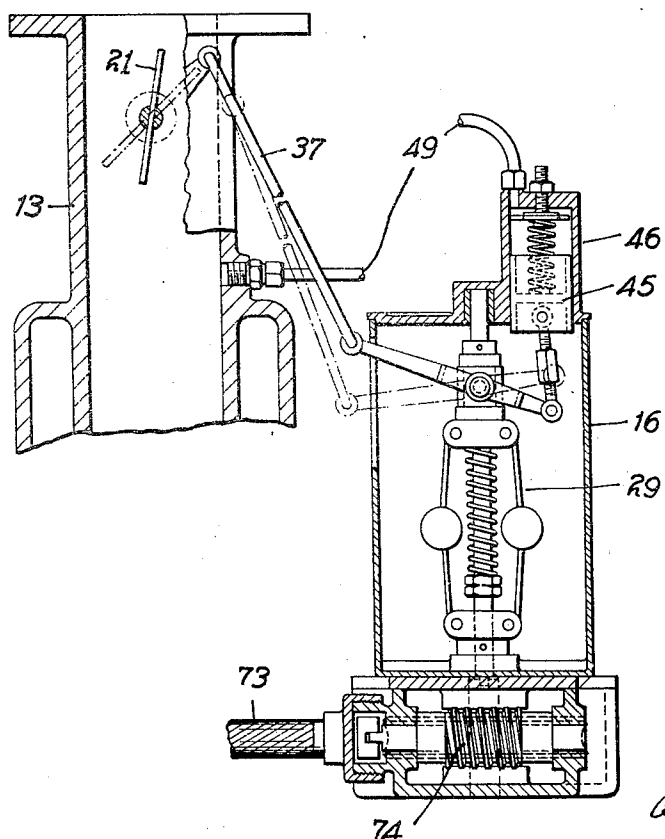


Fig. 11.

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UNITED STATES PATENT OFFICE

2,138,100

SPEED REGULATOR

George E. Howard, Butler, Pa.

Application January 20, 1938, Serial No. 185,861

13 Claims. (Cl. 123-103)

My invention relates to speed regulators of the type for regulating the rate of movement of motor vehicles or their motors, and constitutes a modification of my application Serial Number 180,295, filed December 17, 1937, in that it discloses means whereby a throttle valve can be operated to some extent without direct relation to movements of a centrifugal governor.

Centrifugal governors of forms heretofore employed are objectionable in that usually they have such direct or positive connection with a control throttle that, within the governing range of the governor, all movements of the governor through fluctuations in speed are imparted directly and positively to the throttle. Where fluctuations in speed are such as to cause what may be termed a fluttering of the governor, the control valve is oscillated rapidly, with consequent shifting of the valve from one side to the other over a neutral point where speed and load balance, so that there will be jerky application and cutting-off of power, which causes jerky motions in the transmission mechanism and of the car body.

Another objection to these former types of governors arises out of the fact that they usually have to be so set that the range of their control is over a speed of five to ten miles per hour in variation. For example, if a centrifugal governor is set to prevent the motor running at a speed which will move the vehicle faster than 50 miles per hour, upon deceleration through contractive movements of the governor, the rate of vehicle travel may decrease to the extent of perhaps five or ten miles per hour. While the governor could be so arranged that it would operate within a much narrower speed range—say 48 to 50 miles per hour—the movements of the governor under these slight differences in speed would cause the jerky application and cutting-off of power as above referred to.

In those installations provided with the usual foot-control throttle valve and with a governor-controlled throttle valve, there frequently is too great delay in movement of the governor-controlled valve to a position where it will exercise a controlling effect. For example, if the foot throttle is half closed and the control throttle fully open, there will be considerable time consumed in movement of the control throttle by the governor to a position corresponding to approximately the position of the foot throttle, and the control throttle cannot become effective until it reaches such position.

One object of my invention is to provide a

governor which will operate from full load (wide open throttle) to no load (closed throttle), with greater accuracy than is possible with previous types of governors.

Another object of my invention is to provide means whereby the control throttle is automatically positioned at such points that no great range of movement by the centrifugal governor is required in order to render the control effective.

Still another object of my invention is to prevent fluttering movements of the governor, through load changes, but permitting control valve movement in a wider range under small variations in speed, than can be had with previous types of governors.

A further object of my invention is to provide means whereby a control throttle is automatically actuated upon increase in engine speed above a predetermined rate, to reduce the fuel supply and hence prevent racing of the engine, in combination with a speed-control device actuated by a moving part of the vehicle whereby the fuel supply will be automatically restricted when either the vehicle or the motor itself exceeds a predetermined speed.

Some forms of apparatus for practicing my invention are shown in the accompanying drawings wherein Figure 1 is a side view of a vehicle motor having my invention applied thereto; Fig. 2 is a vertical sectional view on an enlarged scale through a portion of the apparatus of Fig. 1; Fig. 3 is a view taken on the line III—III of Fig. 2; Fig. 4 is a view taken on the line IV—IV of Fig. 2; Fig. 5 is a view similar to Fig. 2, but showing the movable parts in other positions; Fig. 6 shows a modification of the structure of Fig. 5; Figs. 7 and 8 are views illustrative of various positions occupied by the control valve under various governing conditions; Fig. 9 represents a chart illustrative of a relationship between governor speed and pressure conditions within the intake manifold of the motor; Fig. 10 shows a modification of the structure of Fig. 1, in that the centrifugal governor is driven from a moving part of the vehicle, back of the clutch, and Fig. 11 is an enlarged sectional view through a portion of the apparatus of Fig. 10.

An internal combustion motor is indicated by the numeral 11 and is provided with the usual intake manifold 12 to which the explosive mixture is supplied through an intake line 13 from a carburetor 14 and past a foot-controlled throttle valve 15. The governing device is contained within a casing 16 and is here shown as

being driven from the shaft of a generator 17, that is in turn driven from the crank shaft of the motor, through a belt 18 and a pulley 19. Obviously the governor could be driven in some
 5 other manner, and instead of being directly responsive to changes in engine speed, it could be made directly responsive to changes in vehicle speed, by driving it from the speedometer shaft or some other moving part back of the
 10 clutch. A control valve or throttle 21 is provided in the fuel line 13 for actuation by the governor. The centrifugal governor parts are of somewhat standard form and include a shaft 22 which is driven from the generator 17 through
 15 worm reduction gearing 23, the ends of the shaft 22 being journaled in the upper and lower ends of the casing 16. A fixed collar 24 is secured to the shaft 22 and a movable collar 25 is slidably keyed on the shaft. A spring 26 is inter-
 20 posed between nuts 27, adjustable on the shaft, and the collar 25, to yieldably hold the governor in contracted position. Weights 28 are carried by spring arms 29 whose ends are pivotally connected to the collars 24 and 25.
 25 The collar 25 is provided with a sleeve-like extension 30 which is peripherally grooved. A collar 31 loosely surrounds and is contained in the said groove. A yoke 32 is pivotally connected to the collar 31 by pins or screws 33. A stop
 30 collar 34 secured to the shaft 22 limits expansive movement of the spring 26 and hence limits contractive movements of the governor. The yoke 32 has a lever extension 36 which is pivotally connected to a link 37 that in turn has connection with an arm 38 rigidly jointed to the shaft
 35 of the control valve 21.

The yoke 32 has a second lever-like extension 40 which has pivotal connection at 39 with a link 41. It will be seen that with the link 41 in a
 40 fixed position or state of rest, expansive and contractive movements of the governor balls will be imparted through the lever 36 and the link 37 to the control valve 21. Adjustable stops 42 and 43 are provided on the exterior of the fuel line 13
 45 to limit movements of the arm 38. If the point of connection 39 between the lever 40 and the link 41 be maintained fixed or stationary, it will be seen that the governor will operate in substantially the same manner as an ordinary centrifugal governor, and that a full range of centrifugal
 50 movement is required in order to effect complete valve movement.

My invention is primarily concerned with the shifting of the control throttle valve in conjunction
 55 with the governor, in accordance with changes between full load (wide open foot throttle) and no load (closed foot throttle) conditions, and hence through changes in pressure or suction conditions within the manifold, so that normally the position of the control valve will approximate the position of the foot throttle and the control valve will be fully effective under
 60 short ranges of movement of the governor instead of becoming completely effective only after the governor has moved the valve to a position approximating the position of the foot throttle.
 65

The link 41 is made in two threaded sections which are connected by a nut 44 whereby the link may be adjusted to various lengths. The
 70 link is pivotally connected to a piston 45 operating within a cylinder 46. A spring 47 is interposed between the piston and an adjustable screw 48, the spring exerting a force tending to move the piston outwardly. The cylinder has
 75 connection through a pipe 49 with the line 13, at

a point between the manifold 12 and the control valve 21. It will be seen that with the valve 15 partially closed, there will be suction in the line 13 tending to draw the piston 45 inwardly and, through the link 41, lever 32 and link 37, thus
 5 moving the valve 21 toward closed position. The spring 47 will be of such strength that this vacuum force will never be sufficient to cause complete closure of the valve 21. The degree of vacuum within the line 13, will of course depend
 10 upon the position of the valve 15, and the calibration of the spring 47 is such that the piston 45 can be moved by the vacuum only such distance as will cause the valve 21 to move to approximately the position of the valve 15. In
 15 practice, however, the adjustment will be such that the valve 21 will be moved to such a position that its throttling effect will not be quite so much as that of the valve 15.

Assuming that the foot throttle valve is at its
 20 half closed position and the engine rotating at a speed below that at which the centrifugal governor will operate, the degree of suction in the pipe 13 will be such that the valve 21 will be moved to nearly its half closed position. If now the
 25 engine speed is increased to where the centrifugal governor becomes operative, the governor will immediately move the valve 21 further toward its closed position. It will be seen that upon changes in extent of foot throttle opening, the
 30 position of the control throttle will automatically be varied. Therefore, because the governor can immediately become effective to operate the control valve, the speed of the car can be held within a very close range, for example, within a range
 35 of 49 to 50 miles per hour. The vacuum control just described functions in effect as a "finder" whereby the control valve 21 is automatically moved to such position that it will be operated through short movements of the centrifugal gov-
 40 ernor. During travel of the engine or vehicle at any speed, should there be a change in road grade which causes the vehicle and engine to move faster, the increase in engine speed and consequent rapidity of piston displacement will in-
 45 crease the suction in pipe 13, thus causing movement of the valve 21 toward closed position, thereby reducing the fuel supply somewhat in proportion to the load, until the fuel supply is less than that necessary to maintain the accel-
 50 erated speed. Thus the effect is a constant shifting from one side to the other, past some neutral point where speed, load and vacuum balance. While this action of the vacuum force is moving
 55 the valve 21, the centrifugal governor is exerting some pull in opposition to the spring 26, which action is in the same direction and supplements the work of the vacuum cylinder 46. Therefore, neither the vacuum cylinder nor the centrifugal governor will have to vary through so wide a
 60 range as would be the case if each were acting alone instead of supplementing one another.

While the centrifugal governor could itself be designed so as to effect the full movement of the control valve through its opening and closing
 65 cycle, such design or adjustment of the governor would result in a too sudden shutting-off and turning-on of the fuel supply for a close speed variation, and would produce a fluttering or jerky operation, hard on the machine and on the nerves
 70 of the driver.

Stability or smoothness of control results from the fact that there is a lag between the various functional operations that are related to change
 of speed and load. The conditions which cause 75

motivation of the vacuum cylinder and the centrifugal governor are different, and operate in somewhat different sequence and time, thus avoiding the rhythmic action which causes fluttering. As an example, a sudden reduction in speed will cause a quick response by the centrifugal governor, while on the other hand the vacuum force will not be changed instantly, but there will first have to be some exhaustion from the body of gas in the line 13, which will require a brief period of time, before the piston 45 will be operated to supplement the centrifugal governor, owing to the relatively small size of the pipe 49. This movement of the piston 45 may be further delayed or dampened to a desired degree, by adjusting one of the valves 50 and 51. The first-named valve admits atmospheric pressure to the suction line, while the valve 51 controls the port opening into the cylinder 46. This adjustment of vacuum conditions by the valves 50 and 51 is desirable because they can be set to maintain proper vacuum conditions which may change during long use of the vehicle, as from leaky pistons, etc.

The adjustments at the vacuum cylinder, including the adjustment in the length of link 41, the adjustments of the spring 47 and the valves 50 and 51 are such that while the control valve 21 will be moved toward closed position in response to closing movement of the foot throttle valve 15, it will not be moved quite so far as the foot throttle valve. Similarly, it will not cause the control valve to be moved quite as widely open as the foot throttle valve. The centrifugal governor, therefore, will have to move the control valve only a very short distance in order to bring the engine to a desired speed. For example, the vacuum force may cause the throttle valve 21 to assume the full line positions shown in Figs. 7 and 8 under given conditions, and, if the speed is too high, the centrifugal governor will then have to move it only to the dotted line positions, or vice versa.

Referring now to Fig. 8, I show a somewhat different form of governing apparatus wherein the control valve 21 in the fuel intake line 13 is actuated by a centrifugal governor 55 and a vacuum cylinder 56. The governor 55 functions somewhat in the same manner as the centrifugal governor of the other figures in that it causes slidable movement of a collar 57 toward and from a stop shoulder 58 on the governor shaft 59, which may be driven from any suitable moving part of the engine or the vehicle. A lever 60 is pivotally supported at a fixed point 61 and has an extension 62 projecting into the grooved collar 57, so that movements of the lever will be imparted to the collar, and the collar can rotate relatively to the lever. The lever 60 has its outer end connected to a link 63 by which the valve 21 is operated. A link 64 connects the lever 60 with a piston 65, and a pipe 66 connects the cylinder 56 with the intake line 13 at the engine side of the valve.

In this structure as in the other form of control apparatus, pressure fluctuations within the line 13, whether caused by movement of the foot throttle or by changes in engine speed, will create vacuum forces within the cylinder 56 that are transmitted to the collar 57 and move the valve 21. Movement of the lever 60 in a clockwise direction exerts compressive force on the governor spring 67, so that when the valve 21 is thus moved toward closed position, the spring 67 may be compressed to a point that a slight

further increase in speed will render the centrifugal governor effective to move the valve 21.

Assuming that the centrifugal governor were operated as an ordinary centrifugal governor, without the use of the vacuum force, the line *a* may represent the lower-most limit of speed range at which the governor begins to operate, say at a governor shaft speed of 92 R. P. M., at which point the movement of the valve 21 toward closed position would begin. The line *b* represents the position which the governor would assume at say 100 R. P. M., at which position the valve 21 would be fully closed. At 92 R. P. M. the vehicle may be traveling at 45 miles per hour, while at 100 R. P. M. it may be traveling at 50 miles per hour. By the addition of my vacuum control, it is not necessary that the centrifugal governor perform its control function through such a wide range, since the vacuum force in the line 13 may be such that the collar will be moved upwardly to the line *c* independently of the centrifugal force. Further increase in speed will render the governor effective to move from position *c* to perhaps position *d*, which will further close the valve 21, with resulting increase in suction force in the cylinder 56 and consequent supplementing of the governor force, with the result that the governor need not move through its full range. Under other conditions the vacuum force may move the governor to approximately position *d*. In any event, the vacuum device serves as a "finder" which will so position the valve 21 that the centrifugal governor will have to move only through a very short range in order to effect complete control.

Assuming the governor balls to be at a point where they just counterbalance the opposing force of the spring 67 plus the pressure caused by the vacuum cylinder, the centrifugal force on the spring may be five pounds and there may be five pounds additional pressure imposed thereon by the vacuum cylinder, making a total of ten pounds effective to move the collar 57. Any further increase in revolution speed will increase the centrifugal force and cause further movement of the collar.

Thus, if the speed is increased so that the balls produce a centrifugal force of six pounds with no change in the five pounds exerted by the vacuum cylinder, then the spring will be compressed until it has reached a position where its opposing force will be eleven pounds, with a corresponding movement of the yoke, when the whole system will again be in equilibrium.

As indicated by the chart of Fig. 9, the line 68 represents the range of speed through which the centrifugal governor would be operated without the use of the vacuum control. The dotted line 69 represents the vacuum influence on the governor mechanism, whereby it modifies the speed range necessary to render the governor fully effective to move the valve from its fully open position to its fully closed position, and the governor apparatus may be fully effective within the range of 92 R. P. M. to 96 R. P. M., instead of having to move through the range of 92 R. P. M. to 100 R. P. M. to effect the valve and governor motions *a* to *b*. Thus, it will be seen that the movement from *a* to *b* ordinarily requires a change of 8 R. P. M. in governor speed, while with the addition of vacuum force this full control can be effected through a change in of only four R. P. M. Under light vacuum conditions the valve 21 may be moved to approximately its full

line position in Fig. 7 and movement to dotted line position where there is complete control effected by the centrifugal governor. Under heavy vacuum conditions such as when the foot throttle is nearly closed, the valve 21 will be moved to about its full line position of Fig. 8 and further movement to its dotted line position effected by the centrifugal governor.

Referring now to the structures of Figs. 10 and 11, I show therein a form of governing apparatus which is like that shown in Figs. 1 to 5, except for the fact that the centrifugal governor 29 is driven from a moving part of the vehicle located back of a clutch which is controlled by a clutch-actuating pedal 70 instead of from a member (such as the generator shaft) which always rotates in a given ratio to engine speed. This arrangement has the same advantages of the other arrangement, namely that the suction-operated piston 45 will serve as a "finder" to move the control throttle 21 in accordance with change in pressure or suction conditions within the intake line 13 to thereby turn the valve 21 to a position at which it can further be acted upon and rendered effective through but a short movement of the centrifugal governor, and to supplement the said governor. It has the further advantage, however, of a more direct control of vehicle speed and will also prevent racing of the motor, as when the motor is declutched from the transmission mechanism or when the car is being driven in a low gear.

In this structure the centrifugal governor 29 is driven from the speedometer shaft 71 through worm gearing at 72, a flexible shaft 73 and worm gearing 74, the governor 29 and the piston 45 cooperating to actuate the control throttle 21 as in Figs. 1 to 5. If the motor is declutched from the transmission mechanism the governor 29 will, of course, be stationary, but should the foot throttle 15 be moved to such position that the engine approaches racing speed, a subatmospheric pressure condition will be created in the feed line 13 such as to create a suctional force within the cylinder 46, causing the valve 21 to be moved toward its dotted-line position (Fig. 11), thereby reducing the fuel supply and preventing excessive speed of the motor. Similarly, if the car is being driven in low gear, for example, and the engine speed reaches a predetermined degree, the suction will be sufficient to cause restriction of fuel flow even though the vehicle may be moving at a low speed.

The suction-operated control device may be so adjusted that it will permit motor speeds of what would be the equivalent of perhaps 70 miles per hour, with the transmission connected to the motor through high gear, but when the driving connection is made, the centrifugal governor will limit the speed to 50 miles per hour, or other predetermined rate.

I claim as my invention:

1. The combination with an engine having an intake passageway for flow of motive fluid thereto, of a valve for controlling flow of said fluid to the engine, a speed governor driven from the engine and having operative connection with said valve, and means actuated through changes of pressure in said passageway, for supplementing the valve-operating movements of the governor.

2. The combustion with an engine having an intake passageway for flow of motive fluid thereto, of a valve for controlling flow of said fluid to the engine, a speed governor driven from the engine and having a given range of expansive and

contractive movement, a valve-operating connection between the governor and the valve, and means actuated through changes of pressure in said passageway, for varying the point within said range at which the valve will be moved by the governor under predetermined changes in engine speed.

3. The combination with an engine and an intake passageway through which motive fluid is supplied thereto, of a valve for controlling flow through the passageway, a speed governor driven from the engine and having operative connection with the valve, and means actuated through changes of pressure in the passageway, for imparting movements to the valve, supplementary of the movements imparted thereto by the speed governor.

4. The combination with an engine and an intake passageway through which motive fluid is supplied thereto, of a valve for controlling flow through the passageway, a speed governor driven from the engine and having operative connection with the valve, and means actuated through changes of pressure in the passageway, for imparting movements to the valve, independently of the governor.

5. The combination with an engine and an intake passageway through which motive fluid is supplied thereto, of a valve for controlling flow through said passageway, a speed governor driven from the engine and having operative connection with the valve, and means for automatically varying the position of the valve relative to the governor, in accordance with changes of pressure conditions in said passageway.

6. The combination with an engine and an intake passageway through which motive fluid is supplied thereto, of a valve for controlling flow through said passageway, a speed governor driven from the engine and having operative connection with the valve, and means actuated through changes of pressure conditions in the passageway for determining the points in the range of governor movement at which the governor will be effective to move the valve.

7. The combination with an engine and an intake passageway having a throttle valve for controlling the flow of motive fluid to the engine, of a control valve for said passageway, a speed governor driven from the engine and having operative connection with the control valve, and means automatically operable independently of the speed governor, for moving the control valve in predetermined relation to changes in position of the throttle valve.

8. The combination with an engine and an intake passageway having a throttle valve for controlling the flow of motive fluid to the engine, of a control valve for said passageway, a speed governor driven from the engine and having operative connection with the control valve, means automatically operable independently of the speed governor, for moving the control valve in predetermined relation to changes in position of the throttle valve, and means amplifying the last-named control valve movements by valve-operating movements of the governor.

9. The combination with an engine and an intake passageway through which motive fluid is supplied thereto, of a valve for controlling flow through the passageway, a speed governor driven from the engine and having operative connection with the said valve, a piston having operative connection with said valve, a cylinder containing the piston, and a pipe affording communication

between said passageway and the cylinder, whereby movements of the piston may be effected upon changes in pressure conditions within the passageway.

5 10. The combination with an engine and an intake passageway through which motive fluid is supplied thereto, of a valve for controlling flow through the passageway, a speed governor driven from the engine and having operative connection
10 with the said valve, a piston having operative connection with said valve, a cylinder containing the piston, a pipe affording communication between said passageway and the cylinder, whereby movements of the piston may be effected upon changes
15 in pressure conditions within the passageway, and means for adjustably controlling the movement of fluid through said pipe.

11. The combination with an engine and an intake passageway through which motive fluid is
20 supplied thereto, of a valve for controlling flow through the passageway, a speed governor driven from the engine and having operative connection with the valve, means for yieldably maintaining the governor in contracted position, a piston,
25 means for operating the piston through changes in pressure conditions within the said passageway, and a connection between the piston and the governor whereby upon movement of the piston

in one direction the governor is shifted against resistance of said yieldable means.

12. The combination with an engine and an intake passageway through which motive fluid is
5 supplied thereto, of a valve for controlling flow through the passageway, a speed governor driven from the engine and having operative connection with the valve, means for yieldably maintaining the governor in contracted position, a piston,
10 means for operating the piston through changes in pressure conditions within the said passageway, and a connection between the piston and the governor whereby upon movement of the piston the position of the governor is shifted with respect to said yieldable means.
15

13. The combination with an engine and an intake passageway through which motive fluid is supplied thereto, of a valve for controlling flow through the passageway, a speed governor driven from the engine, a lever having pivotal connection with the governor and with the valve, a
20 piston pivotally connected to said lever, and means for moving the piston through changes in pressure conditions within said passageway, whereby the said lever will be rocked through
25 movement either of the piston or of the governor.

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