Oct. 20, 1936. T. I. LARSEN 2,058,160

GOVERNOR

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FIG. 1.

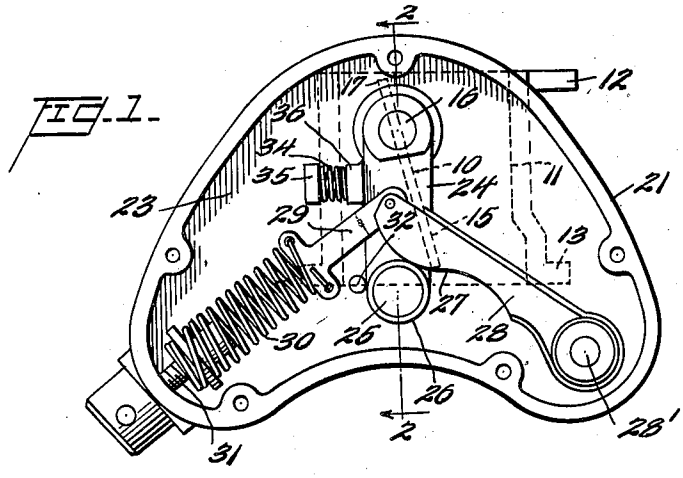


FIG. 2.

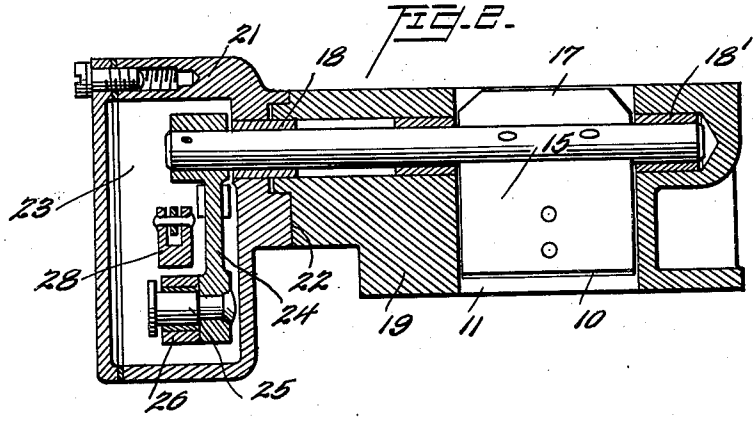


FIG. 3.

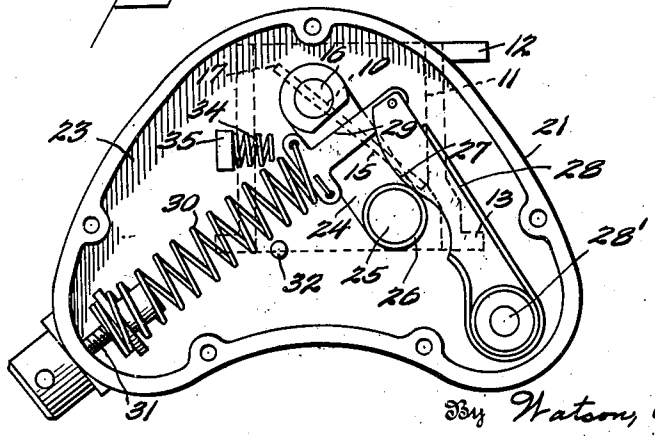
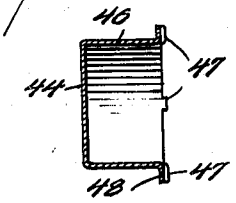


FIG. 6.



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FIG. 4.

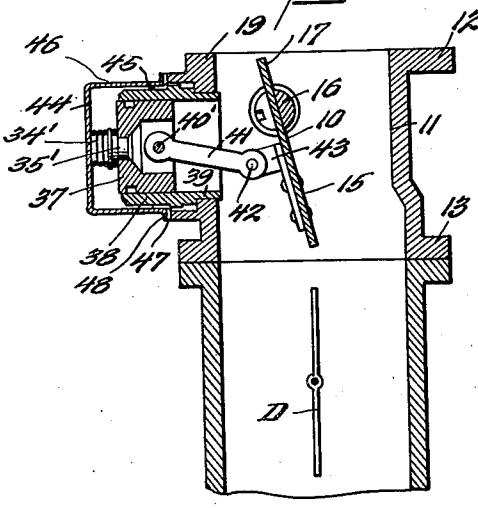


FIG. 5.

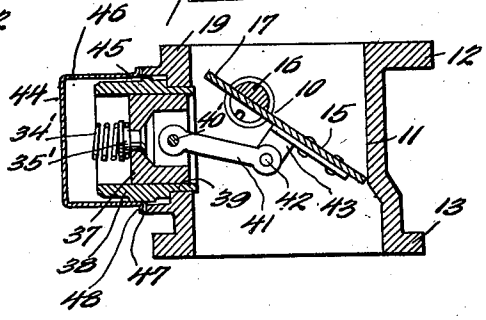
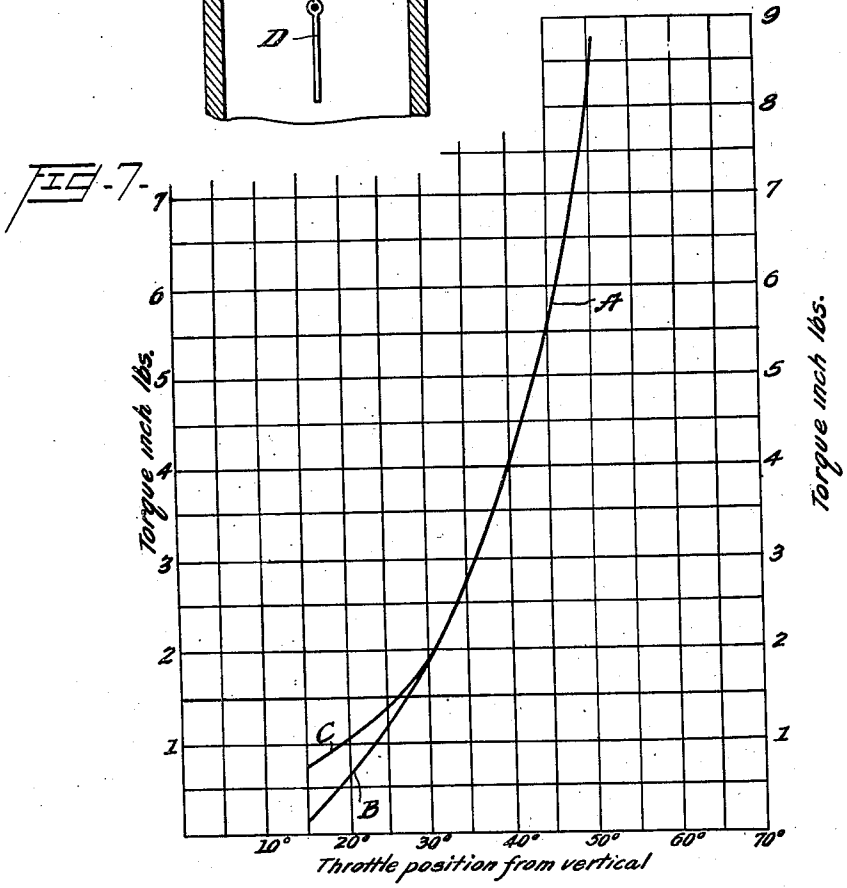


FIG. 7.



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GOVERNOR

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Application November 23, 1933, Serial No. 700,690

4 Claims. (Cl. 137—153)

This invention relates to suction governors for internal combustion engines of the type having an unbalanced butterfly valve actuated in a closing direction by the suction and the movement of the gases in the intake manifold and in an opening direction by resilient means.

The invention further relates to a governor of the type described wherein the closing torque when the valve is fully open is very small and when fully closed is very substantial, and provides means for more accurate control of the movement of the valve.

In governors of the type described, the torque developed by the action of the gases on the valve when wide open is about one inch-pound and when substantially closed is almost nine inch-pounds. When the valves in such governors are fully open, their plane is still at an angle of about 25° to the axis of the intake passage, for if opened to any greater extent the closing torque would become so small that the governor would not act well but would be characterized by violent surging and by inability to retain the engine full load speed at the customary governed speed, permitting it to go considerably higher than the governed speed at intermediate loads.

The initial closing torque of the valve is a function of the angle of the plane of the valve to the axis of the passage. Therefore under ordinary circumstances the valve must be partially closed to provide sufficient starting energy and the necessary inclination of the plate for this purpose sets up a certain resistance to the flow of gaseous fuel which thereby throttles the motor, thus reducing the total horsepower available.

It is therefore the principal object of this invention to provide a means whereby the governor plate may be opened more than the heretofore permissible maximum to thereby approach closer to 100% of the available horsepower of the engine at the governed speed.

To this end the forces acting to move the governor valve in a closing direction when wide open are augmented by means that operates for but a few degrees of the angular movement of the valve and thus acts to supply an additional closing effort opposing the main spring.

In the accompanying drawings and following specification there are disclosed two exemplary embodiments of the invention with the understanding that such changes and modifications may be made therein as fall within the scope of the appended claims without departing from the spirit of the invention.

In said drawings:

Figure 1 is an elevation of a governor constructed according to the present invention, showing the cover plate removed from the mechanism housing;

Figure 2 is a section on line 2—2 of Figure 1;

Figure 3 is a view similar to Figure 1 but showing the valve in fully closed position as distinguished from the opened position of Figure 1;

Figure 4 is a vertical central sectional view through the intake passage of a modified form of governor, showing the same with the governor valve in wide open position;

Figure 5 is a view similar to Figure 4, showing the valve in a closed position;

Figure 6 is a view in detail of the closure cap for the piston cylinder; and

Figure 7 represents the torque curves of a governor with and without the auxiliary closing means of the present invention.

The governor shown in Figures 1 and 3 is essentially that of Patent 1,604,283 granted to R. G. Handy et al. October 26, 1926, and comprises butterfly valve 10 arranged in conduit 11 adapted to be positioned in the induction pipe of the engine between the intake manifold and the carburetor. The governor is adapted to be secured in position by bolting flange 12 to the intake manifold and flange 13 to the flange of the carburetor.

The conduit 11 is preferably square in cross section in order that the valve may have a better fit and that a large area of the unbalanced butterfly valve may be located at a considerable distance from the axis thereof. As shown in Figures 2 and 3, the larger portion 15 of this unbalanced butterfly valve is below the spindle 16 and the smaller portion 17 above the spindle.

It is obvious that the flow of gases in conduit 11 tends to move the unbalanced valve in a closing direction. For proper governing action this closing effort must be balanced in all positions of the valve. For this purpose spindle 16 journalled in bearings 18, 18' in casting 19 projects from one end thereof into housing 21 secured to casting 19 by any suitable joint 22. This housing forms chamber 23 in which the mechanism is located. The shaft 16 extends into this chamber and has crank 24 non-rotatably secured thereto carrying at its outer end stud 25 journalling roller 26 which cooperates with cam face 27 of arm 28 pivoted at 28'. The opposite end of arm 28 is pivoted to link 29 attached to one end of helical spring 30 the opposite end of which is adjustably secured as at 31 to a wall of the housing. A boss

32 forms a stop for lever 24 so that the spring normally holds the valve in the open position shown in Figure 1. It will be seen that as the valve tends to close, lever 24 will rotate in a counter-clockwise direction, as viewed in Figure 1, and the lever arm through which it acts on the spring will be increasingly shortened as roller 25 rolls along surface 27 and approaches pivot 28'. This action is modified to some extent by the curvature of the face of cam 27 which is formed so that the spring exerts a force that substantially counterbalances the suction effect on the butterfly valve in all positions of the latter.

The operation of the above described governor will be clear from the following. If the carburetor throttle valve is substantially wide open and the engine is brought into operation, the upwardly flowing gases tend to close the governor valve, which when the engine is not in operation assumes the position shown in Figure 1 under the action of spring 30, by the combination of two forces, first the velocity impact of the gases on the lower face of the valve plate, and second the difference in pressure on the two sides of the valve plate brought about by the throttling action of the plate in passage 11. The plate moves under the action of these forces and against the opposition of spring 30 until it assumes a position to regulate the rate of flow of the gases to the exact amount to fix the speed of the engine at that predetermined as the desired one. If the engine now has its load decreased, it will tend to increase its speed but the increased velocity of gas through passage 11 will further close the valve until another balance is obtained and substantially the same governed speed restored. The reverse happens if the load is increased, as will be obvious, and there is governing to a fairly close predetermined speed. Since the governor cannot be entirely isochronous, there is a change of 100 to 200 R. P. M. between full load and no load speeds.

As previously stated, the earlier governors had an angle between the plane of the valve plate 10 and the vertical axis of passage 11 of about 25° in order that there would be adequate projected surface for action by the impact of the gases and to produce sufficient difference in pressure on the two sides of the valve to cause it to move toward closing position against the considerable static friction existing. In accordance with the present invention, however, the plate is set so that the angle is approximately 15°, thereby materially reducing the closing torque available. In order now to provide enough to overcome this static friction, some suitable means, as for instance auxiliary spring 34, is provided, acting between stationary abutment 35 mounted on the floor of housing 23 and projection 36 on crank arm 24. This spring is a simple helical spring and preferably has its left hand end securely attached to abutment 35 so that it is held thereby. The length of the spring and its power are so adjusted that it serves to properly augment the closing effort of the gases on the valve plate during only about the first 15° of its movement from its maximum open position. After arm 24 has moved through its first 15°, the small spring is totally relieved and has no further action, so that the governor then acts solely under the forces on the plate resulting from the movement of the gases in the passage 11 and the main spring and cam action.

Referring now to Figure 7, it will be seen that curve A with its respective lower ends B and C is drawn with ordinates as torque in inch-pounds resulting from the movement of the gases in the passage around he throttle valve taken by direct measurement from the shaft 16 while the spring 30 is disconnected. As abscissas are represented the throttle positions in degrees from the passage axis and it will be remembered that in accordance with the present invention 15° is the initial position whereas approximately 25° was the initial position before the addition of the device of the present invention. The lower portion of curve A, marked B, represents the torque available from the action of the gases on the throttle valve without the use of the auxiliary spring 34, and it will be seen that at the position of 15° the torque is only about .2 inch-pound, which is insufficient to overcome the resistance of the static friction of the various parts.

However, by adding the auxiliary spring of proper capacity, the initial closing torque is increased to .75 inch-pound, as seen on the section of the curve marked C. Here the closing effort at the fully opened position of the valve is substantially the same as it would be in the old type of governor with the valve normally set at 25°.

Thus the addition of the small spring makes it possible to open the valve initially about 10° wider, thereby materially increasing the total amount of power available from the engine when used with the governor, and insuring substantial closing forces by supplementing the normal closing torque on the plate and bringing it back to substantially the amount it was before the plate opening was increased. This permits the use of the same cam construction as in the prior governors, and maintains at all times a substantial balance between the main spring through its cam and the forces tending to close the throttle valve.

It may be argued that the same result could be obtained by changing the contour of the cam but it has been found in practice that this cannot properly be done, because the pitch becomes too steep, increasing materially the friction and adding to the difficulty of forming the cam. It is better to actually increase the available torque than to endeavor to multiply the effect of a small torque by cam contours, for more positive results are obtained.

The form of governor disclosed in Figures 4 and 5, with the exception of the auxiliary spring as applied in accordance with the present invention, is shown, described and claimed in the copending application of A. A. Bull Serial Number 369,489. Such a governor includes all of the features of the governor of Figures 1, 2 and 3 so that the main spring and cam mechanism is not required to be shown. In addition to the features of the governor of Figures 1, 2 and 3, however, it includes an auxiliary device primarily intended to prevent "stealing" or overspeeding at light loads, but also having some effect on increasing the closing torque at wide open position.

In Figures 4 and 5 the parts common to the two embodiments bear the same reference characters and there is shown in addition to the governor valve plate 10, the customary carburetor throttle valve D. The added features of the governor of Figures 4 and 5 comprise piston 37 working in cylinder 38 comprising an open ended tube provided with reduced end 39 having a pressed fit into an aperture in the side of the induction pipe 11 closely adjacent the shaft 16 of the governor plate. The piston is provided with wrist pin 40' which is connected by link 41 to pin 42 on clevise 43 riveted to the lower face of the longer arm of

butterfly valve 10. The outer end of the cylinder is closed by pressed metal thimble 44, shown more fully in Figure 6, which has a pressed or tight fit over the outer wall of cylinder 38. To permit a restricted flow of atmospheric air to the outer face of the piston, the outer wall of the cylinder is provided with several longitudinal grooves 45 in the portion over which skirt 46 of the thimble fits and this skirt is provided with a plurality of short projections 47 at the free edge thereof which prevents flange 48 at the bottom of the skirt from fitting too tightly against casting 19.

In normal operation under part load, with the carburetor valve wide open, piston 37 has very little effect on governor valve 10, for the pressure on the carburetor side of the governor valve is almost atmospheric, so that the piston is substantially balanced. However, when the governor valve is in fully opened position, the difference in pressure on the two sides of the piston may rise to as much as one inch of mercury because of the pressure losses in the carburetor, and in this wide open position, when the governor valve has a minimum of closing effort due to the gas flow applied to it, the piston 37 is helpful to move the valve in a closing direction from its fully opened position and serves to prevent "stealing", for if the operator closes the carburetor valve and tries to manipulate the same to run the motor at a higher speed than the governed speed, the piston 37 comes into operation to close the governed valve and prevents this "stealing", for the further the valve D is closed the greater the difference in pressure on the two sides of the piston, thus augmenting the flow of the gases in the closing effort on the valve.

The piston and its cylinder-thimble provide a convenient pair of abutments between which auxiliary spring 34' can be operated and permit the use of this auxiliary spring without making any changes in the main spring and cam housing. As shown in the drawings, spring 34' is attached to the piston head by means of a suitable rivet or stud 35' passing through this head, and the free end of this auxiliary spring is arranged to contact with the inner surface of the thimble head at some appropriate position, for instance, as the throttle valve approaches to within approximately 15° of its fully opened position of approximately 15° from the axis of the conduit 11. The action of this auxiliary spring is identical with that of the one described in connection with Figures 1, 2 and 3 and need not be further enlarged on here except to state that because of the augmentation of the closing effort of the valve plate by the small piston, the spring does not need to have quite so much strength as in connection with the embodiment shown in Figures 1, 2 and 3.

In the embodiment just described the main spring and/or the spring and cam are so arranged as to compensate for the extra effort of the small piston, which is most effective when the governor valve is wide open and has practically no effect after it is closed a few degrees except when the carburetor throttle valve is more nearly closed than the governor throttle valve. Under conditions of wide open carburetor throttle valve, the torque curve combining the action of the gases on the valve and the vacuum on the piston is substantially balanced by the main spring acting through its cam and the slight unbalance effected by the auxiliary spring is used for the purpose of providing the initial closing torque desired as aforementioned.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A governor for hydrocarbon motors including in combination, a conduit, an unbalanced butterfly valve therein, counterbalancing means connected to substantially balance the turning effort of said valve at a predetermined speed of the motor, including an arm secured to turn with said valve, a second arm, one of said arms having a cam and the other a roller bearing on the cam, yielding means continually acting on said second arm and yielding means acting on said first arm only during the first few degrees of movement of the valve from open position and tending to oppose the first yielding means.

2. The combination with the induction pipe of an internal combustion engine having a manually operable throttle valve therein, of a governor including an unbalanced throttle valve in said induction pipe, between the manually operable throttle valve and the engine cylinders actuated toward closed position by the movement of fuel in the induction pipe, yielding means opposing movement of said unbalanced valve, means to substantially balance the closing effort and the effort of the yielding means at a predetermined speed of the engine and at all positions of the unbalanced valve, a cylinder in the wall of said induction pipe between the valves, a piston in said cylinder having one face exposed to atmospheric pressure and the other to induction pipe pressure, means operatively associating said piston and unbalanced valve, a head on said cylinder and a spring abutting between the head and piston and acting in opposition to the yielding means only for the first few degrees of movement of the unbalanced valve from open position.

3. In a suction governor for internal combustion engines having an unbalanced butterfly valve in the intake conduit actuated in a closing direction by the gas flow conditions in said conduit brought about by operation of the engine, counterbalancing means connected to substantially balance the turning effort of the valve in all positions at a predetermined speed of the motor, including a part mounted to turn with said valve, a spring having one end fixed, means cooperating with said part and connected to the free end of said spring to produce said balance, and yielding means continually acting in opposition to the force exerted by said spring during the first few degrees only of movement of the valve from open position.

4. In a suction governor for internal combustion engines having an unbalanced butterfly valve in the intake conduit actuated in a closing direction by the gas flow conditions in said conduit brought about by operation of the engine, counterbalancing means connected to substantially balance the turning effort of the valve in all positions at a predetermined speed of the motor, including a part mounted to turn with said valve, a spring having one end fixed, means cooperating with said part and connected to the free end of said spring to produce said balance, and yielding means continually acting in opposition to the force exerted by said spring during the first few degrees only of movement of the valve from open position, said yielding means being always of less effective strength than the said spring whereby the valve is readily started toward closed position.

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