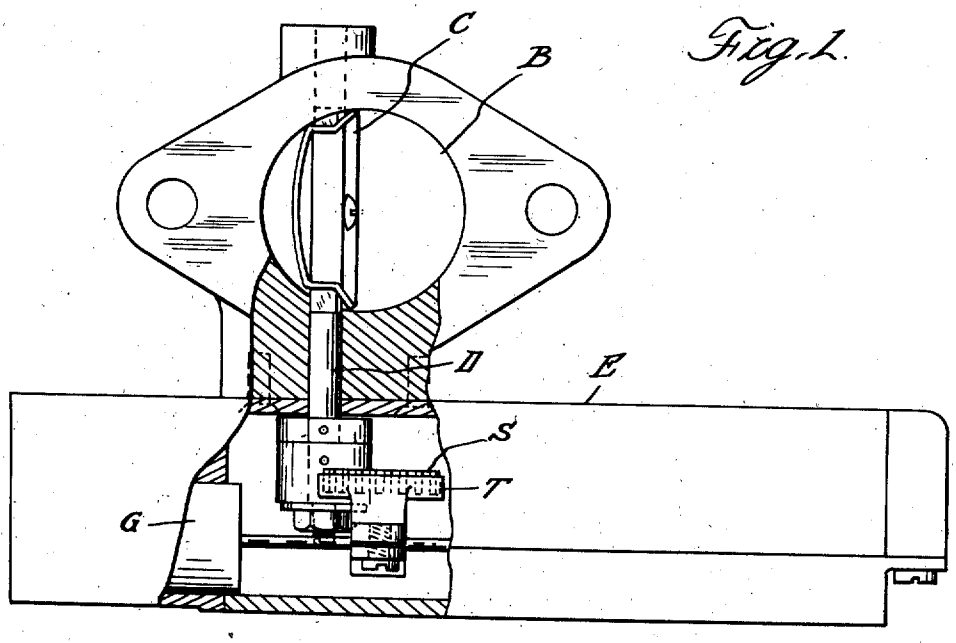
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ENGINE GOVERNOR

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Fig. 1.



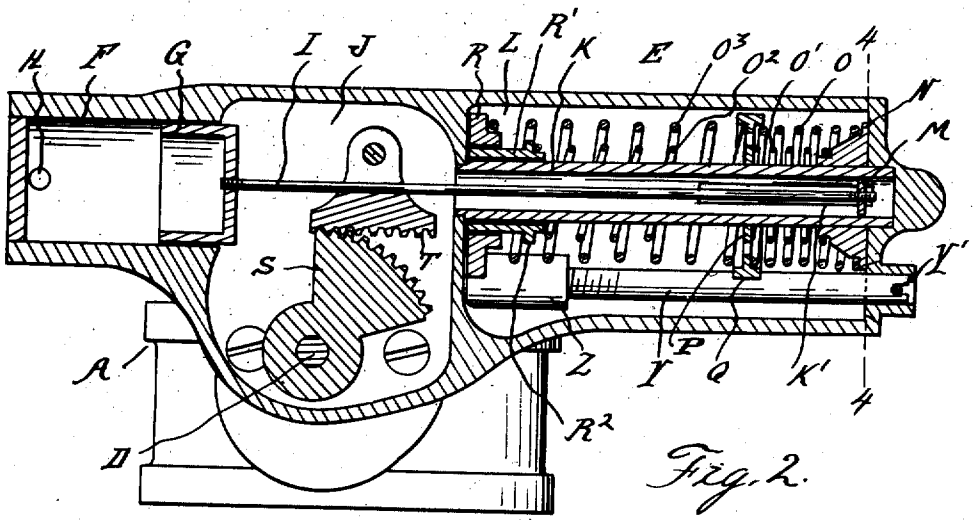


Fig. 2.

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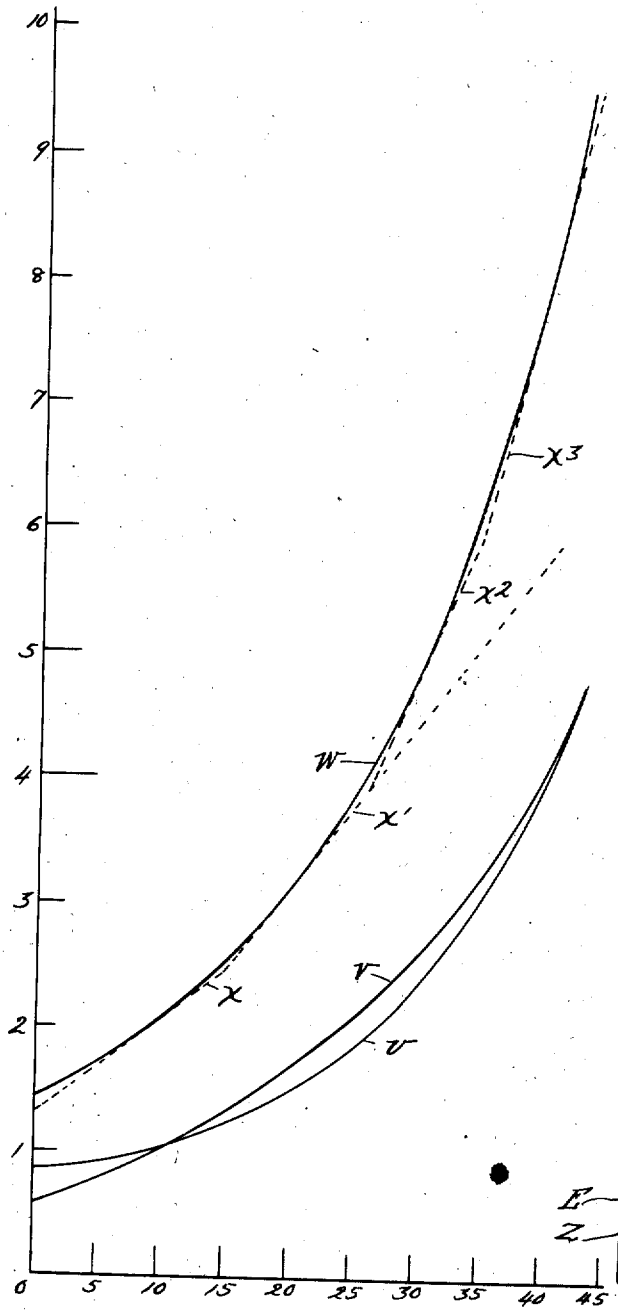
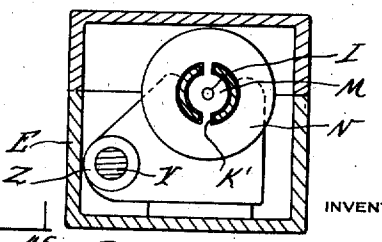


Fig. 3.

Fig. 4.



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ENGINE GOVERNOR

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Application May 27, 1929, Serial No. 366,459

11 Claims. (Cl. 137—153)

The invention relates to speed limiting governors for internal combustion engines of that type in which the force for operating the governor is derived from differential gas pressure. In the present state of the art one construction of governor of this type is organized to derive the actuation force for automatically closing the throttle independent of any force from the throttle itself or other member in the path of the incoming gases. With such construction the force utilized is the differential of static pressures in the engine intake and the external atmosphere, which force is applied through a cylinder and piston or other pneumatic motor. In another construction all of the force for closing the throttle is derived from unbalanced pressures on the throttle itself. With both constructions the throttle is opened by the counter-acting force of a spring which through its own characteristic or through intermediate mechanism balances the opening force to maintain a constant limit of speed with variations in load and power. Each of these constructions has certain advantages and certain detrimental characteristics. Thus with the first mentioned construction the piston required to furnish the necessary motive force is of such size as to be objectionable and to introduce complications in commercial manufacture. The second construction is objectionable primarily for the reason that it is possible to defeat the governing action. This is for the reason that the governing action is dependent upon the differential pressure upon opposite sides of the unbalanced throttle instead of the differential between the pressure on the engine side of the throttle and that of the external atmosphere. Consequently, the operator of a vehicle having such governor can defeat its action by clever manipulation of the manually controlled throttle.

It is the object of the present invention to obtain a construction which comprises the advantages and avoids the defects of each of the constructions above referred to. It is a further object to obtain additional advantages in simplicity of construction, ease of manufacture and accuracy in operation as more fully hereinafter set forth.

In the drawings:

Figure 1 is a sectional plan view of a governor of my improved construction;

Figure 2 is a longitudinal section through the housing for the valve actuating mechanism;

Figure 3 is a graph showing the characteristics of the various forces acting upon the governor;

Figure 4 is a section on the line 4—4 of Fig. 2.

As specifically shown, A is a suitable casing including a conduit portion B which may be inserted between the engine intake manifold and carburetor. C is the governing throttle arranged within the conduit B, this being preferably of butterfly type and designed to expose unbalanced areas on opposite sides of its axis. D is the rock shaft on which the throttle is mounted and which extends from the conduit B into an adjacent housing E. Within this housing E there is arranged a cylinder F containing a piston G; the cylinder being connected by a passageway H with the conduit B on the engine side of the throttle C. The piston G is attached to a stem I which extends through a chamber J and into a tubular guide K in an aligned chamber L. The guide K is longitudinally slotted at K' for the passage of a pin or other connection M between the stem I and a sleeve or collar N slidable on the outside of said guide. This collar N forms an abutment for one or more members of a compound spring including individual springs O, O', O^2, O^3, each having a different characteristic. A second collar P is arranged intermediate the springs O' and O^2 and a collar Q is placed between the springs O and O^3. R is an abutment adjustably mounted on the guide K for the opposite ends of the springs O^2 and O^3.

The collar P is freely slidable on the guide K relatively to and through the central opening in the collar Q, there being a substantial gap between the inner ends of springs O' and O^2, which are separated by collar P, to permit idle travel of the spring O' and collar P toward spring O^2 before either of these springs comes into action. The collar Q is likewise freely slidable on and relatively to the guide K, and is shifted toward the left in Fig. 2 by the travel of the abutment N after collapse of spring O.

With the construction as thus far described it will be understood that the compound spring opposes inward movement of the piston G into the cylinder F and that by properly selecting the individual units of this compound spring any desired characteristic may be imparted thereto. This is because the units operate successively, either individually or in combination so that the graph representing the characteristic is composed of a succession of straight line curves at different angles approximating a continuous curve.

In the intermediate chamber J of the casing A is arranged a gear segment S mounted on the shaft D and a rack member T mounted on the stem I. These cooperate to translate the angular movement of the throttle C and shaft D into

rectilinear movement of the stem I in the direction of the axis of the cylinder F. Thus the forces derived from the piston and cylinder will be communicated to both the stem I and to the shaft D and throttle C, while in the same manner force derived from the throttle C will be communicated to the stem I. The arrangement is also such that the movement of the stem I under the actuation of unbalanced forces on the throttle is in the same direction as the movement under actuation of the piston G in the cylinder F and the combined force from both of these sources is counter to the force of the compound spring.

As graphically represented in Figure 3, U is a curve having the characteristic of the variable force on the piston G in different angular positions of adjustment of the throttle and at maximum limit of engine speed. V is a curve characteristic of the differential force on the throttle C under the same conditions. W is a curve which is characteristic of the combination of the forces of the curves U and V. The characteristics of the compound spring are indicated by the dotted lines X, X', X^2, X^3, each being a straight line curve which is tangent to a portion of the curve W. Thus it will be seen that the characteristic of the compound spring approximates that of the combined forces operating on the throttle and the piston G. Furthermore, with the specific arrangement shown the characteristic of the straight line section X is produced by the combined action of the springs O and O^3. The spring O is of lighter tension than the spring O^3 and abuts at one end against the collar N and at its opposite end against the intermediate collar Q which also constitutes the abutment for the spring O^3. Thus in the first portion of the movement of the stem I and the collar N, the spring O will be fully collapsed so as to become a practically rigid member. The characteristic represented by the straight line curve X' is produced by the action of the spring O^3 alone, there being provided sufficient clearance or lost motion between the spring O' and O^2 to delay their coming into action. The characteristic of the straight line curve X^2 is produced by the combined action of springs O', O^2 and O^3, this occurring after the lost motion between the springs O' O^2 and the collar Q has been taken up. The characteristic of the straight line curve X^3 is produced by the action of springs O^3 and O^2 which occurs after the collapsing of the spring O' so as to render this member substantially rigid.

In operation, when the governor is properly adjusted, its action is as follows: Assuming the vehicle to be running at maximum or limit speed but under very light load as for instance on a down grade, the throttle C will assume a nearly closed position. This is due both to the differential pressure on the unbalanced throttle and the pressure on the piston G due to the depression in the cylinder F which communicates with the intake on the engine side of the throttle. These combined forces are sufficient to balance the resilient pressure of the spring as represented by the portion X^3 of the graph. As soon, however, as the vehicle meets greater resistance so that its speed is reduced, the combined forces of the unbalanced throttle and of the piston G are lessened so that the spring will, through the medium of the collar N, stem I, rack T, segment S and shaft D, adjust the throttle to a more open position. With further increase in load, there will be a still further opening of the throttle until at maximum load it will assume wide open position. On the other hand, when the load is decreased, the engine speed will be accelerated which by developing greater forces acting upon the unbalanced throttle and the piston G will bring about the adjustment of the throttle to a more closed position.

Some of the advantages of my improved construction are:

First:—Only a portion of the force required for closing the throttle is developed through pressure on the throttle itself and therefore the friction is much less than would be the case if all the force were developed through the unbalanced throttle;

Second:—The forces of the piston and spring are rectilinear and in opposite directions and the force exerted by the throttle is translated into a rectilinear force in the same direction. This also produces frictional resistance and increases the sensitiveness of the governor in operation;

Third:—A constant ratio transmission is used between the throttle shaft and the opposing forces which simplifies the adaptation of the throttle to different uses as either one may be changed independent of the other;

Fourth:—Adaptation to engines having different manifold pressures may be accomplished by more or less closing or opening of the connecting passage between the cylinder and manifold. This also permits of setting the throttle in wide open position when maximum power is required and starting the closing effort of the valve by opening the orifice leading to the piston.

It is desirable to have a governor so constructed that it may be set to operate at different maximum speeds. This I have accomplished by providing means for adjusting the abutment R so as to place the springs O O^3 under initial compression. If, however, a single abutment were used for the springs O^2 and O^3 such adjustment would alter the amount of lost motion before bringing the springs O^2 and O' into action, which would change the characteristic of the compound spring as a whole. I have therefore devised a construction in which the spring O^2 abuts against a collar R' sleeved on the guide K and independent of the collar R forming the abutment for the spring O^3. The collar R' is, however, provided with a shoulder R^2 which after a certain degree of adjustment of the collar R will contact therewith so that further adjustment will move both abutments together. Thus by suitably proportioning the parts it is possible to adjust the compound spring so that the governor will function correctly at each of a series of varying maximum speeds.

As specifically shown, this adjustment means comprises a screw threaded stem Y located in the chamber L but having a head portion Y' extending outside of the casing A. The threaded portion of the stem Y engages a nut Z attached to the abutment R which latter is apertured to be sleeved about the abutment R'.

By turning the slotted head Y' of stem Y the nut Z may be shifted longitudinally. Since abutment R is attached to nut Z it will be seen that rotation of stem Y will shift the member R relatively to and on the cylindrical bearing portion of member R'. Movement of member R to the right in Fig. 2 as far as stop shoulder R^2 will only effect an adjustment of springs O^3 and O by compression thereof, or in other words, a differential adjustment of the outer and inner sets of springs. Further movement of member R to the right will

cause simultaneous movement of members R and R' through engagement of member R with the stop R^2.

What I claim as my invention is:

1. A governor for internal combustion engines comprising an engine inlet conduit, an unbalanced throttle therein adapted to be actuated by the gaseous stream towards closed position, a rock shaft on which said throttle is mounted, a cylinder in communicating connection with said inlet on the engine side of the throttle, a piston in said cylinder movable therein in a rectilinear direction, a constant ratio transmission between the throttle rock shaft and said piston whereby the movement of one is communicated to the other, and resilient means acting in the rectilinear direction of movement of said piston and operating the same to open the throttle, said resilient means having a characteristic substantially that of the combined closing forces.

2. A governor for internal combustion engines comprising a casing having a conduit section adapted for connection into the engine intake, an unbalanced throttle in said conduit section adapted to be actuated by the gaseous stream towards closing position, a rock shaft on which said throttle is mounted, a cylinder in said casing in communication with said conduit on the engine side of the throttle, a piston in said cylinder, a stem connected to said piston in axial alignment therewith, a guide for said stem, a rack on said stem and an intermeshing gear segment on said rock shaft, a compound coil spring sleeved about said stem, a collar on said stem forming a movable abutment for one end of said compound spring and a normally stationary abutment for the opposite end of said compound spring.

3. A governor for internal combustion engines comprising a casing having a conduit section adapted for connection into the engine intake, said casing being also provided with a transversely extending chambered portion including a cylinder in communication with said conduit, an unbalanced throttle in said conduit section, a rock shaft on which said throttle is mounted extending into said chambered portion, a piston in said cylinder, a stem connected to said piston in axial alignment therewith and extending in said chambered portion, a slotted tubular guide for said stem, a rack on said stem and an intermeshing gear segment on said rock shaft, a collar slidable on said tubular guide and connected through the slot therein with the stem, a compound coil spring sleeved about said guide and having one end abutting against said collar, said spring having a plurality of members having different characteristics, at least one of said members being adapted to collapse during the movement of said collar and to become rigid, and at least one of said members having a clearance or lost motion to delay its coming into action in the movement of said collar, and a normally stationary abutment for the opposite end of said compound spring.

4. A governor for internal combustion engines comprising a casing having a conduit section adapted for connection into the engine intake, said casing being also provided with a transversely extending chambered portion including a cylinder in communication with said conduit, an unbalanced throttle in said conduit section, a rock shaft on which said throttle is mounted extending into said chambered portion, a piston in said cylinder, a stem connected to said piston in axial alignment therewith and extending in said chambered portion, a slotted tubular guide for said stem, a rack on said stem and an intermeshing gear segment on said rock shaft, a collar slidable on said tubular guide and connected through the slot therein with the stem, a compound coil spring sleeved about said guide and having one end abutting against said collar, said spring consisting of a plurality of members having different characteristics and arranged in concentric pairs, each of said pairs having aligned members, one of which is adapted to be collapsed and to become rigid and the members of one pair being arranged for lost motion to delay their coming into action and a normally stationary abutment on the opposite end of said concentric pairs.

5. A governor for internal combustion engines comprising a casing having a conduit section adapted for connection into the engine intake, said casing being also provided with a transversely extending chambered portion including a cylinder in communication with said conduit, an unbalanced throttle in said conduit section, a rock shaft on which said throttle is mounted extending into said chambered portion, a piston in said cylinder, a stem connected to said piston in axial alignment therewith and extending in said chambered portion, a slotted tubular guide for said stem, a rack on said stem and an intermeshing gear segment on said rock shaft, a collar slidable on said tubular guide and connected through the slot therein with the stem, a compound coil spring sleeved about said guide and having one end abutting against said collar, and an adjustable abutment for the opposite end of said compound spring.

6. In a governor for internal combustion engines, the combination with a throttle valve and pneumatic means for actuating said valve towards closed position, of a compound spring including a plurality of spring elements, said compound spring having a characteristic corresponding to that of the closing force at a predetermined maximum speed, and a single adjustment device for differentially and relatively adjusting said elements to change the characteristic of said compound spring to correspond to the pneumatic force at a different maximum speed.

7. In a governor for an internal combustion engine having an intake passage, the combination of a throttle valve in said passage adapted to be shifted toward closed position by differential pressure in said intake, spring mechanisms for resisting closing movement of said valve, including a pair of springs, and a device for independently adjusting each spring and also one spring relatively to the other.

8. In a governor for an internal combustion engine having an intake passage, the combination of a throttle valve in said passage adapted to be shifted toward closed position by differential pressure in said intake, spring mechanism for resisting closing movement of said valve, comprising a pair of springs located one within the other and means operative at adjacent ends of the springs for simultaneously and relatively adjusting the springs.

9. In a governor for an internal combustion engine having an intake passage, the combination of a throttle valve in said passage adapted to be shifted toward closed position by differential pressure in said intake, spring mechanism for resisting closing movement of said valve, including a pair of springs and a pair of abutments therefor, and means for simultaneously and differentially adjusting said abutments.

10. In a governor for an internal combustion engine having an intake passage, a throttle valve in said passage, a piston for moving said valve toward closed position, spring mechanism for resisting said movement and comprising outer and inner spring means, one operating within the other, the inner spring means comprising a plurality of individual springs, and a common means operated by the piston for successively actuating the outer spring means and shifting the inner springs into operation one against the other.

11. A governor for internal combustion engines comprising a casing having an intake passage adapted for connection with the intake of the engine, an unbalanced butterfly valve in said passage adapted to be actuated toward closed position by the gaseous stream passing toward the engine, means arranged out of the path of travel of the gaseous stream for exerting an additional force tending to close said valve substantially throughout the governing range and comprising a piston subjected on one side to the static pressure in said intake passage at the engine side of the axis of the valve and on the other to atmospheric pressure, a connection between said piston and valve whereby the valve will be moved toward closed position when the piston is moved by the atmospheric pressure thereon, and resilient means arranged to oppose the closing movement of said valve and having a characteristic substantially that of the combined forces tending to close said valve.

RAYMOND HUFFORD.

CERTIFICATE OF CORRECTION.

Patent No. 2,100,805. November 30, 1937.

RAYMOND HUFFORD.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 52, claim 7, for the word "mechanisms" read mechanism; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of February, A. D. 1938.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.

10. In a governor for an internal combustion engine having an intake passage, a throttle valve in said passage, a piston for moving said valve toward closed position, spring mechanism for resisting said movement and comprising outer and inner spring means, one operating within the other, the inner spring means comprising a plurality of individual springs, and a common means operated by the piston for successively actuating the outer spring means and shifting the inner springs into operation one against the other.

11. A governor for internal combustion engines comprising a casing having an intake passage adapted for connection with the intake of the engine, an unbalanced butterfly valve in said passage adapted to be actuated toward closed position by the gaseous stream passing toward the engine, means arranged out of the path of travel of the gaseous stream for exerting an additional force tending to close said valve substantially throughout the governing range and comprising a piston subjected on one side to the static pressure in said intake passage at the engine side of the axis of the valve and on the other to atmospheric pressure, a connection between said piston and valve whereby the valve will be moved toward closed position when the piston is moved by the atmospheric pressure thereon, and resilient means arranged to oppose the closing movement of said valve and having a characteristic substantially that of the combined forces tending to close said valve.

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