July 17, 1923.

1,461,933

E R. PIERCE

SPEED GOVERNOR FOR INTERNAL COMBUSTION ENGINES

Filed Oct. 31, 1919

2 Sheets-Sheet 1

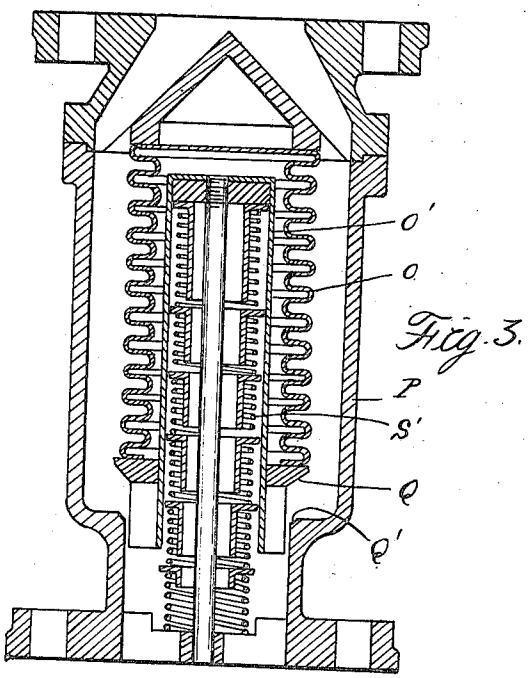


Fig. 3.

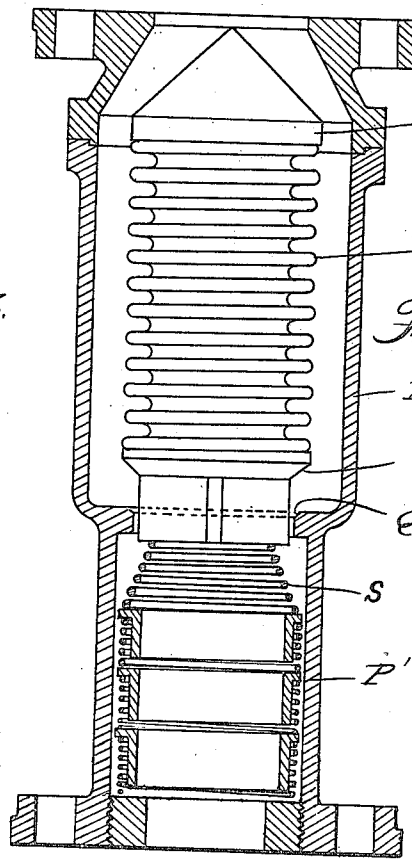
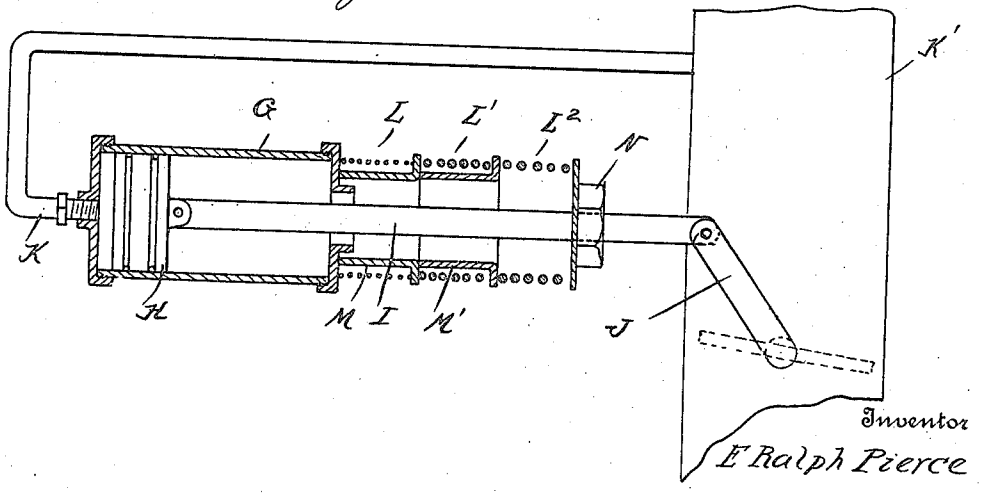


Fig. 2.

Fig. 1.



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E Ralph Pierce

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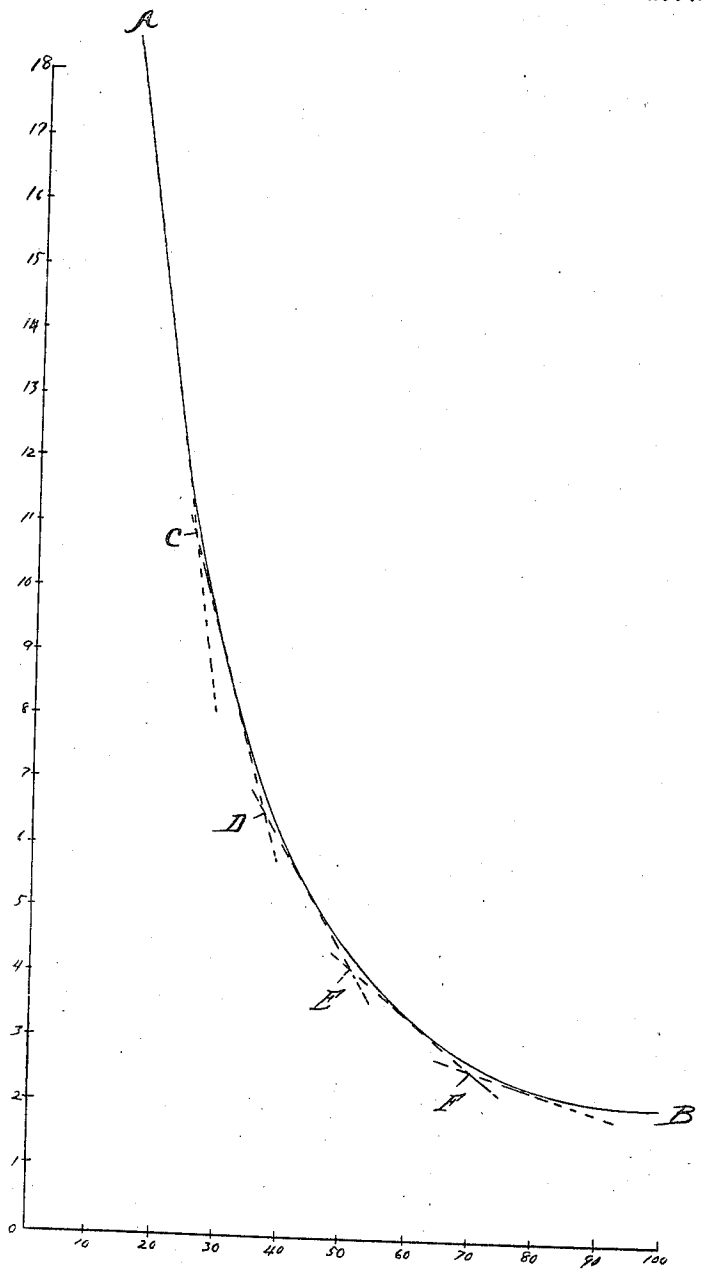
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2 Sheets-Sheet 2

Fig. 4.



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UNITED STATES PATENT OFFICE.

E RALPH PIERCE, OF ROCHESTER, MICHIGAN, ASSIGNOR TO MONARCH GOVERNOR COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN.

SPEED GOVERNOR FOR INTERNAL-COMBUSTION ENGINES.

Application filed October 31, 1919. Serial No. 334,748.

To all whom it may concern:

Be it known that I, E RALPH PIERCE, a citizen of the United States of America, residing at Rochester, in the county of Oakland and State of Michigan, have invented certain new and useful Improvements in Speed Governors for Internal-Combustion Engines, of which the following is a specification, reference being had therein to the accompanying drawing.

The invention relates to governors for internal combustion engines of that type in which the admission of the combustible charge is controlled by slight variations in speed to prevent further variation. It is the object of the invention; first, to obtain more sensitive means of response to variations; second, to simplify the construction.

For various uses it is desirable to govern internal combustion engines so as to maintain a substantially constant maximum speed, or a predetermined limit of speed under varying conditions of load. In one type of governor this is accomplished by mechanical means driven by a moving part which adjusts the throttle, or other controlling means, for the combustible mixture. In another type an adjustment is accomplished by the variable pressure of gases passing through the intake. With both types there is required a counter-acting force, such as a spring, or its equivalent, but difficulty has been experienced in securing a proper reaction. This is for the reason that the curve representing the reaction of an ordinary spring differs from the curve representing the variable force derived from the engine and it is therefore difficult to obtain the balancing of force required for corrective adjustment of the throttle.

It is one of the features of my improved construction that the force employed for adjusting the throttle is the variable static within the intake. Another feature is the peculiar characteristic of the reactive force and the method of obtaining the same, as hereinafter set forth.

In the drawings:

Figure 1 is a diagrammatic longitudinal section through one form of my improved governor;

Figures 2 and 3 are similar views of modified constructions;

Figure 4 is a diagram illustrating the method of deriving a spring, or other re-active force, corresponding in characteristic to the variable force derived from the engine.

My improved governor is applicable either to engines controlled by a throttle, or to those in which the control is over the fuel alone and not the combustible mixture. I have, however, specifically shown and will describe this application to the former type only. With this type for each variation in load there must be a corresponding adjustment of the throttle if the speed or R. P. M. is maintained substantially constant. Also for each adjustment of the throttle, the load varying and the R. P. M. remaining constant, there will be a definite condition of pressure within the intake. Making use of the latter fact, my improved governor operates upon the principle of adjusting the throttle by variations in the static pressure within the intake in cooperation with a properly compensated spring or other opposing force.

The method of deriving the proper adjustment of opposed force is as follows: The engine is operated under varying loads and with each variation the throttle is adjusted until a predetermined constant maximum speed is obtained. Also with each adjustment, the static pressure within the intake is accurately measured. A curve is then plotted in variables of throttle opening and intake pressure to determine the proper characteristic of the re-active force required. This curve, as represented by the line A—B in Figure 4, has a very different characteristic from the curve of an ordinary spring, which latter is a substantially straight line as, for instance, represented by the line A—C in Figure 4. However, a series of straight lines, respectively tangent to different portions of the curve A—B, will if combined have substantially the same characteristic as said curve, and each of these straight lines is representative of a particular spring, or group of springs. Thus, as shown, the line A—C, which is tangent to a portion of the curve A—B, represents a spring of certain tension; the line C—D, which is tangent to another portion of said curve, represents a spring, or a group of springs, of a different tension; the line D—E, which is tangent to a succeeding portion of the curve, repre-

sents still another spring or group of springs, and so on. To produce a spring having the characteristic of the curve A—C, D—E, etc., a series of simple springs may be compounded, so that their combined effect will correspond to the curve. Thus, in each position of adjustment the re-action of the spring will correspond to the force derived from the intake, producing a state of equilibrium.

The construction illustrated in Figure 1 is one form of my invention, in which G is a cylinder containing a piston H which is connected by the pitman rod I with the rock-arm J for adjusting the throttle. K is a conduit leading from the end of the cylinder G to the engine intake K′, by which the pressure within said cylinder is equalized with the static pressure within the intake. L, L′, L² are the several units of a compound spring, each of which is selected to produce, in cooperation with the other units, the desired characteristic. These springs, as shown, are arranged in tandem and surround the rod I, each element having its action limited by a suitable stop, such as formed by the thimbles M, M′, etc. One end of the spring abuts against the cylinder G, while the opposite end is in engagement with a collar on the rod I, such as the nut N.

In operation, whenever there is a change in load upon the engine, this will produce a change in static pressure within the intake, which is communicated to the cylinder G. This in turn will unbalance the pressures upon opposite sides of the piston H, one side of which is exposed to atmospheric pressure, and the differential pressure assisting or opposing the compound spring will cause an adjustment of the piston, which through the rod I operates the rock-arm J and adjusts the throttle. Furthermore, the several elements of the spring will operate successively, the action being limited by the stop thimbles M, M′, etc., thereby producing just the required movement of the throttle for each change of load to maintain the R. P. M. constant.

In the modified constructions shown in Figures 2 and 3 the same principle is employed in a more compact structure. Thus in Figure 2, O is a collapsible sealed chamber of bellows form, which is arranged within the casing P, forming a portion of the intake. One end of this chamber is attached to a valve Q for engaging a seat Q′ and which forms the governing throttle, while the other end of the chamber is anchored to a suitable spider R. A compound spring S, similar in construction to that shown in Figure 1, is arranged within a portion P′ of the casing to operatively engage the valve Q. With this construction the operation is substantially the same, the static pressure within the casing P varying with load, while the pressure of the air sealed within the chamber O, or in communication with the external atmosphere, is substantially constant.

In the construction shown in Figure 3, the arrangement is substantially the same as in Figure 2, with the exception that the chamber O has arranged therewithin the casing O′ within which is located the compound spring S′.

In each of the several modifications, variations in static pressure incident to a change of load on the engine will unbalance the opposing forces resulting in adjustment of the throttle, or other engine controlling means, so as to maintain with the changed load a substantially constant speed.

What I claim as my invention is—

1. A governor for internal combustion engines comprising a controlling member subjected to variable pressure corresponding to variations in static pressure in the intake incident to changes in the load, a plurality of springs arranged in tandem forming an opposing pressure upon said member, and thimbles separating said springs, each of said springs being of different tension.

2. A governor for internal combustion engines comprising a controlling member subjected to variable pressure corresponding to variations in static pressure in the intake incident to changes in the load, a plurality of springs of different tension arranged in tandem to form an opposing pressure upon said member, and means for limiting the action of each of said springs to a predetermined range whereby said controlling member is actuated to maintain a substantially constant speed of the engine under changing loads.

3. A governor for internal combustion engines comprising a controlling member subjected to variable pressure corresponding to the variations in static pressure in the intake incident to changes in load, a plurality of springs arranged to form an opposing pressure upon said member, and means for limiting the action of each of said springs to a predetermined range whereby the combined action of said springs corresponds to a predetermined characteristic.

4. A governor for internal combustion engines comprising a controlling member subjected to variable pressures incident to variations in operating the engine, a plurality of springs arranged to form an opposing pressure upon said member, and means for limiting the action of one of said springs whereby the combined action of said springs corresponds to a predetermined characteristic such as to maintain under changing loads a substantially constant speed.

5. In a governor for internal combustion engines the combination with a throttle

valve controlling the fuel supply to the intake, of a member for actuating said throttle subjected to variable pressure corresponding to the static pressure in said engine, a plurality of springs arranged to form an opposing pressure upon said member, and means for limiting the action of each of said springs to a predetermined range whereby the combined action of said springs has a characteristic such as to maintain substantially constant speed under varying conditions of load.

In testimony whereof I affix my signature.

E RALPH PIERCE.