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SPEED GOVERNING MECHANISM

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Fig. 1

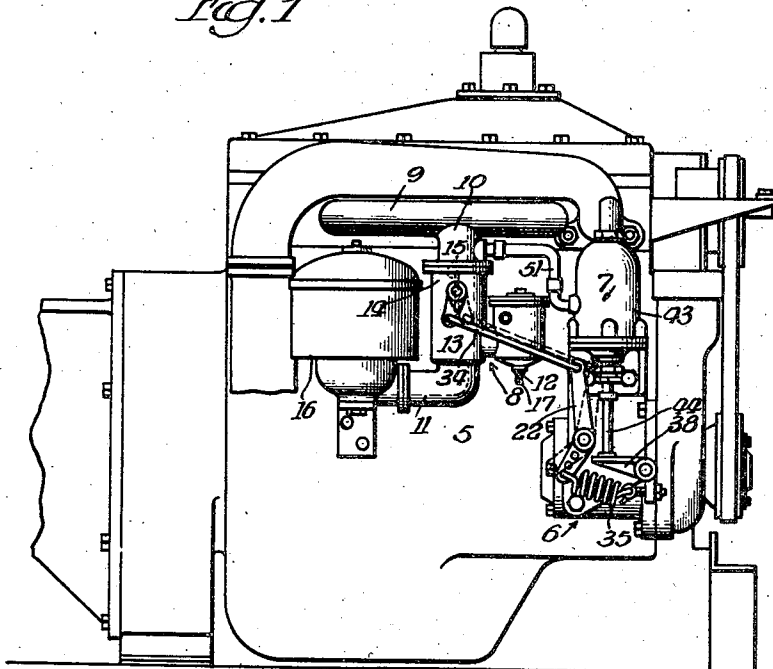
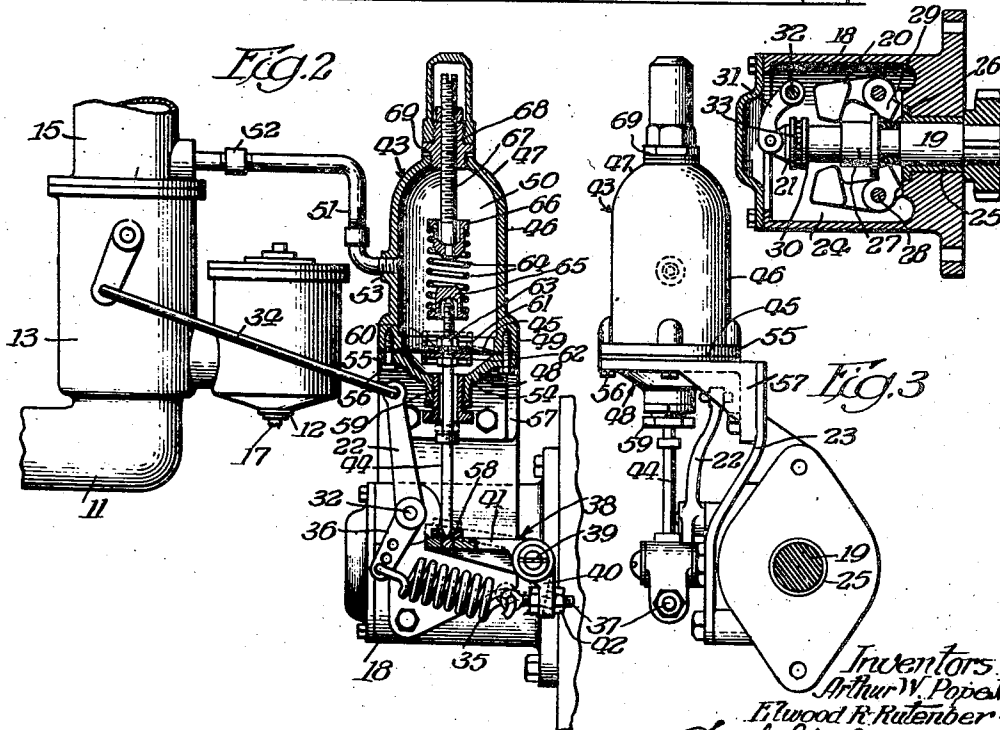


Fig. 4



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SPEED GOVERNING MECHANISM

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7 Claims. (Cl. 123-103)

The present invention relates generally to speed governing mechanism. More particularly the invention relates to that type of speed governing mechanism which is designed for use with, and to form an operating or control part of, an internal combustion engine having an intake manifold for gaseous fuel or air and a butterfly valve for controlling the passage of fuel or air to the combustion chambers via the intake manifold, and comprises an engine driven conventional fly-weight governor for automatically adjusting or controlling the butterfly valve in order to maintain a substantially fixed or set engine speed, and in addition a device for modifying the valve control action of the governor under certain operating conditions of the engine.

One object of the invention is to provide a speed governing mechanism of this type which includes a novel form or type of governor modifying device whereby the mechanism as a whole is capable of maintaining the idle or light load governed speed and the full load governed speed of its engine more nearly alike than previously designed mechanism of the same general character.

Another object of the invention is to provide a speed governing mechanism of the type under consideration in which the device for modifying the valve control action of the governor under certain operating conditions of the engine is in the form of a pneumatic compensator which operates in response to suction or vacuum variations in the intake manifold due to changes in the load on the engine to vary the loading of the fly-weight resisting spring of the governor.

Another object of the invention is to provide a speed governing mechanism of the last mentioned character in which the pneumatic compensator comprises a casing with a vacuum chamber therein in communication with the interior of the intake manifold of the engine, and also comprises a flexible diaphragm which is mounted in the casing to fluctuate in response to suction or vacuum variations in the vacuum chamber and operates through the medium of a mechanical arrangement such as a push-rod and bell crank or push-rod only between it and the fly-weight resisting spring of the governor to reduce or lessen the loading of the governor spring and reduce the governed speed of the engine at high manifold vacuum due to light load on the engine or idle running of the engine and to increase the tension or loading of the governor spring and thus increase the governed speed

of the engine when the manifold vacuum is low due to heavy or full load on the engine.

Another object of the invention is to provide a speed governing mechanism of the type and character under consideration in which the vacuum chamber in the casing of the pneumatic compensator is of such volume and the connection between the chamber and the intake manifold is so proportioned that manifold pressure fluctuations as well as governor surge characteristics are effectively and efficiently eliminated or damped.

A further object of the invention is to provide a speed governing mechanism of the hereinbefore mentioned type and character in which the pneumatic compensator includes as parts thereof a spring for the flexible diaphragm and adjusting means for such spring whereby compression or loading of the spring may be varied in order to change the performance or engine controlling characteristics of the governor.

A still further object of the invention is to provide a speed governing mechanism which may be produced at a low and reasonable cost and is not only efficient in operation but also compact and practical from a design or construction standpoint.

Other objects of the invention and the various advantages and characteristics of the present speed governing mechanism will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawing which accompanies and forms a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a side elevation of an internal combustion engine with a speed governing mechanism embodying the invention;

Figure 2 is an enlarged vertical section of the pneumatic compensator of the mechanism, illustrating in detail the construction and arrangement of the various parts of the compensator and showing the manner in which the flexible diaphragm of the compensator is operatively connected to the fly-weight resisting spring of the governor;

Figure 3 is an enlarged elevation of the speed controlling mechanism, taken at right angles to the elevation constituting Figure 1; and

Figure 4 is a vertical longitudinal section of the engine governor.

The speed governing mechanism which is shown in the drawing constitutes the preferred embodiment of the invention. It is designed for use in connection with, and serves as an operating part of, a multi-cylinder internal combustion engine 5, and comprises as its primary parts or elements an engine governor 6 and a pneumatic compensator 7 for modifying the action or operation of the governor. The engine 5 is of standard or conventional construction and is designed to have gaseous fuel supplied to the combustion chambers thereof by way of a carburetor 8 and an intake manifold 9. The intake manifold is connected to one side of the cylinder block of the engine and has a depending inlet nipple 10. The carburetor 8 underlies this nipple and has an inlet 11 for air, an inlet 12 for fluid fuel, an air and fuel mixing chamber 13, an upstanding gaseous fuel outlet 14, and a butterfly valve 15. The air inlet is provided with an air strainer 16 at its outer end and operates to deliver air into the mixing chamber 13 for admixture with the fluid fuel. The inlet 12 of the carburetor leads to the mixing chamber 13 and is connected to a source of fluid fuel by way of a pipe 17. The upstanding outlet is connected to and communicates with the inlet nipple 10 and serves when the engine is in operation to deliver gaseous fuel from the mixing chamber 13 to the intake manifold 9 for passage into the combustion chambers. The valve 15 serves to control the speed of the engine by regulating the amount of gaseous fuel passing into the combustion chambers via the intake manifold 9. It is automatically actuated or controlled, as hereinafter described, by the governor and is mounted in the outlet 14 for pivotal or swinging movement about a horizontal axis.

The governor 6 is positioned at one side of the engine 5 in opposed relation to the air strainer 16 and the carburetor air inlet 11 and consists of a housing 18, a drive shaft 19, a plurality of fly-weights 20, a shift plate 21, and an upstanding lever 22. The housing 18 is substantially cylindrical and extends horizontally. It is suitably fixed to the engine by a bracket 23 and has a cover closed chamber 24 therein. The bracket 23 is upwardly elongated and operates to support the compensator 7 above the governor, as shown in the drawing. The shaft 19 is journaled in a bearing 25 in one end of the housing 18 and is connected for drive by the engine 5 in any suitable manner. The inner end of the shaft 19 projects into the chamber 24 and has mounted thereon a weight support 26 and a flanged sleeve 27. The weight support 26 is keyed or otherwise fixedly secured to rotate with the shaft 19 and carries hinge pins 28. The fly-weights 20 are mounted on these pins so that during drive of the shaft 19 they are permitted to swing or fly outwards in response to centrifugal force. They are disposed in the chamber 24 and have inwardly extending legs 29 which abut against the flange of the sleeve 27 and operate in response to outward movement of the weights to shift the sleeve 27 axially away from the bearing 25, that is, in the direction of the carburetor 8. The sleeve is slidably mounted on the inner end of the shaft 19 and embodies in addition to the leg engaged flange a disk-like head 30. The shift plate 21 is aligned with and spaced a small distance from the head 30 and is pivotally connected to one end of an arm 31. This arm is dis-

posed in the chamber 24 in the governor housing 18 and is keyed or otherwise fixedly secured at its other end to a horizontally extending rock shaft 32 which extends through and is journaled in opposed bearings in the side wall of the cylindrical governor housing 18. A ball bearing 33 in the form of an annular retainer and a series of steel balls, is disposed between the shift plate 21 and the disk-like head 30 on the sleeve 27 and operates in response to shift of the sleeve by the weights 20 to shift the plate 21 so that it rocks the shaft 32 in one direction. The lever 22 is disposed exteriorly of the governor housing 18 and is fixed to one end of the shaft 32 so that it rocks therewith. A rod 34 extends between and is pivotally connected to the control valve of the carburetor 8 and the distal end of the lever 22. When the shaft 32 is rocked as a result of outward movement of the weights of the governor the lever 22 swings in one direction and operates through the medium of the rod 34 to close the control valve so that it operates to cut down or retard the speed of the engine 5. A tension spring 35 opposes outward movement of the fly-weights 20 and in addition serves to urge the control valve into its open position. This spring is connected at one end thereof to an arm 36 which is formed integrally with, and extends radially and downwardly from, the hub portion of the lever 22. The other end of the spring is anchored or attached by way of an I-bolt 37 to a bell crank 38. The latter, as shown in Figure 2, is pivotally connected by way of a horizontal pivot stud 39 to the lower end of the bracket 23 and embodies a downwardly extending substantially vertical arm 40, and a horizontally extending arm 41. The I-bolt 37 extends through the distal end of the arm 40 and is provided on opposite sides of said arm with nuts 42 whereby it may be adjusted longitudinally in connection with manual adjustment or setting of the spring 35. When it is desired to increase the normal operating speed of the engine the tension of the spring 35 is increased by adjusting the I-bolt 37 away from the arm 36. When it is desired to decrease the normal operating speed of the engine, the tension of the spring 35 is decreased by adjusting the I-bolt towards the arm 36. The nuts 42 on the I-bolt 37 constitute means whereby the governor may be manually adjusted when it is desired either to increase or decrease the normal operating speed of the engine. When the engine is rotating at its normal operating speed the fly-weights 20 are held against outward movement by the action of the spring 35. If for any reason there is a tendency of the engine to increase in speed, that is, to assume an abnormal speed, the fly-weights swing or fly outwards against the force of the spring 35 and through the medium of the sleeve 27, the shift plate 21, and the arm 31 rotate the rock shaft 32 so that it together with the lever 22 and the rod 34 closes to a certain extent the butterfly valve 15 and thus slows down or reduces the speed of the engine.

The compensator 7 operates, as hereinafter described, so to modify or control the action of the governor that the latter in turn controls the engine so that the latter's idle or light load governed speed is substantially identical to its full load governed speed. It operates in response to vacuum variations in the intake manifold due to changes in the load on the engine to vary the loading or tension of the governor spring 35 and comprises a vertically extending casing 43, 75

a push rod 44, and a flexible diaphragm 45. The compensator casing is mounted over the bell crank 38 of the governor 6 and consists of a cylindrical side wall 46, a dome shaped top wall 47, and a removable bottom wall 48. The side wall embodies an integral out-turned annular flange 49 at its lower end and defines with the dome-shaped top-wall 47 a vacuum-chamber 50. The latter is in communication with the intake manifold 9 of the engine 5 by way of a pipe 51 and hence is subject to the vacuum or suction variations in said manifold. One end of the pipe 51 is connected by way of a nipple 52 to the inlet nipple 10 of the intake manifold and the other end of the pipe fits within and is connected by a screw thread connection to an integral annular boss 53 on the cylindrical side wall 46 of the compensator casing 43. The bottom wall 48 is disposed beneath the lower end of the side wall 46 and embodies a downwardly dished central portion 54, and an annular marginal flange 55. The flange 55 of the bottom wall underlies the out-turned flange 49 at the lower end of the side wall of the compensator casing 43 and is connected to such flange by an annular series of bolts 56. A lug 57 is formed integrally with and depends from one side of the flange 55 and this flange fits against and is bolted to the upper end of the bracket 23 and serves to hold the pneumatic compensator in connected relation with the generator. The push-rod 44 extends vertically and is arranged or positioned so that the lower end thereof engages the outer or distal end of the horizontally extending arm 41 of the bell crank 38. Preferably the lower end of the push-rod is pointed and fits within a tapered socket in a button-like formation 58 on the arm 41. The central portion of the push-rod extends through and is slidably mounted in a stuffing box 59 at the center of the downwardly bulged central portion 55 of the bottom wall 48. The upper end of the push-rod projects into the lower end of the vacuum chamber 50 and terminates an appreciable distance above the out-turned annular flange 49. The push-rod operates in response to vertical sliding thereof to rotate the bell-crank 38 and thus vary the tension of the fly-weight resisting spring 35 of the governor. When the push-rod 44 is slid downwards, the bell-crank 38 is rotated counterclockwise, as viewed in Figure 2, with the result that the arm 40 is swung away from the arm 36 and places the spring 35 under increased tension. When the push-rod 44 is slid upwards with respect to the compensator casing 43, the bell-crank 38 rotates clockwise with the result that the arm 40 is swung towards the arm 36 and the spring 35 is placed under less tension. The diaphragm 45 is located at the bottom of the vacuum chamber 50 and has a central hole 60 through which extends the upper end of the push-rod 44. The outer margin of the diaphragm fits and is clamped between the opposed flanges 49 and 55 of the side and bottom walls of the compensator casing. The central portion of the diaphragm, that is, the portion which surrounds the upper end of the push-rod is fixedly connected to the push-rod by way of an upper washer 61 and a lower washer 62. The two washers surround the upper end of the push-rod and are clamped against the central portion of the diaphragm by means of a pair of nuts 63. As the result of the joint or connection between the push-rod and the central portion of the diaphragm the push-rod is caused

to move upwards in response to upward flexure of the diaphragm and is caused to move downwards when the diaphragm recedes or flexes downwards. A vertically extending compression spring 64 is disposed in the vacuum chamber 50 and serves to retract or flex downwardly the diaphragm and counteract the tendency of the bell-crank 38 to rotate clockwise in response to the action of the spring 35. The lower end of the spring 64 surrounds the upper end of the push-rod 44 and is operatively connected to such end by means of a thimble 65. The upper end of the compression spring 64 is provided with a thimble 66 and this thimble fits around the lower end of a vertically elongated adjusting screw 67. The upper end of the screw 67 extends through an internally threaded bore 68 in a screw plug 69 in the central portion of the top wall 47 of the compensator casing 43. By turning the screw 67 in one direction or the other the tension of the spring 64 may be increased or decreased and the compensator thus adjusted. The compression spring 64 is normally under such adjustment that it retains the diaphragm 45 in its downwardly flexed position when the intake manifold vacuum is low due to heavy or full load on the engine, and collapses and permits upward flexure of the diaphragm when the intake manifold vacuum is high due to light load on the engine or idle running of the engine.

Assuming that the compression spring 64 in the vacuum chamber 50 of the compensator casing is properly set or adjusted the operation of the speed governing mechanism is as follows: When the load on the engine 5 is materially diminished or is completely eliminated, high vacuum is created in the intake manifold 9 and also in the vacuum chamber 50. As soon as the vacuum in the chamber 50 increases sufficiently to overcome the compression of the spring 64 the flexible diaphragm 45 is caused to flex upwards and this action on the part of the diaphragm causes raising or upward sliding movement of the push-rod 44. As soon as the push-rod slides upwards the bell crank 38 rotates clockwise and diminishes or lessens the tension of the governor spring 35. As soon as the tension of the governor spring is lessened by upward movement of the diaphragm and push-rod of the compensator and limited clockwise rotation of the bell-crank 38, the governor acts as a result of the action or performance of the fly-weights to close the butterfly control valve 15 to a limited extent and thus decrease or reduce to a slight extent the fuel or air flow and the speed of the engine. As soon as the engine is placed under heavy or full load and the intake manifold vacuum is resultantly decreased, the flexible diaphragm 45 of the pneumatic compensator 7 flexes downwards in response to the action of the compression spring 54 in the vacuum chamber 50 and this action on the part of the diaphragm effects downward sliding movement of the push-rod 44 and counterclockwise rotation of the bell-crank 38. In response to counterclockwise rotation of the bell-crank the tension of the governor spring 35 is increased to the point where the spring swings inwards the fly-weights 20 and operates through the medium of the lever 22 and the rod 34 to open fully the control valve 15. Upon opening of the control valve more gaseous fuel enters the combustion chambers and the speed of the engine increases. From the foregoing it is manifest that by in-

creasing the tension of the governor spring at low intake manifold vacuum due to heavy load on the engine the governed speed of the engine is increased and that by reducing the load or tension of the governor spring at high manifold vacuum due to light engine load or idle running of the engine the governed speed of the engine is reduced. By proper setting or adjustment of the pneumatic compensator 7 the engine may be governed or controlled so that there is substantially no variation between its idle and full load governed speeds. By adjusting the tension of the compression spring 64 of the compensator through the medium of the adjusting screw 67 different governor characteristics may be obtained and it is possible so to control the engine that the latter has a lower idle governed speed than full load governed speed. The vacuum chamber 50 has an appreciable volume and the internal cross-sectional area of the pipe 51 is comparatively small with the result that manifold pressure fluctuations as well as governor surge characteristics are damped to the point where they are negligible and hence do not affect the operation of the speed governing mechanism as a whole.

The herein described speed governing mechanism is extremely efficient in operation and affords little if any variation between the idle and full load governed speeds of the engine with which it is associated. It occupies but a comparatively small amount of space due to its compactness and may be built at a comparatively low and reasonable cost. In addition to the foregoing the mechanism requires little if any servicing and is not likely to become inoperative. Furthermore it permits of a measurable adjustment range as far as the pneumatic compensator is concerned and as a result its capabilities of use are many.

Whereas the improved speed governing mechanism has been described and illustrated in connection with an internal combustion engine having an intake manifold and a carburetor for supplying gaseous fuel into the engine cylinders by way of the manifold it will be understood that such mechanism may also be used equally as well in connection with an injector type internal combustion engine wherein air only is introduced into the intake manifold and the fuel is injected either into the ports having the intake valves or directly into the combustion chambers. It is also to be understood that the invention is not to be restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention, what we claim as new and desire to secure by Letters Patent is:

1. In combination with an internal combustion engine having an intake manifold for fluid and a valve for controlling the flow of fluid through said manifold, a speed controlling mechanism for the engine comprising an engine driven governor provided with a spring for resisting the fly-weights thereof and having a valve shifting connection between it and the valve whereby it operates partially to close the valve upon the fly-weights overcoming the spring, and modifying means for the governor actuated by variations in intake manifold vacuum and operative automatically to lessen the loading of the governor spring when the intake manifold vacuum is high, and to increase the loading of the governor

spring when the intake manifold vacuum is low, said modifying means being independent of said valve shifting connection.

2. In combination with an internal combustion engine having an intake manifold through which fluid is drawn by suction and in addition having a butterfly type valve for controlling the flow of fluid through said manifold, a speed controlling mechanism for the engine comprising an engine driven fly-weight type governor provided with a tension spring for resisting the fly-weights thereof and having a valve shifting connection between it and the valve whereby it operates partially to close the valve when the fly-weights overcome the tension of the spring, and modifying means for the governor actuated by variations in intake manifold vacuum and operative automatically to lessen the tension of the spring when the intake manifold vacuum is high and to increase the tension of the governor spring when the intake manifold vacuum is low, said modifying means being independent of said valve shifting connection.

3. In combination with an internal combustion engine having an intake manifold through which fluid is drawn by vacuum and also having a valve for controlling the flow of such fluid through said manifold, a speed controlling mechanism for the engine comprising an engine driven governor having a spring for resisting the fly-weights thereof and having a valve shifting connection between it and the valve, and a pneumatic compensator for modifying the valve controlling action of the governor including a casing with a vacuum chamber therein in communication with, and subject to the same vacuum variations as, the intake manifold, a flexible diaphragm disposed in the casing and arranged so that it flexes in response to vacuum variations in the chamber, and means between the diaphragm and the governor spring and independent of said valve shifting connection, for varying the loading of the spring in response to flexing of the diaphragm.

4. In combination with an internal combustion engine having an intake manifold through which fluid is drawn by vacuum and also having a valve for controlling the flow of such fluid through said manifold, a speed controlling mechanism for the engine comprising an engine driven governor having a spring for resisting the fly-weights thereof and having a valve shifting connection between it and the valve, and a pneumatic compensator for modifying the valve shifting action of the governor, including a casing with a vacuum chamber therein in communication with, and subject to the same vacuum variations as, the intake manifold, a flexible diaphragm disposed in the casing and arranged so that it flexes in one direction in response to high vacuum in the chamber and flexes in the opposite direction in response to low vacuum in said chamber, and an operating connection between the diaphragm and the governor spring and independent of said valve shifting connection, whereby the loading of the spring is lessened when the diaphragm flexes in said one direction, and is increased when the diaphragm flexes in said opposite direction.

5. In combination with an internal combustion engine having an intake manifold through which fluid is drawn by vacuum, and also having a valve for controlling the flow of fluid through said manifold, a speed controlling mechanism for the engine comprising an engine driven governor hav-

ing a tension spring for resisting the fly-weights thereof and connected operatively to the valve in such manner that it partially closes the latter upon the fly-weights overcoming the spring, and
5 a pneumatic compensator for modifying the valve controlling action of the governor including a casing with a vacuum chamber therein in communication with, and subject to the same vacuum variations as, the intake manifold, a flexible diaphragm disposed in the casing and arranged so

10 that it flexes in one direction in response to high vacuum in the chamber, and flexes in the opposite direction in response to low vacuum in said chamber, and a push-rod and bell crank operating connection between the diaphragm and the governor spring, whereby the tension of the spring is decreased when the diaphragm flexes in said one direction, and is increased when the diaphragm flexes in said opposite direction.

20 6. In combination with an internal combustion engine having an intake manifold through which fluid is drawn by vacuum and also having a valve for controlling the flow of fluid through said manifold, a speed controlling mechanism for the engine driven governor having a spring for resisting the fly-weights thereof and having a valve shifting connection between it and the valve, and
25 a pneumatic compensator for modifying the valve shifting action of the governor, including a casing with a comparatively large chamber therein in communication by a comparatively small duct with, and subject to the same vacuum variations as, the intake manifold, a flexible diaphragm disposed in the casing and arranged so that it flexes
30 in one direction in response to high vacuum in the chamber, and flexes in the opposite direction in response to low vacuum in said chamber, and

an operating connection between the diaphragm and the governor spring and independent of said valve shifting connection, whereby the loading of the spring is lessened when the diaphragm flexes in said one direction, and is increased when the diaphragm flexes in said opposite direction. 5

7. In combination with an internal combustion engine having an intake manifold through which fluid is drawn by vacuum and also having a valve for controlling the flow of fluid through said manifold, a speed controlling mechanism for the engine comprising an engine driven governor having a spring for resisting the fly-weights thereof, and having a valve shifting connection between it and the valve, and a pneumatic compensator for modifying the valve shifting action of the governor, including a casing with a vacuum chamber therein in communication with, and subject to the same vacuum variations as, the intake manifold, a flexible diaphragm disposed in the casing and arranged so that it flexes in one direction in response to high vacuum in the chamber, and flexes in the opposite direction in response to low vacuum in said chamber, an operating connection between the diaphragm and the governor spring and independent of said valve shifting connection, whereby the loading of the spring is lessened when the diaphragm flexes in said one direction, and is increased when the diaphragm flexes in said opposite direction, and spring means in the casing arranged to urge the diaphragm in said opposite position, and adapted to be overcome and permit flexing of the diaphragm in said one direction when said diaphragm is subjected to high vacuum in the chamber. 35

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