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Vuaille

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[54] **DEVICE FOR CONTROLLING THE DELIVERY PER REVOLUTION OF AN INTERNAL COMBUSTION ENGINE INJECTION PUMP**

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[51] **Int. Cl.** **F02d 1/04,** F02d 1/06

[58] **Field of Search**... 123/140 FG, 140 MP, 140 R, 123/103 C, 179 G, 179 L

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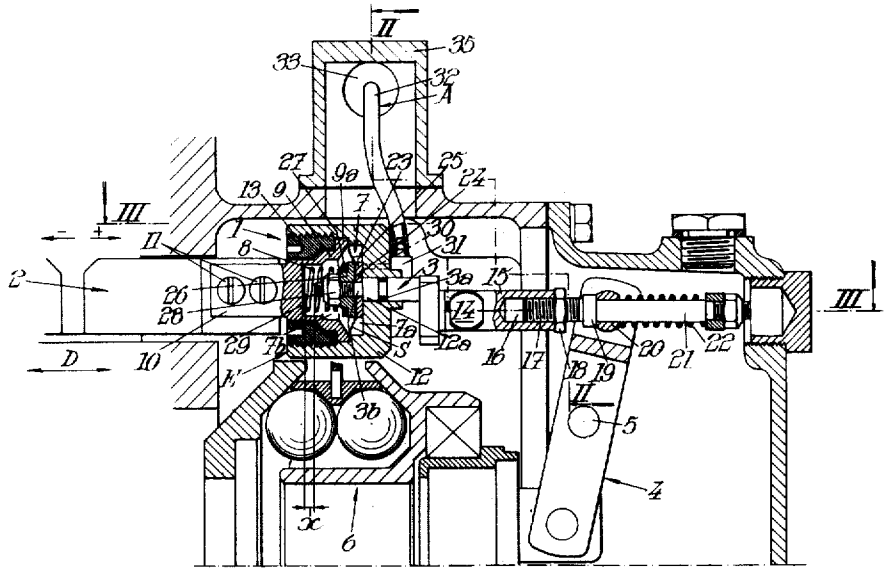
[57] **ABSTRACT**

A device for controlling the delivery per revolution of an internal combustion engine injection pump includes a regulating member arranged to be moved by a control member. Connecting means between the regulating and control members comprises an envelope structure borne by the regulating member and defining a chamber, and a diaphragm borne by the control member and separating the chamber of the envelope structure into two chamber parts, the envelope structure and the diaphragm being relatively movable. Fluid at a variable pressure is admitted to one of the chamber parts and a return spring is provided in the other chamber part to act in opposition to the fluid pressure.

4 Claims, 4 Drawing Figures



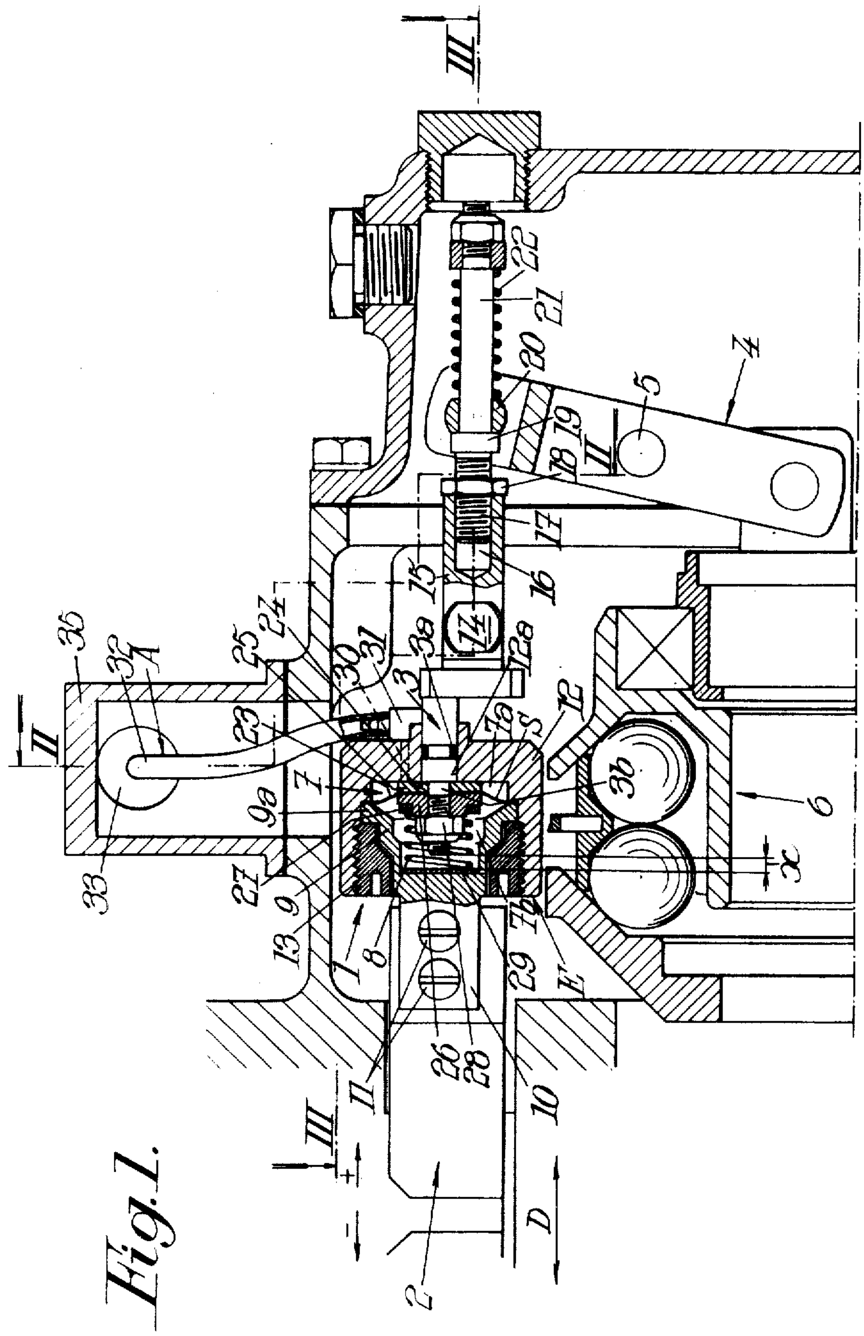


Fig. 1.

Fig. 2.

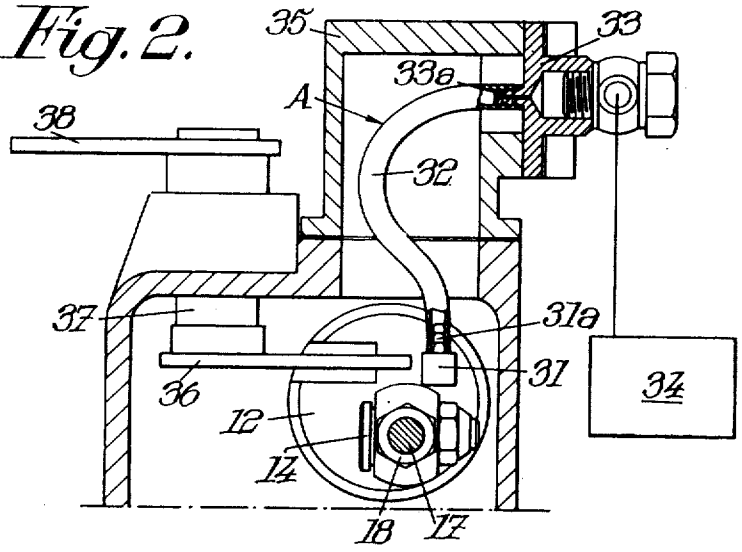

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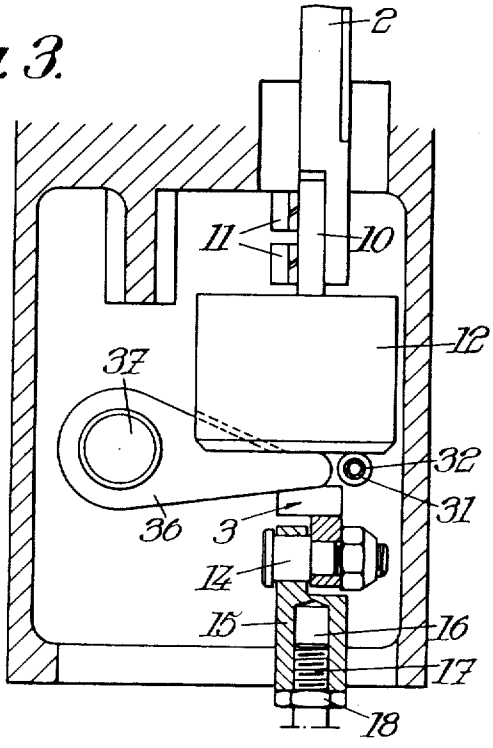
Fig. 3.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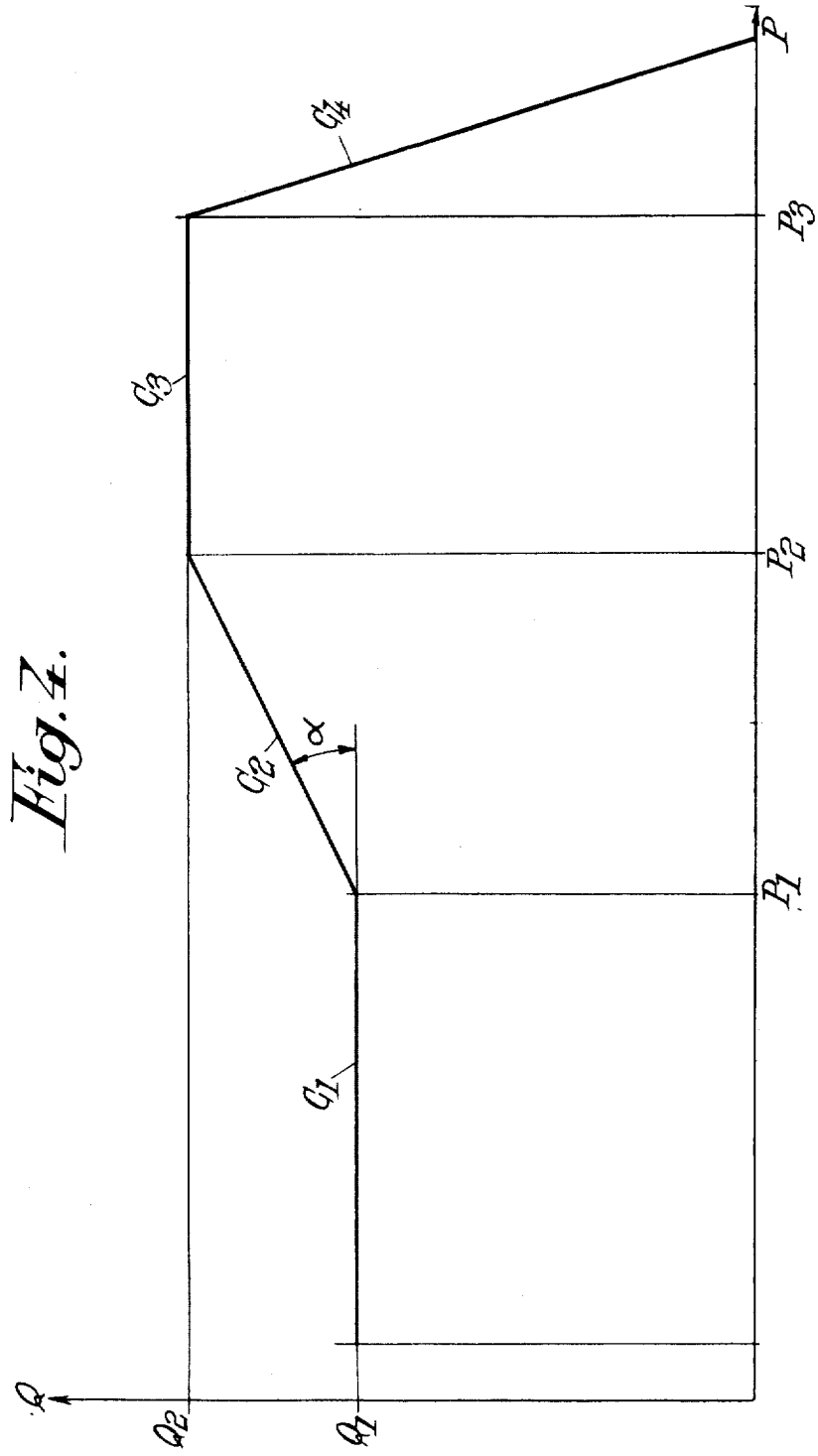

Fig. 4.

DEVICE FOR CONTROLLING THE DELIVERY PER REVOLUTION OF AN INTERNAL COMBUSTION ENGINE INJECTION PUMP

This invention relates to a device for controlling the delivery per revolution of an internal combustion engine injection pump comprising a regulating member whereby the delivery per revolution can be adjusted and which is adapted to be moved, in one direction of movement, by a control member, said device comprising connecting means between the control member and the regulating member, said means consisting firstly of envelope means connected to one of the members and defining an inner chamber which extends in the direction of movement of the regulating member and, secondly, closure means connected to the other member and extending transversely with respect to the direction of movement of the regulating member, the envelope means and the closure means being adapted to move relatively to one another, admission means being provided to apply a fluid, the pressure of which can vary, to the said internal chamber.

A device of this kind is disclosed in French Patent No. 824,199, wherein the inner chamber is connected via a conduit to a point of the intake conduit situated downstream of the gas butterfly valve. Guide means connected to the pump casing and different from those provided for the regulation member for the delivery per revolution are required for the envolope means.

British Patent No. 529,672 discloses a device of the same type wherein the fluid introduced into the inner chamber is oil under pressure for lubrication of the engine. Guide means connected to a casing and other than those provided for the member for regulating the devlivery per revolution are also required for the envelope means.

An object of this invention is to provide an improved device which does not require any additional guidance connected to a casing, more particularly the pump casing, and different from that of the delivery regulation member.

Another object is to provide a compact device which can be readily incorporated in any type of internal combustion engine injection pump regulator.

According to the invention there is provided a device for controlling the delivery per revolution of an internal combustion engine injection pump, including:

a regulating member operatively connected to the pump to adjust the delivery per revolution thereof;

a control member movable to indicate required adjustments of the delivery of the pump;

connecting means operatively connecting said regulating member to said control member;

envelope means in said connecting means, said envelope means being connected to one of said regulating and control members and defining a chamber which extends in the direction of movement of said regulating member;

closure means in said connecting means movable relative to said envelope means, said closure means being connected to the other of said regulating and control members and extending transversely of the direction of movement of said regulating member;

admission means connected to said envelope means to apply a fluid at a variable pressure to the chamber of the envelope means;

wherein the improvement comprises:

said closure means being arranged to separate the chamber of said envelope means into two chamber parts which are isolated from one another in fluid-tight manner;

said admission means being in communication with one of the chamber parts of the envelope means;

resilient return means disposed in the other of the chamber parts of said envelope means between said closure means and said envelope means and acting against the fluid pressure in the one chamber part of the envelope means; and

the one of said envelope and closure means connected to the regulation member providing guidance of the control member and of the other of said envelope and closure means connected to the control member.

Preferably, the closure means comprise a flexible diaphragm, the central part of which is rigidly connected to that one of the members which does not bear the envelope means and the periphery of which is secured to the envelope means.

The device according to the invention is advantageously used on a supercharged engine injection pump in which the air for combustion is delivered under pressure by auxiliary means such as a turbocompressor, in which case the inner chamber part of the envelope means to which the fluid under pressure is admitted, is connected to the engine air intake conduit in such a manner that the air pressure delivered by the auxiliary means is operative in the said chamber part, the system being so arranged that the correction device controls an increase in delivery per revolution when said air pressure increases, and vice versa, in the case of a reduction.

In order that the invention may be readily understood, an embodiment thereof will now be described in more detail, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 of the drawings is an axial section of a correction device embodying the invention mounted on an injection pump equipped with a centrifugal governor.

FIG. 2 is a section on the line II—II in FIG. 1.

FIG. 3 is a section on the line III—III in FIG. 1.

FIG. 4 is a curve illustrating an operation of the engine whose injection pump is provided with the correction device shown in FIGS. 1 to 3.

FIG. 1 shows a device 1 for correcting the delivery per revolution of an injection pump for an internal combustion engine.

The pump comprises a conventional regulating member 2 consisting of a rectilinear rod or rack adapted to slide longitudinally and thus allow the delivery of the pump per revolution to be adjusted. In FIG. 1, when the rod 2 moves from left to right, the pump delivery per revolution is increased as indicated by the arrow extending from left to right and surmounted by the "+" sign. In the opposite direction there is a reduction of the delivery per revolution. The movements of the rod 2 are controlled by a control member 3 adapted to push or pull the rod 2. The control member 3 is mechanically connected to a lever 4 centrally pivoted at 5, the rod being rotated about the pivot 5 by means of a centrigual governor 6 driven at a speed proportional to that of the engine fed by the injection pump.

The correction device 1 comprises connection means between the control member 3 and the control rod 2. These connection means comprise firstly envelope means E borne by the rod 2 and defining an internal

chamber 7 which extends in the direction of movement D of the control rod 2 and, secondly, closure or separation means S borne by the control member 3 and extend transversely of the direction D.

The closure or separation means S are adapted to separate the chamber 7 into two parts 7*a*, 7*b* which are isolated from one another in fluid tight relationship. The envelope means E and the separation means S are adapted to move relatively to one another.

Admission means A are provided for the introduction of a gas of varying pressure into the part 7*a* of the chamber 7. The other part 7*b* of this chamber comprises resilient return means formed by a helical spring 8 disposed between the envelope means E and the separation means S and adapted to act against the gas admitted into the chamber 7*a*.

The envelope means E are formed by a cap 9 which forms the enlarged end of a connecting member 10 secured to the rod 2 by two screws 11 with the concave face of the cap 9 facing the control member 3. The cap 9 presents a collar 9*a* which is clamped between a cover 12 and a hollow screw 13 screwed into the cover 12. The concave face of the cover 12 faces the cap 9 so that the chamber 7 is defined by the adjoining concave faces of the cap 9 and of the cover 12.

The control member 3 is formed by a lug extending through a guide bore 12*a* in the cover 12. The lug 3 is adapted to slide in guide bore 12*a* and is provided with a sealing gasket 3*a*. The lug 3 supports a pivot 14 on which a fork 15 is articulated. The end of the fork remote from the lug 3 has a screwthreaded blind hole 16 into which there is adjustably screwed the end of a screwthreaded rod 17 locked by a lock nut 18.

The screwthreaded rod 17 has a shoulder 19 adapted to bear on the head 20 of a pivot connected to the lever 4. Beyond the shoulder 19 the rod 17 is extended in the form of a plain rod 21 extending through the head 20 and acting as a guide for a return spring 22 adapted to hold the head 20 in contact with the shoulder 19.

The separation means S of the chamber 7 are advantageously formed by a flexible diaphragm 23, through the central part of which extends a reduced diameter prolongation 3*b* of the lug 3 and which is fixed on said prolongation. As shoulder 24 is formed at the junction of the large-diameter part of the lug 3 and of its smaller-diameter prolongation 3*b*. A flat washer 25 engaging around the prolongation 3*b* bears on one side against the shoulder 24 while the surface of the washer 25 remote from the shoulder 24 is used to clamp the diaphragm 23.

A cup 26, having two zones of different diameters which form a shoulder adapted to receive an annular shim 27, is engaged around the prolongation 3*b* on that side of the surface of the diaphragm 23 which is adjacent the part 7*b* of the chamber 7.

That end of the prolongation 3*b* which is adjacent the cap 9 is screwthreaded to receive a nut 28 whereby the diaphragm 23 can be clamped in a fluid-tight relationship between the cup 26 and the washer 25. The periphery of the flexible diaphragm 23 is clamped in fluid-tight manner between the cap 9 and the cover 12, which for this purpose has matching abutment surfaces.

A disc 29 is housed preferably in the base of the cap 9 to act as an abutment for the end of the prolongation 3*b*. The disc 29 acts as a control shim for the relative travel *x* between the lug 3 and the envelope means E. Its thickness is therefore selected according to the required travel.

The spring 8 is disposed between the disc 29 and the shim 27. It will therefore immediately be apparent that the thickness of the shim 27 in the direction D defines the initial tension of the spring 8. To adjust this tension all that is required is an appropriate thickness of the shim 27.

Admission means A for fluid, more particularly gas, to the part 7*a* of the chamber 7, comprise a duct 30, the axis of which is parallel to the direction D, said duct extending through the base of the cover 12 and leading at one end into the chamber 7*a*. The other end of the duct 30 is provided with a connection 31 presenting a barbed spigot 31*a*, which fits into a flexible hose 32 of heat-resistant, oil-resistant and hydrocarbon-resistant material. The axis of the spigot 31*a* is directed perpendicularly to the direction D in a plane parallel to that of FIG. 1.

The complete system is so arranged that the flexible hose 32 extends in an open loop, the shape of which will be apparent from FIG. 2 and which, when the envelope means E and the lug 3 occupy their mean relative position, is situated substantially in a plane perpendicular to direction D. The positions of the spigot 31*a* corresponding to the relative end positions of the lug 3 and of the envelope means E obtained when the washer 25 bears against the cover 12 as in FIG. 1, i.e. when the prolongation 3*b* abuts the disc 29, are symmetrical with respect to the central plane of the loop formed by the tube 32.

The other end of the flexible tube 32 is engaged over the barbed spigot 33*a* (FIG. 2) of a connection 33 adapted to be connected to a gas source 34. The axis of the spigot 33*a* is perpendicular to the plane of FIG. 1. The loop of the tube 32 is protected by a rigid cap 35.

A stop lever 36 shown in FIGS. 2 and 3 is secured to the same axis of rotation 37 as an arm 38 accessible from the outside of the casing protecting the governor and pump assembly, such arm enabling the stopping of the engine to be controlled.

The correction device according to the invention is advantageously used for an internal combustion engine of the supercharged diesel type, in which the air for combustion is delivered by auxiliary means, such as a blower or turbocompressor, which are driven by the engine exhaust gases. In that case, the gas source 34 adapted to supply the part 7*a* of the chamber 7 is the blower or turbocompressor and the gas admitted to the chamber part 7*a* is air, whose pressure is equal to that of the air for combustion fed to the engine.

FIG. 4 is a graph showing the delivery per revolution Q (along the *y*-axis) of an injection pump for a supercharged internal combustion engine provided with the correction device embodying the invention, the chamber part 7*a* of the device being connected to the output of the auxiliary means delivering the air for combustion as explained hereinbefore. The *x*-axis of FIG. 4 shows the pressure P of the engine supercharging air. The graph in FIG. 4 comprises four curve segments C_1, C_2, C_3, C_4.

The segment C_1 is substantially a straight-line segment parallel to the *x*-axis at Q_1 along the *y*-axis and terminating at a point P_1 on the *x*-axis. The segment C_1 continues in the form of another straight-line segment C_2 which is inclined at an angle α to the *x*-axis, and the

end of which remote from the segment C_1 is at Q_2 on the y-axis and P_2 on the x-axis. The segment C_3 forming the continuation of the segment C_2 consists essentially of a straight-line segment parallel to the x-axis, of which the end remote from the segment C_2 is at the point P_3 on the x-axis. The segment C_4 consists essentially of a straight-line segment of negative slope forming the continuation of the segment C_3 towards the x-axis.

The correction device embodying the invention operates as follows.

For the explanation, it will be assumed that the device is applied to a supercharged engine and that the source delivering the gas adapted to act in the chamber part *7a* is a turbocompressor charging the engine.

When the air pressure in the chamber part *7a* is inadequate to overcome the action of the spring **8**, the washer **25** remains in abutment against the cover **12** and the rod **2** will follow the movements of the lug **3**. If the engine operates at full load, the lug **3** remains stationary and the pump delivery per revolution will be Q_1 (see FIG. **4**).

When the air pressure in the chamber part *7a* reaches the value P_1 (FIG. **4**), the force exerted by the pressure on the diaphragm **23** and the cover **12** becomes equal to the force developed by the spring **8**. If the air pressure continues to rise, the spring **8** is compressed. There will be a relative movement between the lug **3** and the envelope means E. If the engine operates at full load, the lug **3** remains stationary and when the air pressure increases in the chamber part *7a* the cover **12** will be pushed to the right in FIG. **1** and drive the rod **2** in the direction to increase the delivery per revolution. The straight-line segment C_2 in FIG. **4** will then apply.

The relative movement between the envelope means E and the lug **3** will cease when the prolongation *3b* abuts the disc **29**. This occurs when the pressure in the chamber part *7a* becomes equal to P_2. The delivery per revolution is then Q_2 (FIG. **4**). At full load, the lug **3** will remain stationary and the pump delivery per revolution will remain substantially constant. The segment C_3 in FIG. **4** will then be described.

When the supercharging air pressure reaches the value P_3 corresponding to the cut-out speed of the governor **6**, the latter will result in rotation of the lever **4** in the anticlockwise direction so that the lug **3** pushes the rod **2** in the direction to reduce the delivery per revolution until such delivery is possibly cancelled. This corresponds to the segment C_4 in FIG. **4**.

Adjustment of the supercharging air pressure value P_1 from which the correction device starts to come into operation is obtained by adjustment of the initial tension of the spring **8**. Such adjustment of the initial tension is preferably obtained by adjustment of the thickness of the shim **27** and, possibly, by adjustment of the thickness of the disc **29**. The thickness of the disc **29** is in fact particularly intended to adjust the maximum relative travel *x* of the lug **3** and of the cover **12**. Adjustment of the travel *x* provides adjustment of the difference $Q_2 - Q_1$.

The slope of the segment C_2, i.e. the angle α can be selected by using a spring **8** of appropriate stiffness.

The place where the correction device **1** embodying the invention is situated is particularly advantageous for good regulation, because the forces required to move the rack **2** are relatively small in relation to those which would be required to act on the governor **6**.

The stray resistances introduced by the flexible piping **32**, one end of which follows the movements of the cover **12**, are small as a result of the arrangement adopted. The piping **32** undergoes only slight flexure and slight twisting, which in no way affects the qualities of the correction device.

The engine can be stopped by pushing the rod **2** in the direction to cancel the delivery by means of the stop lever **36** (FIGS. **2** and **3**).

In addition to the advantages provided by conventional correction devices, in which the injection pump delivery per revolution is so related to the engine supercharing air pressure that smoke is avoided because the maximum delivery per revolution is provided only when the supercharging air pressure is sufficient to provide complete combustion of the injected fuel, the device embodying the invention is of very small size and, because it is directly mounted on the rod **2**, is very easily fitted to all types of governor **6**.

Of course the gas admitted to the chamber part *7a* controlling the operation of the correction device **1** could be delivered by an ancillary compressed air source so that engine supercharging can be controlled as required by any means (on/off operation).

In a variant, the chamber part *7a* could be connected to atmospheric pressure, in which case the correction device would enable the pump delivery per revolution to be modified in dependence on the external air pressure. In another variant, the fluid acting in the chamber part *7a* could be a liquid and not a gas such as air.

I claim:

1. A device for controlling the delivery per revolution of an internal combustion engine injection pump, including:

a regulating member operatively connected to the pump to adjust the delivery per revolution thereof;

a control member movable to indicate required adjustments of the delivery of the pump;

connecting means operatively connecting said regulating member to said control member;

envelope means in said connecting means, said envelope means being connected to one of said regulating and control members and defining a chamber which extends in the direction of movement of said regulating member;

closure means in said connecting means movable relative to said envelope means, said closure means being connected to the other of said regulating and control members and extending transversely of the direction of movement of said regulating member;

admission means connected to said envelope means to apply a fluid at a variable pressure to the chamber of the envelope means;

wherein the improvement comprises:

said closure means being arranged to separate the chamber of said envelope means into two chamber parts which are isolated from one another in fluid-tight manner;

said admission means being in communication with one of the chamber parts of the envelope means;

resilient return means disposed in the other of the chamber parts of said envelope means between said closure means and said envelope means and acting against the fluid pressure in the one chamber part of the envelope means; and

the one of said envelope and closure means connected to the regulating member providing guidance of the control member and of the other of said envelope and closure means connected to the control member,

said closure means comprising a flexible diaphragm,

the central part of said diaphragm being rigidly connected to said other of said regulating and control member, and

the periphery of said diaphragm being secured to said envelope means,

said regulating member comprising a rod arranged to slide in its longitudinal direction and having said envelope means mounted at one end thereof;

said envelope means comprising a cover presenting a guide bore, a screwthreaded element screwed into the cover, a cap mounted on said one end of said rod and having its periphery clamped between said cover and said screwthreaded element, and confronting concave faces on said cover and said cap to define the chamber of said envelope means;

said flexible diaphragm being clamped at its periphery between said cap and said cover; and

said control member comprising a lug which extends through said diaphragm and to which the central part of said diaphragm is secured, said lug extending slidably in fluid-tight manner through the guide bore provided in said cover.

2. The device of claim **1,** wherein:

said return means are constituted by a helical spring disposed between said cap and the free end of said lug.

3. The device of claim **1,** wherein:

said cap has a base facing said lug; and

a shim of selected thickness is disposed against said base of said cap to determine the amplitude of the relative movement of said lug and said cap.

4. The device of claim **2,** wherein:

said lug carries a cup presenting an abutment shoulder; and

a shim of selected thickness is disposed between said helical spring and the shoulder on said cup to determine the initial tension of said spring.

* * * * *