

[54] **REGULATING DEVICES FOR THE FLOW OF FUEL FOR INTERNAL COMBUSTION ENGINES**[75] Inventor: **Andre Vuaille**, Lyon, France[73] Assignee: **Societe Industrielle Generale de Mecanique Appliquee S.I.G.M.A.**, France[22] Filed: **May 21, 1973**[21] Appl. No.: **362,360**[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.**..... **123/140 FG; 123/140 R; 123/119 CE; 417/462**[51] **Int. Cl.²**..... **F02D 1/04; F02D 1/06**[58] **Field of Search** ... **123/140 FG, 140 R, 119 CE, 123/140 MP, 140 MC; 417/462, 282, 294**[56] **References Cited****UNITED STATES PATENTS**

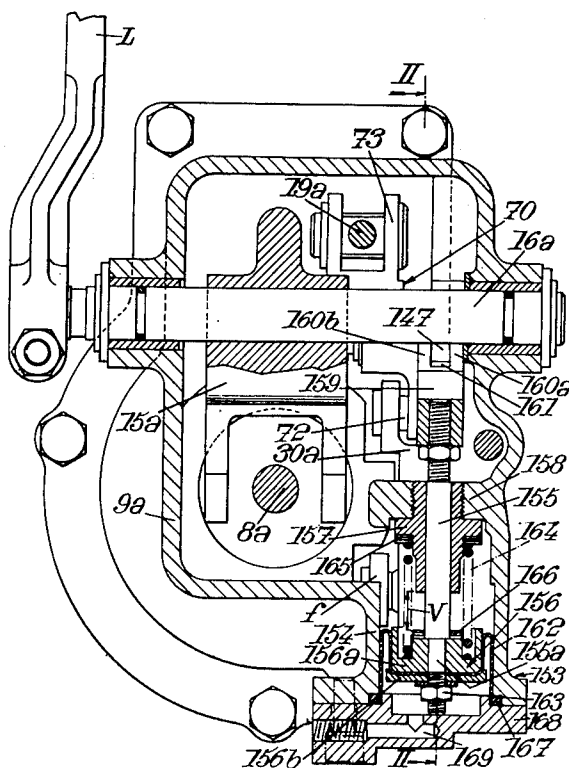
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Primary Examiner—Charles J. Myhre*Assistant Examiner*—Ronald B. Cox*Attorney, Agent, or Firm*—Larson, Taylor and Hinds[57] **ABSTRACT**

The device comprises a centrifugal regulator sensitive to the rotary speed of the engine having a pusher element adapted to slide in the direction of the axis of a drive shaft of the centrifugal regulator; a regulating member for the flow-rate per revolution of the pump; and linking means between the pusher element and the flow-rate regulating member. The linking means comprises at least one transmission lever connected, by its ends, respectively, to the pusher element and to the flow-rate per revolution regulating member, the middle portion of this transmission lever being mounted on pivoting means borne by a casing in which is housed the regulating device, first elastic means coaxial with the drive shaft of the centrifugal regulator, whose tension is determined by the position of an accelerator lever, preferably second elastic means, coaxial also with the drive shaft of the centrifugal regulator and adapted to cooperate with stop members. The assembly is advantageously arranged so that when the second elastic means undergo a variation in length, the movement of the flow-rate per revolution regulating member, for a displacement in one direction of the pusher element, is reversed with respect to that which is produced for a displacement of said pusher element, in the same direction, but causing a variation in length of the first elastic means. The pivoting means of the transmission lever on the casing are arranged so as to enable a displacement of the geometric axis of rotation of said lever causing a movement of the flow-rate per revolution regulating member and it comprises actuating means for this displacement of the axis of rotation of said lever, sensitive to the pressure of a fluid.

2 Claims, 11 Drawing Figures

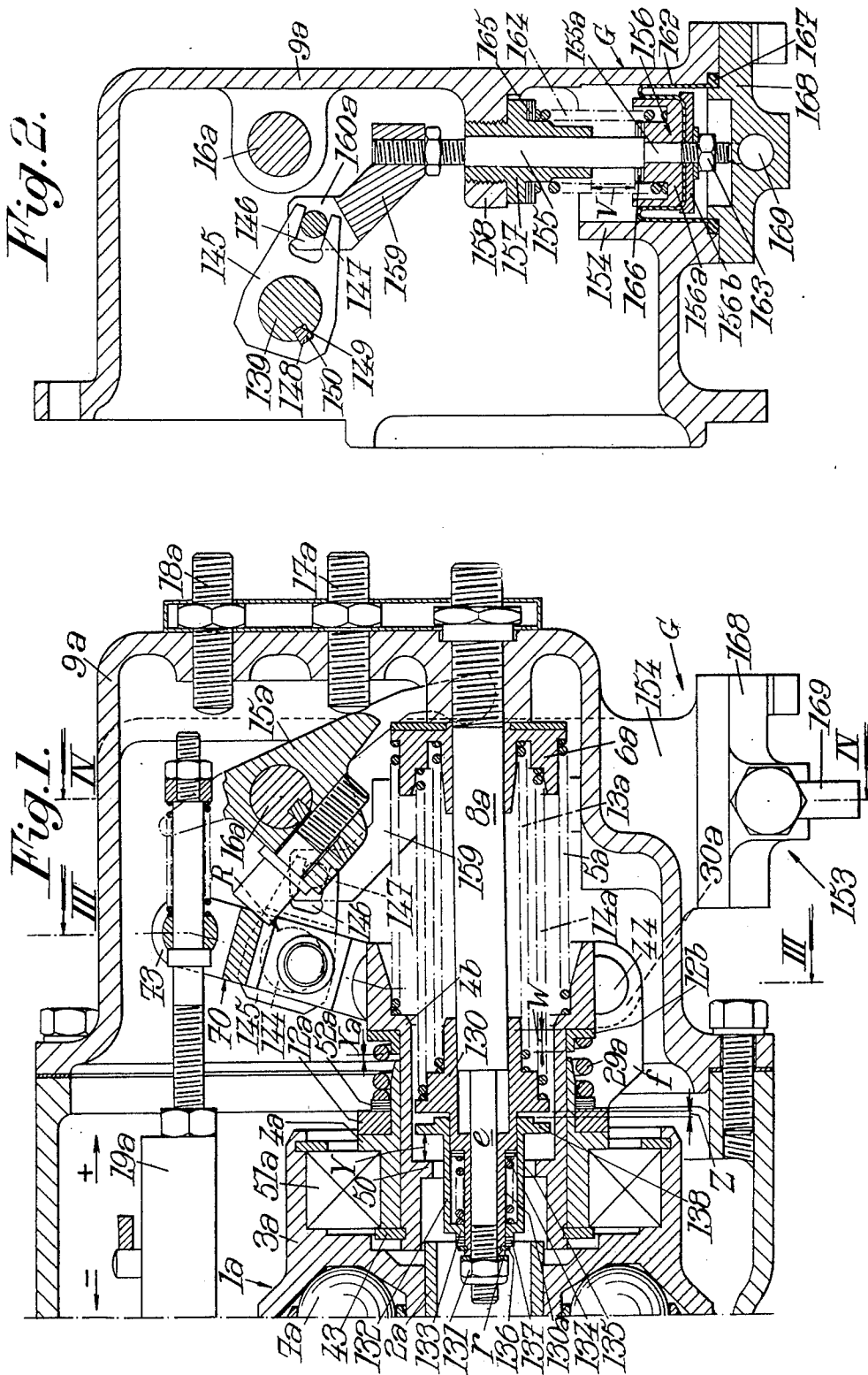


Fig. 3.

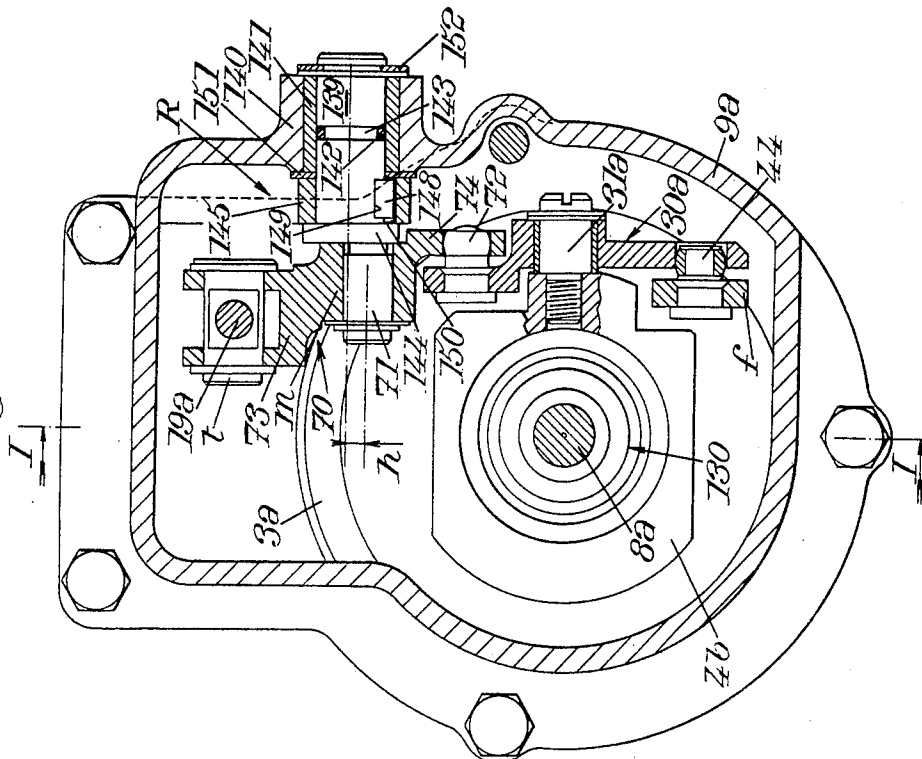
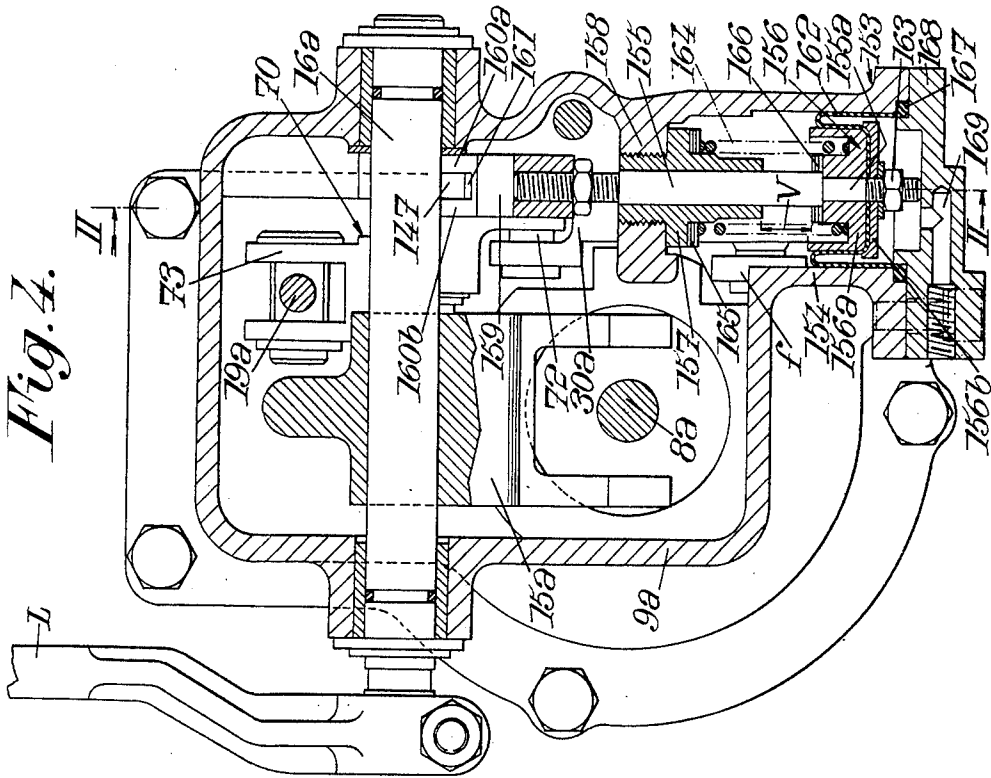
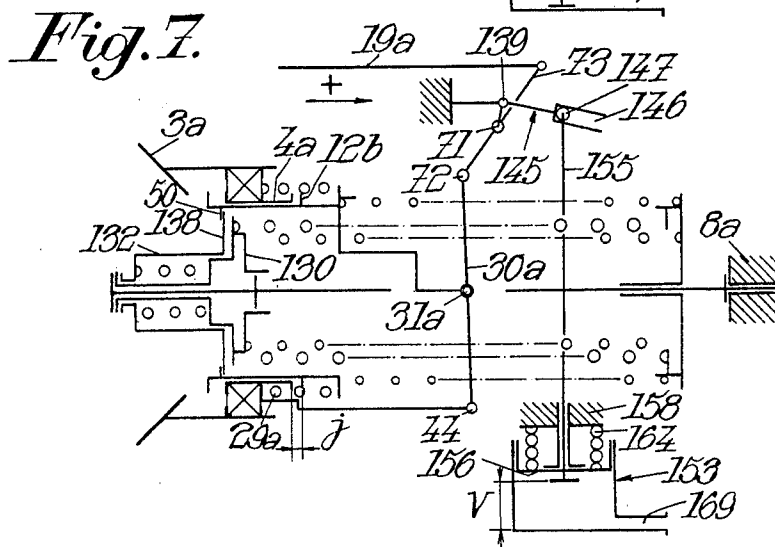
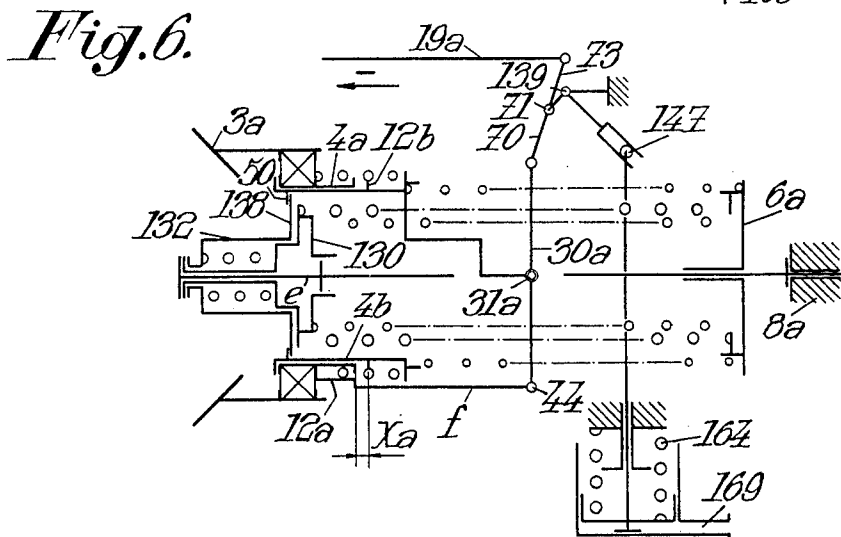
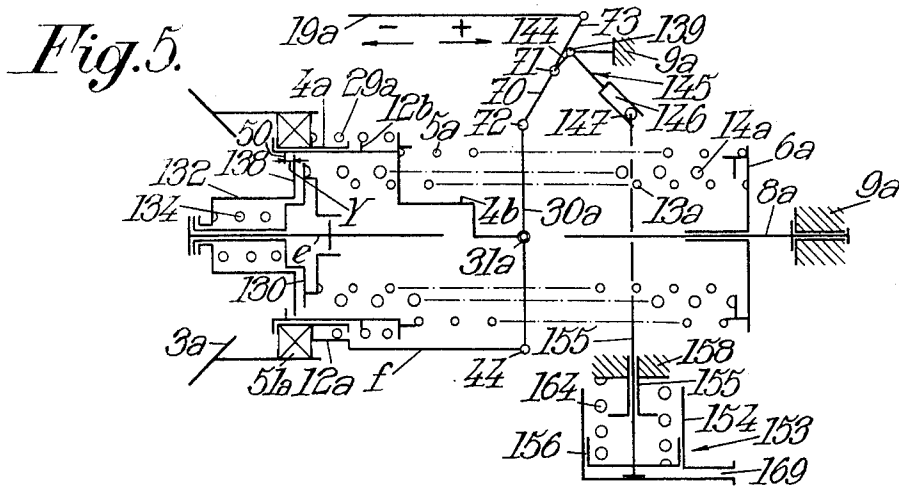


Fig. 4.





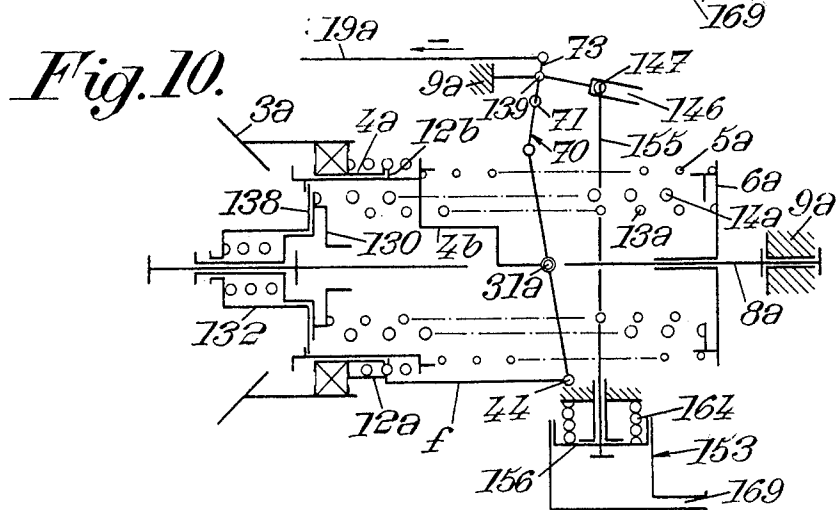
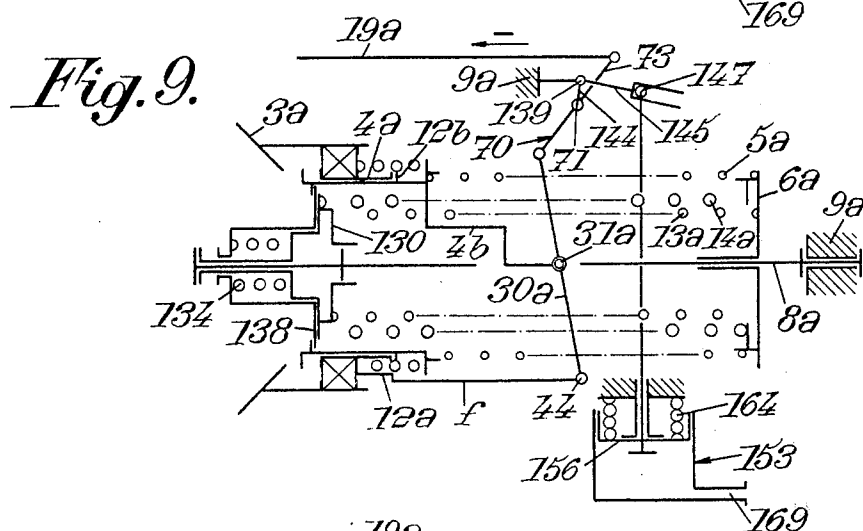
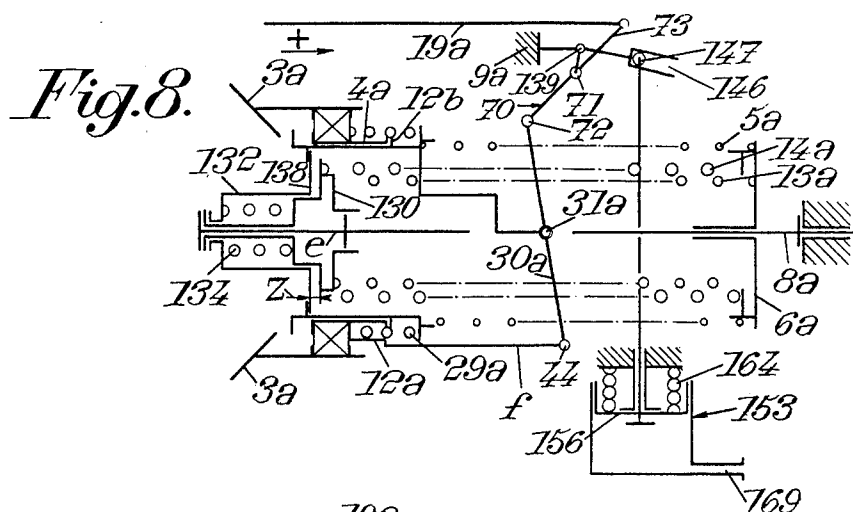
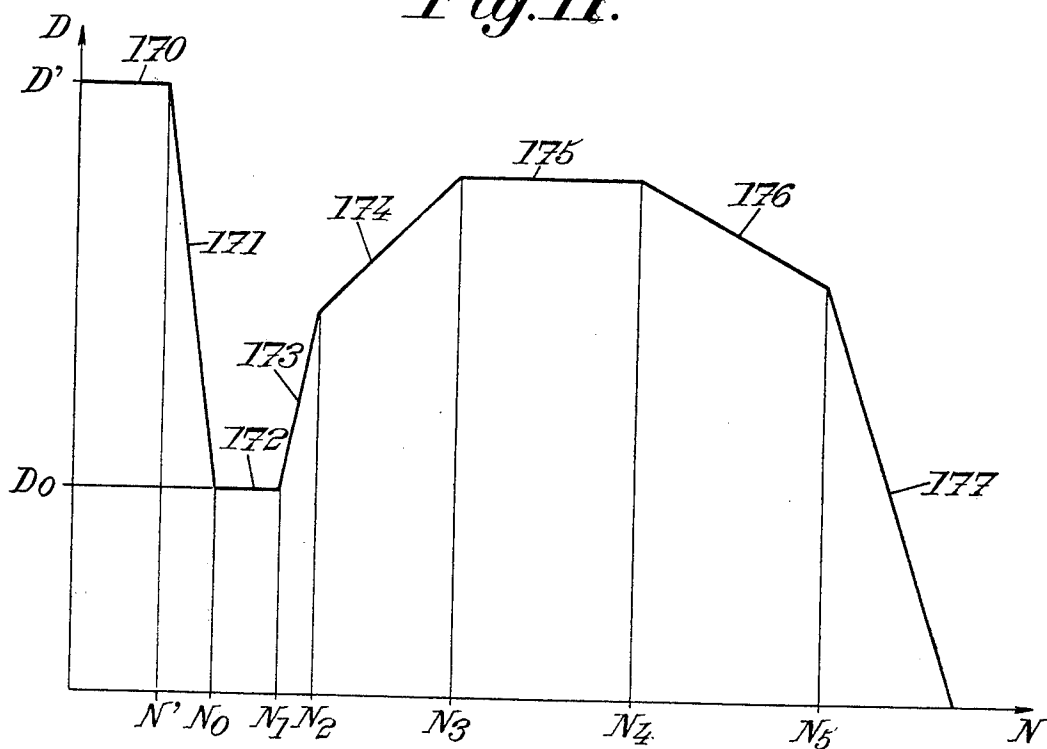


Fig. 11.



REGULATING DEVICES FOR THE FLOW OF FUEL FOR INTERNAL COMBUSTION ENGINES

The invention relates to regulating devices for the delivery per revolution of an injection pump for an internal combustion engine, of the type which comprise:

a centrifugal regulator sensitive to the rotary speed of the engine, comprising a pusher element adapted to slide in the direction of the axis of a drive shaft of the centrifugal regulator,

an adjusting member for the flow-rate per revolution of the pump,

linking means between the pusher element and the adjusting member of the delivery per revolution, comprising at least one transmission lever, connected by its ends, respectively, to the pusher element and to the flow-rate adjusting member, the middle part of this transmission lever being mounted on pivoting means borne by a casing in which is housed the regulating device,

first elastic means coaxial with the drive shaft of the centrifugal regulator, of which the tension is determined by the position of an accelerator lever,

preferably second elastic means, coaxial also with the drive shaft of the centrifugal regulator and adapted to cooperate with the stop members, the assembly being advantageously arranged so that when these second elastic means undergo a variation in length, the movement of the adjusting member of the flow-rate per revolution, for a displacement in one direction of the pusher element, is reversed with respect to that which is produced for a displacement of said pusher element in the same direction, but causing a variation in length of the first elastic means.

The invention relates, more particularly, because it is in this case that its application seems to be most advantageous, but not exclusively, to a regulating device for an injection pump equipping a supercharged internal combustion engine, that is to say whose combustion air is supplied by a turbo-compressor or similar device, driven by the engine.

It is a particular object of the invention to render the regulating device such that it responds to the various exigencies of practice better than hitherto, and especially such that it permits a correction of the flow-rate per revolution to be effected in response to the pressure of a fluid.

According to the invention, a regulating device for the flow-rate per revolution of an injection pump for internal combustion engines, of the previously defined type, is characterised by the fact that pivoting means of the transmission lever on the casing are arranged so as to enable a displacement of the geometric axis of rotation of said lever causing a movement of the regulating member of the flow-rate per revolution and that it comprises actuating means for this displacement of the geometric axis of rotation of the transmission lever, sensitive to the pressure of a fluid.

Preferably, the pivoting means of the transmission lever comprise a pivot borne by the casing and a pivoting axle of said lever fast to the pivot, parallel and eccentric with respect to the latter; a rigid linking part may be provided between the pivot and the eccentric pivoting axle.

The actuating means of the displacements of the geometric axis of rotation of the transmission lever are ad-

vantageously constituted by a jack, especially a single acting jack.

In the case of a supercharged engine, these actuating means are sensitive to the pressure of the supercharging air and are arranged so that a diminution in the pressure of the supercharging air causes a diminution in the flow-rate per revolution of the pump and conversely in the case of an increase.

Generally, the regulating member for the flow-rate per revolution of the pump is constituted by a rod parallel to the axis of the drive shaft of the centrifugal regulator and adapted to slide in the direction of this axis; linking means between the rod and the pusher element of the centrifugal regulator then comprise, advantageously, an intermediate lever connecting one end of the transmission lever to the pusher element, this intermediate lever being pivoted, in its middle part, on a sleeve coaxial with the drive shaft of the regulator, which sleeve is adapted to be displaced, with the pusher element, when the first elastic means undergo a variation in length, and to be displaced with respect to the pusher element, when the second elastic means undergo a variation in length, this intermediate lever being pivoted, at one of its ends, on the transmission lever and, by its other end, on a rigid arm connected in translation to the pusher element.

The invention consists, apart from the features mentioned above, of certain other features which will be more explicitly considered below, with regard to a preferred embodiment of the invention which will be described, in more detailed manner, with reference to the accompanying drawings, but which is of course to be considered in no way as limiting.

FIG. 1 of these drawings is a section along the line I—I of FIG. 3, with parts removed, of one embodiment of a regulating device according to the invention.

FIG. 2 is a section along the line II—II, FIG. 4, of the regulating device.

FIG. 3 is a section along the line III—III, FIG. 1.

FIG. 4 is a section along the line IV—IV, FIG. 1.

FIGS. 5 to 10 are diagrams showing various respective positions taken by the elements of the regulating device in the course of operation.

FIG. 11, lastly, is a curve representing the variations in flow-rate per revolution (D), borne as ordinates, as a function of the rotary speed of the engine (N), borne as abscissae.

Referring to FIGS. 1 to 4, it is seen that the regulating device comprises a centrifugal regulator 1a, shown partially and mounted on a drive shaft 2a which is rotated by the internal combustion engine (not shown).

The regulator comprises a pusher element 3a, or receiver plate, free in translation with respect to the shaft 2a with which it rotates. A sleeve 4a is connected in translation to the receiver plate 3a, but is free in rotation, with respect to the latter, due to a stop bearing 51a. The plate 3a is displaced under the effect of centrifugal force acting on the ball masses 7a.

A regulating member for the flow-rate per revolution of the injection pump is constituted by a rod or rack 19a whose axis is parallel to that of the shaft 2a and which is adapted to slide in the direction of this axis. According as the rod 19a slides towards the left or towards the right of FIG. 1, a diminution or an increase in the flow-rate per revolution of the pump is actuated. Arrows surmounted respectively with the sign “—” and with the sign “+” indicate these variations. The rack

19a comprises two parts hinged on an axle (not shown) perpendicular to the plane of FIG. 1.

Linking means between the pusher element 3a and the regulating member 19a comprise a first lever 70. In its middle part, this lever is composed of a cylindrical sleeve *m* which is engaged on a rotary axle 71 (FIG. 3) and fast to two diametrically opposite arms 73, 74. The upper arm 73, offset towards the inside of the casing 9a in which the regulating device is housed, comprises one end in the shape of a fork, articulated directly on the regulating rod 19a by a pivot *t*. The lower arm 74 (FIG. 3) is offset towards the closest wall of the casing 9a and is connected, by its lower end, to the pusher element 3a, through a second lever 30a, and an arm *f* (FIGS. 1 and 3). This arm extends parallel to the axis of the shaft 2a and it is fast to a ring 12a (FIG. 1) connected in translation to the sleeve 4a. As previously explained, the latter is connected in translation to the pusher element 3a. It is hence clearly evident that the lower arm 74 of the lever 70 is connected (indirectly) to the pusher element 3a.

The linkage between the arm 74 and the upper part of the lever 30a is ensured by a ball joint articulation 72 (FIG. 3).

The linkage between the lower part of the lever 30a and the arm *f* is also ensured by a ball joint articulation 44. In its middle part, the lever 30a is articulated on an axle of rotation 31a borne by a sleeve 4b (FIGS. 1 and 3). The latter is coaxial with the receiver plate 3a and adapted to be engaged in the sleeve 4a, as seen in FIG. 1, so as to be centered by the stop 51a, with respect to the receiver plate 3a.

First elastic means 5a, 13a, 14a, coaxial with the shaft 2a and mounted around a guide-rod 8a adjustable in the longitudinal direction and coaxial with said shaft 2a, are provided to exert, on the sleeve 4b, a return force directed from right to left in FIG. 1. At their end distant from the sleeve 4b, the latter elastic means are supported against a cup 6a slidable on the guide-rod 8a, under the effect of an accelerator fork 15a which is keyed in rotation on the shaft 16a actuated by a lever L (FIG. 4) and at right angles to the rod 8a. By acting on the accelerator fork 15a, the cup 6a is spaced along the guide-rod 8a so that the tension of the first elastic means 5a, 13a, 14a is determined by the position of said fork 15a. Two adjustable stops 17a, 18a are provided respectively for slow speed and high speeds.

The spring 5a, which is the overload spring, has a diameter greater than that of the springs 13a, 14a and is compressed between the cup 6a and the sleeve 4b. The springs 13a and 14a are compressed between the cup 6a and a bush 130 mounted at that of the ends of the rod 8a which is closest to the shaft 2a. This bush 130 comprises a bore adapted to slide on a part of largest diameter of the rod 8a and it is extended, towards the shaft 2a, by a cylindrical part 130a of smaller diameter. This part 130a comprises a bore adapted to slide on a coaxial extension *e*, of smaller diameter, of the rod 8a. The free end of the extension *e* is threaded and a nut 131 is screwed on this end to stop the bush 130, a washer *r* being advantageously provided between the nut 131 and the bush 130. A sleeve 132, coaxial with the bush 130, is engaged on the latter and comprises, on the side of the shaft 2a, a collar 133 adapted to slide on the extension 130a. A helical spring 134 is arranged inside the sleeve 132 around the extension 130a of the bush 130. This spring 134 is compressed between an inner shoulder formed by the collar 133 and an outer

shoulder provided on the bush 130. Shims 135 are placed between the spring 134 and the shoulder of the bush 130, to enable adjustment of the tension of said spring.

An elastic open ring 136 is anchored in a groove provided towards that of the ends of the extension 130a which is neighboring the nut 131, to serve as a stop for the sleeve 132 pushed by the spring 134. Regulating shims 137 are placed between the ring 136 and the nose of the collar 133 turned towards the nut 131.

The end of the sleeve 132 which is distant from the nut 131 forms a shoulder 138 of larger diameter, adapted to come into abutment in the axial direction against the bush 130. When the sleeve 132, pushed by the spring 134 is supported against the shims 137, the latter in abutment against the ring 136, the axial distance, between the surfaces of the sleeve 132 and the bush 130, which are perpendicular to the axis of the rod 8a and adapted to come into abutment against one another, is equal to Z (FIG. 1).

The sleeve 4b comprises an inner shoulder 50 situated, axially, between the shaft 2a and the shoulder 138 of the sleeve 132. This shoulder 50, on a sufficient displacement of the sleeve 4b in the direction which compresses the spring 5a, is adapted to cooperate with the shoulder 138. At rest, when the sleeve 4b is pushed back to the maximum by the spring 5a, and the sleeve 132 is stopped by the ring 136, the axial distance, between the surfaces of the shoulder 50 and the shoulder 138 adapted to become supported against one another, is equal to Y (FIG. 1).

Second elastic means 29a, coaxial with the first elastic means, are mounted around sleeves 4a, 4b so as to cooperate with the stop members constituted, on the side of the sleeve 4a, by adjusting shims 52a and, on side of the sleeve 4b, by a ring 12b with an L-shaped transverse section of which the concavity is turned towards the sleeve 4a. The shims 52a are supported against the ring 12a, itself stopped by an outer shoulder of the sleeve 4a. The dimension of the ring 12b, along the axis of the shaft 2a, is equal to W (FIG. 1).

The axial distance between the surfaces of the sleeve 4a and of the ring 12b which are facing and adapted to come into abutment against one another, is equal to X_a (FIG. 1). The ring 12b is in unilateral abutment against a shoulder of the sleeve 4b. The distance X_a is obtained between the abovesaid elements when the spring 29a pushes the sleeve 4a in abutment against an elastic ring 43 anchored in the sleeve 4b, at the end of the latter which is neighboring the receiver plate 3a.

The assembly is arranged so that, when these second elastic means 29a undergo a variation in length, the movement of the rack 19a, for a displacement in one direction of the pusher element 3a, is reversed with respect to the movement of the rack 19a which is produced by a displacement in the same direction of said pusher element 3a causing a variation in length of the first elastic means 5a, 13a, 14a.

Pivoting means R (FIG. 3) of the lever 70, on the casing 9a, comprise the axle 71 and are arranged so as to enable a displacement of said axle 71 which causes a movement of the rack 19a. The axle 71 may be displaced by actuating means G, sensitive to the pressure of a fluid.

As seen in particular in FIG. 3, the pivoting means R comprise, in addition to the axle 71, a pivot 139 borne by a sleeve 140 which is provided in the wall of the casing 9a, a bearing 141 being arranged between the

sleeve 140 and the pivot 139. Substantially at mid-length of the bearing 141, a fluid-tight seal 142 is mounted in a groove 143 provided on the pivot 139 to isolate from the outside, the inside of the casing 9a.

The geometrical axis of the axle of rotation 71 is parallel to the geometrical axis of the pivot 139 but is eccentric, with respect to the latter, by a distance h (FIG. 3). A rigid linking plate 144, whose middle plane is perpendicular to the axis of the pivot 139, ensures the linkage between the latter and the axle 71, said plate 144 being fast to said axle and to said pivot.

A fork 145, constituted by a plate whose plane is perpendicular to the axis of the pivot 139 (see FIG. 2), comprises an indent 146, oriented along the large dimension of the fork 145 and open at one end, so that a finger 147, perpendicular to the plane of the fork 145, can be engaged in said indent 146. This fork 145 is keyed in rotation on the pivot 139 by a cotter 148 (FIG. 3) adapted to cooperate with a housing 149 which is provided in the pivot 139 between the part 144 and the inner wall of the casing 9a. The introduction of the cotter 148 into this housing is done by displacement in the radial direction. An axial groove 150, provided in the bore of the fork 145, opens on each surface of this fork, so that, after having placed the cotter 148 in the housing 149, the fork 145 can be engaged on the pivot 139 by axial sliding, the cotter 148 then sliding into the groove 150.

A washer 151 (FIG. 3) is arranged between the fork 145 and the wall of the casing 9a. The pivot 139 is blocked, in translation, by an elastic open ring 152 anchored in a groove provided at the outer end of the pivot. This elastic ring 152 is in abutment, through a washer, against the end of the sleeve 140.

Actuating means G comprise a single acting jack 153 (FIGS. 1, 2 and 4) whose axis is at right angles to a plane passing through the axle 71 and parallel to the axis of the shaft 2a. The cylindrical envelope 154 of this jack is constituted by a part of the wall of the casing 9a. The rod 155 of the piston 156 of the jack slides in a guide bush 157 screwed into a support lug 158. This lug 158 is fast to the casing 9a and projects towards the inside of the latter. The end of the rod 155 which is distant from the piston 156 is threaded and a bent arm 159, whose shape is visible in FIG. 2, is screwed in adjustable manner on this threaded end. A lock-nut is provided for blocking the arm 159. The upper end of this arm 159, neighboring the fork 145, ends in two arms 160a, 160b separated by a slot 161, so as to form a fork into which the end of the fork 145 is engaged comprising the indent 146. The finger 147 passes through the two arms 160a, 160b and is borne by these latter.

The piston 156 is constituted by two cups 156a, 156b between which is clamped the zone of lesser diameter of a flexible diaphragm 162 with circular edges. The cups 156a, 156b are engaged on the lower end 155a of smaller diameter of the rod 155 and are clamped, against the shoulder formed at the zone of change of diameter of this rod, by a nut 163 screwed on the threaded free end of the part 155a. A return spring 164 is arranged between the bush 157 and the cup 156a. Shims 165 are provided between the bush 157 and the spring 164 for the adjustment of the tension of the latter. Shims 166 are provided against the cup 156a for the adjustment of the travel V of the piston 156.

The circular outer edge of the diaphragm 162 is constituted by a beading 167 which is clamped, in fluid-

tight manner, between the envelope 154 and an end plug 168, which is fixed on the envelope or cover by screws. A passage 169 opens into the fluid-tight chamber comprised between the diaphragm 162 and the plug 168. The passage 169 comprises a portion pierced in the plug 168 (see FIGS. 2 and 4).

In the case of a supercharged engine, that is to say whose combustion air is supplied by a turbo-compressor or a blower, the fluid admitted through the passage 169, into the abovesaid chamber is constituted by air under pressure delivered by the turbo-compressor driven by the engine.

The operation of the regulating device according to the invention is as follows. It will be assumed, for these explanations, that it relates to the case mentioned in the previous paragraph (supercharged engine).

The diagrams of FIGS. 5 to 10 and the curve of FIG. 11 enable the phases of operation to be easily followed, the conditions being those of full load.

On starting, the elements of the regulating device occupy the positions as shown in FIG. 5. The receiver plate 3a is pushed to the maximum by the overload spring 5a towards the left of FIG. 5 and, with it, the sleeve 4b and the lever 30a. The end of the arm 73 of the lever 70 and, with it, the rack 19a are displaced to the maximum in the direction + so that starting is effected with a maximal flow-rate per revolution D' . In FIG. 11, the segment 170, parallel to the axis of abscissae, that is to say the axis of speed of rotation, represents the operation of the pump on starting for speeds of rotation of the engine less than N' . The delivery per revolution of the pump, borne as ordinates, remains constant.

When the rotary speed of the engine reaches the value N' , the effect of centrifugal force, on the plate 3a, is sufficient to overcome the effect of the overload spring 5a, so that the plate 3a and with it the sleeve 4b, since the tension of the spring 29a is greater than that of the spring 5a, become displaced so as to compress the spring 5a.

This displacement is produced until the shoulder 50 provided inside the sleeve 4b becomes supported against the shoulder 138 of the bush 132 (FIG. 6). This is produced when the sleeve 4b is displaced, from left to right, by a distance Y (FIG. 1). The overload flow-rate, on starting, is then eliminated. The rotary speed for which the shoulder 50 comes into abutment against the shoulder 138 is equal to N_0 . The lever 30a is displaced parallel to itself, since the axes 31a and 44 are displaced together, from left to right, so that the lever 70 has turned in anti-clockwise direction around the axle 71 and has actuated a displacement of the rack 19a in the direction -: the flow-rate per revolution has hence diminished. The segment of the curve representing the operation of the pump during this phase is indicated by 171 in FIG. 11.

For the rotary speed N_0 , when the overload is removed, the flow-rate per revolution of the pump is D_0 . It will be noted that the rotary speed of the engine was, until now, insufficient for the supercharging air, delivered by the turbo-compressor driven by the engine, to reach a sufficient pressure to move the piston 156. As seen in FIG. 6, where the various elements are shown in the positions that they occupy for a rotary speed of the engine equal to N_0 , the sleeve 4b is stopped by the shoulder 138. The tensions of the various springs are such that, for an increase in the speed of the engine, the spring 29a yields first, before the spring 134, then the

group of springs 13a, 14a.

The speed of the engine, for which the spring 29a starts to yield, is equal to N_1 , so that between the speeds N_0 and N_1 , the segment 172 representing the operation of the pump is parallel to the axis of abscissae.

The spring 164 of the jack 153 has also a tension such that, when the engine rotates at speed N_1 , the supercharging pressure delivered by the turbo-compressor is sufficient to start to move the piston 156 against the effect of the abovesaid spring 164.

There are as a result two simultaneous phenomena:

on one hand, the sleeve 4b remains stationary, in the axial direction, whilst the sleeve 4a approaches the sleeve 4b as a consequence of the compression of the spring 29a; the axle 31, connected to the sleeve 4b, remains stationary whilst the axle 44, connected in translation to the sleeve 4a, is moved from left to right, causing thus rotation of the lever 30a around the axle 31a in anti-clockwise direction. This rotation of the lever 30a causes rotation of the lever 70 around the axle 71, in clockwise direction, which produces a movement of the rack 19a in the direction + and an increase in the delivery per revolution;

On the other hand, the movement of the piston 156, which compresses the spring 164, causes the rise of the rod 155 and of the finger 147 and a rotation of the fork 145, of the linking part 144 and of the axle 71, in anti-clockwise direction, around the pivot 139. The latter being situated beyond the axle 71 with respect to the pivot 72, this movement of the axle 71 causes a rotation of the lever 70 around the pivot 72 in clockwise direction and the rack 19a is moved in the direction +; the delivery per revolution of the pump is hence increased.

The two phenomena are added, the segment 173 (FIG. 11), representing the operation of the pump, has a relatively steep slope which corresponds to rapid increase in the delivery per revolution as a function of the speed of the engine.

When the engine reaches the speed N_2 , the piston 156 has finished its travel V, as shown in FIG. 7, so that the correction, as a function of the pressure of the supercharging air, is ended. However, there subsists an axial play j between the sleeve 4a and the ring 12b, so that the spring 29a can still be compressed.

This compression of the spring 29a is pursued until the play j is eliminated, which is produced when the sleeve 4a comes into abutment against the ring 12b, the position shown in FIG. 8. This position is reached for a speed of the engine equal to N_3 . Between the speeds N_2 and N_3 , the axle 44 has hence continued to be displaced, with respect to the stationary axle 31a, in a direction such that the lever 30a has turned around said axle 31a, in anti-clockwise direction, which has caused a rotation of the lever 70 around the axle 71, in clockwise direction. This rotation is accompanied by a movement of the rack 19a in the + direction with an increase in the delivery per revolution. However, the jack 153 no longer causes movement of the axle 71, increase of the flow-rate per revolution will be less rapid than for the segment 173; it is this which explains that the segment 174 representing the operation of the pump, between the speeds N_2 and N_3 , has a slope less than that of the segment 173.

From the rotary speed N_3 , the elements of the regulating device remain in the position shown in FIG. 8 until the speed N_4 is reached for which the spring 134, arranged between the sleeve 132 and the bush 130, starts to yield. Between the speed N_3 and N_4 , the seg-

ment 175 (FIG. 11) represents the operation of the pump.

Starting from the speed N_4 , the sleeve 4b is moved towards the cup 6a, thereby entraining the sleeve 132. The bush 130 is held immobile axially by the springs 13a, 14a. The displacements of the sleeve 4a, in abutment against the ring 12b, and of the sleeve 4b are identical, so that the axles 31a and 44 remain immobile in the axial direction with respect to one another and the lever 30a is moved parallel to itself, this lever preserving the inclined position shown in FIG. 8. The movement in translation of the lever 30a towards the cup 6a causes rotation, in anti-clockwise direction, of the lever 70 around its immobile axle 71. The rack 19a is moved in the - direction and the delivery per revolution of the pump diminishes (FIG. 9).

The segment 176 (FIG. 11) represents, between the rotary speeds N_4 and N_5 , the operation of the pump, on the compression of the spring 134. For the speed N_5 , the rear shoulder 138 of the bush 132 comes into abutment against the bush 130.

For speeds greater than N_5 , the springs 13a, 14a start to yield, N_5 constituting the starting cut-off speed. The delivery per revolution of the pump diminishes rapidly, as shown by segment 177 of which the negative slope is greater in absolute value than that of the segment 176. FIG. 10 shows the positions of the various elements at the end of cut-off.

The various segments of the curve of FIG. 11 can be adjusted at will.

The overload flow-rate D' depends on the adjustment of the length of the rack 19a which comprises, as seen in the drawings, a threaded adjusting rod.

The speed N' depends on the tension of the overload spring 5a, whilst the slope of the segment 71 depends on the stiffness of said overload spring.

The flow-rate D_0 is determined by the position of the rod 8a which is adjustable by a screw and nut device.

The speed N_1 is determined by the tension of the springs 29a and 164. The tension of the spring 29a is adjustable by the thickness of the shims 52a, whilst that of the spring 164 is adjustable by the thickness of the shims 165.

The slope of the segment 173 depends on the stiffness of the springs 29a and 164 as well as on the distance h between the geometrical axes of the axle 71 and of the pivot 139.

The speed N_2 depends on the stroke V of the jack 153 adjustable by the shims 166.

The slope of the segment 174 depends on the stiffness of the spring 29a whilst the speed N_3 depends on the travel X_a (FIG. 1) which can be adjusted by acting on the axial dimension W of the shim 12b.

The speed N_4 depends on the tension of the spring 134, adjustable by the shims 135. The slope of the segment 176 depends on the stiffness of this spring 134.

The speed N_5 depends on the travel Z possible between the sleeve 132 and the bush 130, this travel Z being adjustable by the shims 137.

The slope of the segment 177 depends on the stiffness of the springs 13a, 14a and 5a.

The adjusting device according to the invention enables numerous corrections of the curve of the delivery per revolution of the pump to be ensured as a function of the rotary speed of the engine.

In particular, in the case of a supercharged internal combustion engine, the flow-rate per revolution can be limited to a low value D_0 whilst the supercharging pres-

sure has not been established, which corresponds, in the curve of FIG. 11, to the case of the speeds of the engine comprised between N_0 and N_1 . In consequence, due to the steeper slope of the segment 173 obtained by the pivoting means R of the axle 71 on the casing 9a, the flow-rate per revolution resumes a high value compatible with the supercharging air pressure.

When the axis of the drive shaft 2a is substantially parallel to the direction of advance of the vehicle, and when the two levers 70 and 30a are provided, the regulator is of the balanced type, that is to say the effects of inertia, on the rack 19a, are compensated and do not modify the regulation.

The device comprises, in addition, a negative correction device enabling the segment 174 to be obtained and a positive correction device enabling the segment 176 to be obtained on the curve of FIG. 11.

The actuating means G constituted by the jack 153 are of small bulk.

With the device of the invention applied to a supercharged engine, on acceleration, the production of smoke is reduced or eliminated, in spite of the inertia of the turbo-compressor which is manifested by a delay in increase of the supercharging air pressure with respect to the increase in speed of the engine.

The invention is not limited to the case of supercharged engines. The fluid admitted into the jack 153 can be a liquid or a gas supplied by an auxiliary source. The pressure of the fluid delivered by this auxiliary source can be servocoupled to an operating parameter of the engine.

The jack 153 could, in a modification, be associated with a device sensitive to the variations in atmospheric pressure so that the correction device would enable modification of the delivery per revolution of the pump as a function of the external pressure of the air.

I claim:

1. Device for regulating the flow rate per revolution of an injection pump for an internal combustion engine, comprising:

- a centrifugal regulator sensitive to the rotary speed of the engine, comprising a pusher element slideable along the axial direction of the centrifugal regulator,
- elastic means operating in a direction opposite to the direction of operation of the centrifugal regulator, said elastic means having a tension which depends upon the position of an accelerator,
- a regulating member for regulating the flow rate per revolution of the pump,

linking means between the pusher element and the flow rate regulating member, comprising at least one transmission lever respectively connected to the pusher element and to the flow-rate per revolution regulating member, a middle portion of this transmission lever being mounted on pivoting means borne by a casing in which is housed the regulating device,

said pivoting means of the transmission lever comprising a pivot borne by the casing and a pivoting axle of said lever fast to the pivot, the geometric axis of this pivoting axle being parallel and eccentric with respect to the geometric axis of the pivot, said pivot and said pivoting axis being fast to a linking element, said linking element being situated between said axle and said pivot,

said pivoting means enabling a displacement of the geometric axis of rotation of said lever, causing a movement of the flow rate regulating member, and actuating means for controlling the displacement of the pivoting axle of said lever, said actuating means being sensitive to the pressure of a fluid, said transmission lever being pivoted by one end on the regulating member for the flow rate per revolution of the pump and, by its other end, on an intermediate lever, said intermediate lever connecting one end of the transmission lever to the pusher element, said intermediate lever being pivoted, in its middle part, on a first sleeve movable with the pusher element, said first sleeve being slidably mounted in a second sleeve connected for translation with said pusher element, the first-named elastic means being in abutment against said first sleeve, and a further elastic means being provided between said first sleeve and said second sleeve so as to enable relative movement of said two sleeves which causes rotation of the levers and movement of the flow rate regulating member.

2. Device according to claim 1, wherein the first-named elastic means are mounted around a rod entering in the said first sleeve coaxial with the centrifugal regulator, said first-named elastic means being compressed between a cup spaced from said first sleeve and a bush neighbouring the latter, said first sleeve comprising an inner shoulder, said device further comprising a third sleeve adapted to slide on said bush, a spring being arranged between the bush and the third sleeve, in order to push back the latter against a stop anchored in the bush, said second sleeve comprising a shoulder adapted to cooperate with the inner shoulder of the first sleeve.

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