(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 438 871 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **90313108.4**

(51) Int. Cl.[5]: **F02D 1/04**

(22) Date of filing: **03.12.90**

(30) Priority: **20.01.90 GB 9001372**

(43) Date of publication of application:
31.07.91 Bulletin 91/31

(84) Designated Contracting States:
DE FR GB IT

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(54) Fuel Pumping apparatus.

(57) A fuel pumping apparatus includes a fuel quantity control 13 which is coupled to a first pivotal lever 19 of a centrifugal governor mechanism. The lever is acted upon at one end by governor weights 16 and at its other end it engages a further lever 22 which is pivotally mounted on an adjustable member 24. A governor spring 31 is coupled to the further lever to oppose the force exerted on the first lever by the weights. The adjustable member 24 can be adjusted to determine the effective rate of the governor spring.

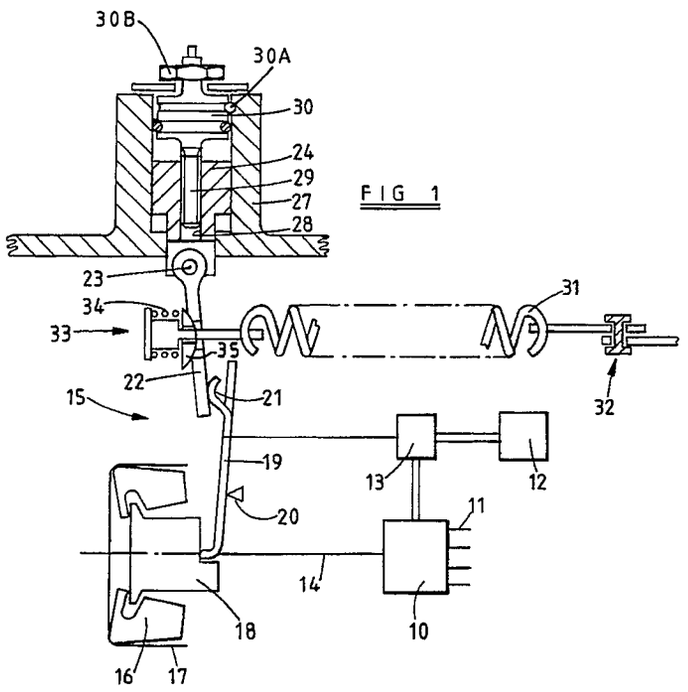

FIG 1

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FUEL PUMPING APPARATUS

This invention relates to a fuel pumping apparatus for supplying fuel to an internal combustion engine and of the kind comprising a high pressure pump which is driven in timed relationship with an associated engine, a fuel quantity control operable to determine the quantity of fuel delivered by the high pressure pump to the associated engine, a mechanical governor mechanism for determining the setting of said quantity control, said governor mechanism comprising a lever pivotally mounted intermediate its ends, a centrifugal weight mechanism acting on one end of the lever, a linkage connecting the lever to said quantity control whereby with increasing engine speed the quantity control member will be operable to reduce the amount of fuel delivered to the associated engine and resilient means acting to oppose the movement of the lever by the weight mechanism, the force exerted by said resilient means being adjustable to determine the speed of the associated engine.

In practice the resilient means will comprise a spring one end of which is operatively connected to the lever and the other end of which is coupled to an adjustable member which in the case of a vehicle, is connected to the throttle pedal of the vehicle. For a given setting of the throttle pedal the engine will assume a speed depending upon the applied load and as the load varies the engine speed will vary and the governor mechanism will adjust the amount of fuel supplied to the engine. The governor mechanism can vary the fuel between a minimum which may be zero, and a maximum amount, the latter being determined by a maximum fuel stop and the variation in engine speed which has to take place to accomplish the aforesaid variation in fuel supply is known in the art as the "droop".

The droop of the governor mechanism is determined by the effective rate of the spring and this is determined during manufacture of the spring. Although every effort may be made to produce springs having the same rate there will nevertheless be differences which will result in variations in the droop between governor mechanisms which incorporate the springs. Moreover, the required value of the droop will depend upon the engine application. For example, where the engine is driving a vehicle it is desirable that there should be an appreciable variation of speed but where the engine is used to power an electrical generator the variation of speed should be very much less. Furthermore, particularly in the electrical generator application, it may be desirable to be able to adjust the droop whether or not the engine is in operation particularly where two generators are connected in parallel. Adjustment of the droop may be required as a result of wear.

The object of the invention is to provide a fuel pumping apparatus in a simple and convenient form.

According to the invention a fuel pumping apparatus of the kind specified includes a further lever pivotally mounted at one end on an adjustable support and engaging said first mentioned lever, and said resilient means being coupled to said further lever so that the force exerted by the resilient means is transmitted through said further lever to the first mentioned lever, said support being adjustable to vary the effective rate of the resilient means as applied to the first mentioned lever.

An example of an apparatus in accordance with the invention will now be described with reference to the accompanying drawings in which:-

Figure 1 shows the apparatus in diagrammatic form;

Figure 2 shows a modification of one part of the apparatus seen in Figure 1; and

Figure 3 shows a modification of a further part of the apparatus seen in Figure 1.

Referring to the drawing the apparatus comprises a high pressure pump 10 having outlets 11 for connection to the injection nozzles of the associated engine. Fuel is supplied to the high pressure pump by a low pressure pump 12 by way of an adjustable quantity control in the form of a throttle 13. The pump 10 is driven by means of a drive shaft the axis of which is indicated at 14. Such an apparatus can be a rotary distributor type of fuel pumping apparatus. A governor mechanism generally indicated at 15 is provided and this comprises a plurality of centrifugal weights 16 which are located in a cage 17 mounted on the drive shaft. The weights engage through a thrust bearing not shown, with a sleeve 18 slidable on the drive shaft and the sleeve engages one end of a pivotal lever 19 the pivot point for which is indicated at 20.

The lever 19 is coupled to the throttle 13 in such a manner that as the weights move outwardly with increasing engine speed, the throttle will move to reduce the amount of fuel which is supplied to the high pressure pump 10.

The end of the lever 19 remote from the sleeve 18 is deformed to define a curved portion 21 which is engaged by a further lever 22 pivotally mounted at 23 on an adjustable support member 24, the member 24 being movable towards and away from the axis 14 of the drive shaft. The member 24 is of cylindrical form but has a portion of non-circular section which extends through an aperture of com-

plementary shape formed in a housing 27 having a cylindrical bore. The member is provided with a screw threaded aperture 28 in which is engaged a complementarily screw threaded rod 29 extending from the end of an axially fixed but rotatable member 30 mounted in the housing 27. The member 30 is held against axial movement by a pin 30A which is secured within the housing 27 and locates in a circumferential groove in the member. By rotating the member 30 the adjustable member 24 will move towards or away from the axis 14 of the drive shaft and the pivot point 20 of the lever 19. In this manner the point of engagement of the lever 22 with the curved portion 21 of the lever 19 can be varied. The member 30 can be secured in position by means of a locknut 30B which is engagable with a washer engaging the housing 27.

The governor mechanism also includes a governor spring 31 and this is in the form of a coiled tension spring one end of which is connected to an operator adjustable member 32 and the other end of which is connected to a spring abutment 33. The spring abutment also includes an idling spring 34 which in known manner, can be compressed a limited extent as the engine speed increases above the idle speed. The idling spring is located between the abutment and a shoe 35 having a curved surface which is located against a curved surface on the lever 22. Both the shoe and the lever define apertures through which extends a rod connecting the spring abutment with the spring 31.

The maximum amount of fuel which can be supplied by the high pressure pump 10 to the associated engine is determined by limiting in known manner, the maximum pumping stroke of the pumping plunger or plungers of the pump 10.

By the construction described the governor droop can be adjusted to suit the particular engine application and furthermore, the droop can be adjusted with the engine in operation.

In operation, as the speed of the associated engine increases, the weights 16 will move outwardly to urge the lever 19 in the anti-clockwise direction as seen in the drawing, against the force exerted by the spring 31, it being assumed that the speed of the engine is above the idling speed so that the spring 34 is compressed. As the lever moves in the anti-clockwise direction, the quantity of fuel which is supplied to the engine will be reduced. Eventually the engine speed will assume an equilibrium value which depends upon the load applied to the engine.

If the operator adjustable member 32 is moved to increase the force exerted by the spring 31, the weights 16 will be collapsed and the lever 19 will be moved in the clockwise direction to effect an increase in the amount of fuel supplied to the engine. The engine speed will therefore increase until a new equilibrium speed is established. When the engine has attained an equilibrium speed, variation in the load applied to the engine for a given setting of the operator adjustable member 32 will result in a variation in engine speed with the lever 19 moving in the clockwise direction if the speed decreases, thereby resulting in an increase in the supply of fuel to the engine and in the anti-clockwise direction if the engine speed should increase thereby resulting in a decrease in the amount of fuel supplied to the engine.

The effective rate of the spring 31 as applied to the lever 19 and which varies the governor droop, can be altered by adjustment of the adjustable member 24 towards or away from the axis 14 of the drive shaft. This adjustment can be carried out with the engine running if so required. In the example if the adjustable member 24 is moved upwardly the effective spring rate is reduced and vice versa.

In the arrangement shown in Figure 1 the lever 22 defines a part spherical recess in which is located the shoe 35 having a spherical surface engaging the surface of the recess and a flat surface which is engaged by one end of the spring 34. As the levers 19 and 22 move about their respective pivots the surfaces of the shoe and recess move relative to each other.

An alternative form of shoe is seen in Figure 2 which shows to an enlarged scale a section through the modified lever 22A and a side view of the modified shoe 35A. The lever 22A defines a pair of "V" grooves 36 on opposite sides of a through aperture and the shoe 35A defines on opposite sides of a through aperture a pair of knife edges 37 having a smaller included angle than the grooves.

An alternative form for the point of engagement between the levers 19 and 22 is seen in Figure 3. As seen in Figure 3, there is interposed between the two levers 22A and 19A a slide 38 having a pair of spaced side limbs 39 which locate on opposite edges of the lever 22A so that the slide is guided for movement along the length of the lever. The lever 19A is provided with an end portion 40 which extends towards the lever and is provided with a radiused end which locates within a transverse recess in the face of the slide remote from the limbs. The recess is radiused having a radius which is slightly larger than that of the end of the lever 22A. The slide is provided with an elongate slot which coincides with the through aperture in the lever 22A.

The provision of the slide 38 which moves along the lever 22A as the levers pivot relative to each other provides a substantial bearing surface and therefore reduced wear as compared into the arrangement shown in Figure 1 where it is possible for a ridge to be formed particularly where the

governor is used in a constant speed application for example a generating set.

A further modification not shown, is the replacement of the pin 30A which secures the member 30 against axial movement, by a circlip which bears against a shoulder defined on the member and which is located within a groove formed in the bore in the housing 27.

The use of the modified shoe 35A and the lever 22A reduces the friction between the part spherical surfaces of the shoe 35 and lever 22. Such friction may be appreciable even though the surfaces may be lubricated, and can reduce the sensitivity of the governor to changes of engine speed.

Claims

1. A fuel pumping apparatus for supplying fuel to an internal combustion engine including a fuel quantity control (13) movable to control the quantity of fuel delivered by a high pressure pump (10) to the engine, a mechanical governor mechanism (15) for determining the setting of the quantity control, the governor mechanism comprising a lever (19, 19A) pivotally mounted intermediate its ends, a centrifugal weight mechanism (16, 17, 18) acting on one end of the lever, a linkage connecting the lever (19, 19A) to said quantity control (13) whereby with increasing speed the quantity control will be operated to reduce the amount of fuel delivered to the associated engine and resilient means (31) acting to oppose the movement of the lever (19, 19A) by the weight mechanism, the force exerted by the resilient means being adjustable to determine the speed of the engine characterised by a further lever (22, 22A) pivotally mounted at one end on an adjustable support (24) and being engaged by said first mentioned lever (19, 19A), and said resilient means (31) being coupled to said further lever (22,22A) so that the force exerted by the resilient means is transmitted through said further lever to the first mentioned lever, said support (24) being adjustable to vary the effective rate of the resilient means as applied to the first mentioned lever (19, 19A).

2. An apparatus according to Claim 1, characterised in that said resilient means (31) is coupled to said further lever (22, 22A) through a shoe (35, 35A) which is pivotable relative to the further lever.

3. An apparatus according to Claim 2, characterised in that said shoe (35A) defines a knife edge (37) engagable within a "V" groove (36) formed in the further lever (22A).

4. An apparatus according to Claim 1, characterised in that one of said levers (19, 22) defines a curved end portion (21) engagable with the other lever.

5. An apparatus according to Claim 1, characterised in that there is interposed between said levers (19A, 22A) a slide (38) which is slidable on one of the levers, the other lever being provided with a radiused end portion (40) which is located in a recess formed in the slide.

6. An apparatus according to Claim 1, characterised in that the slide (38) is provided with a pair of spaced side limbs (39) which locate against opposite edges of the one lever.

7. An apparatus according to Claim 1, characterised in that said support comprises a support member (24) slidable in housing (27) means for preventing rotation of the member (24) within the housing, a screw threaded bore in the support member (24), an axially fixed rotatable member (30) mounted in the housing and carrying a screw threaded rod (29) engaged in said bore, whereby rotation of the rotatable member (30) will result in axial movement of the support member (24) towards or away from the pivot point (20) of the first lever (19).

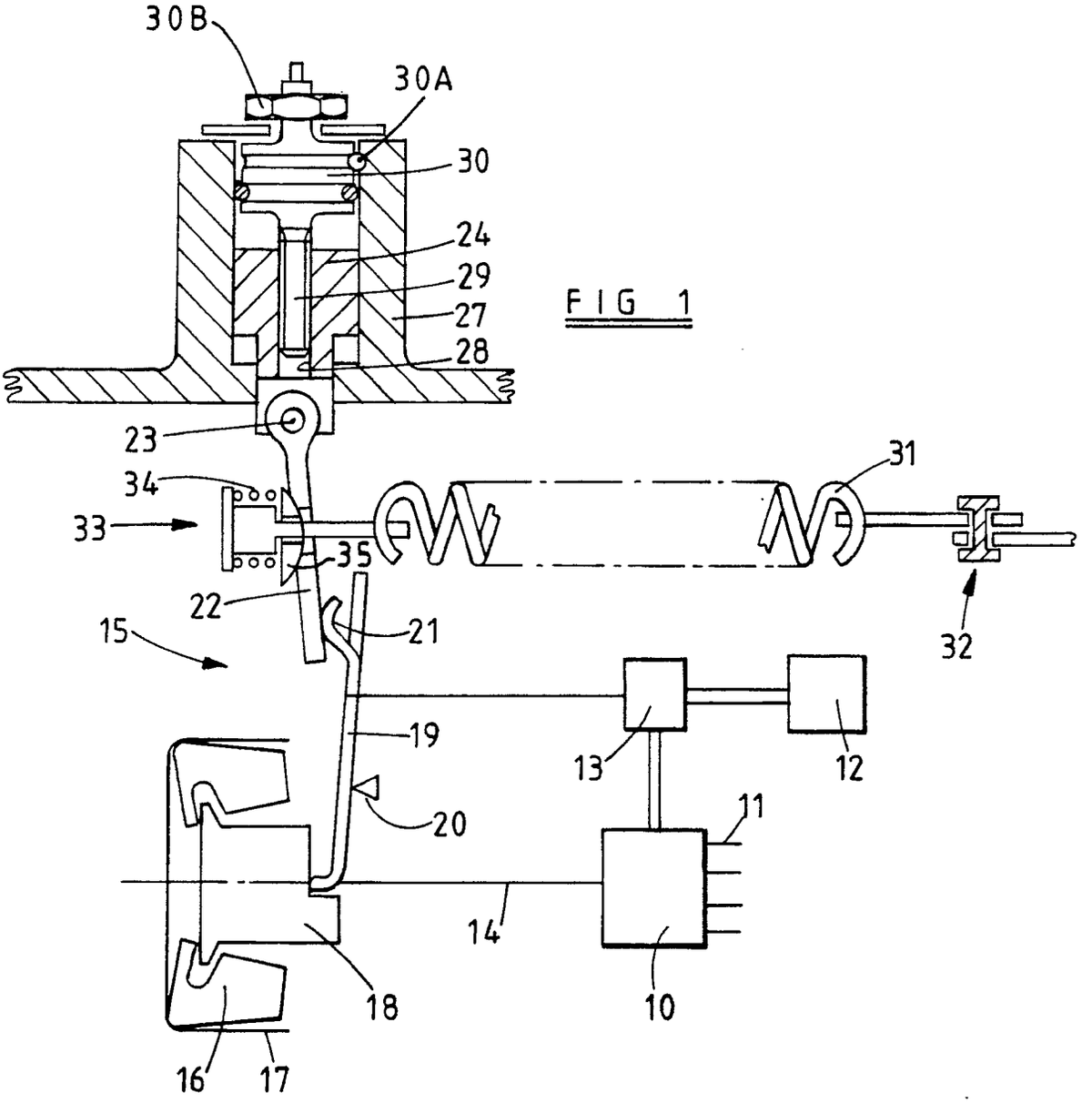
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FIG 1

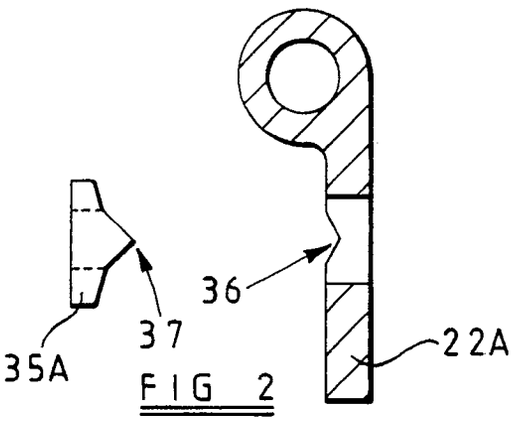

FIG 2

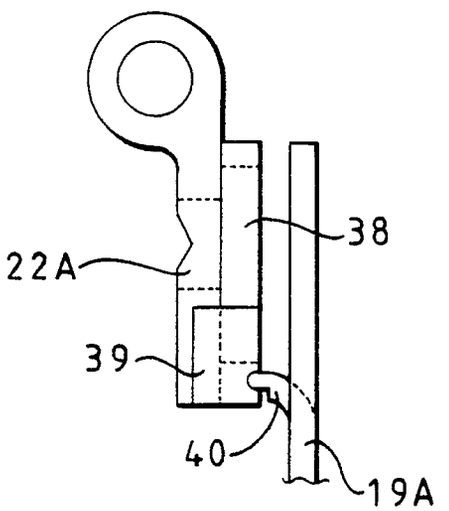

FIG 3

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EUROPEAN SEARCH REPORT

Application Number

EP 90 31 3108

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	DE-B-1 197 274 (FRIEDMANN & MAIER) * Column 8, lines 26-44; figure 7 *	1,4	F 02 D 1/04
Y	GB-A-2 000 881 (DIESEL KIKI) * Abstract *	1,4	
A		7	
A	GB-A-2 154 338 (BOSCH) * Page 2, lines 23-112; figure 1 *	2,3	
A	FR-A-2 220 675 (CAV)		
A	DE-A-1 912 919 (BOSCH)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F 02 D

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	19 March 91	SIDERIS M.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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