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[54] ACTUATOR MECHANISM

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[52] **U.S. Cl.** .... **74/479;** 123/32 EA; 123/139 E; 123/139 R; 123/140 MC; 123/198 DB

[51] **Int. Cl.**[2] **G05G 11/00**

[58] **Field of Search** .... 74/108, 105, 469, 470, 74/479; 123/32 EA, 139 E, 140 MC, 140 MP, 110, 198 D, 198 DB; 60/403, 431, 432; 417/1

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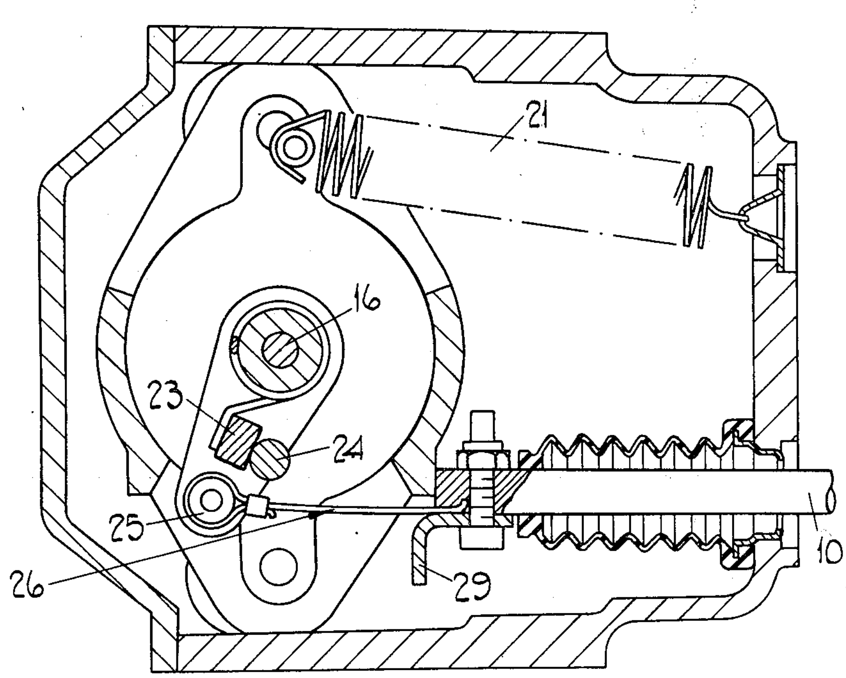
[57] **ABSTRACT**

An actuator mechanism for the fuel quantity control member of a fuel injection pump includes an output member movable angularly by an electro-magnetic device, a radial arm pivotally mounted about the member and movable thereby by the intermediary of resilient means, the arm being connected to the control member through a link which is sufficiently stiff to transmit movement between the arm and the control member, but which can flex to permit variation in the paths of movement of the control member and the arm.

9 Claims, 4 Drawing Figures



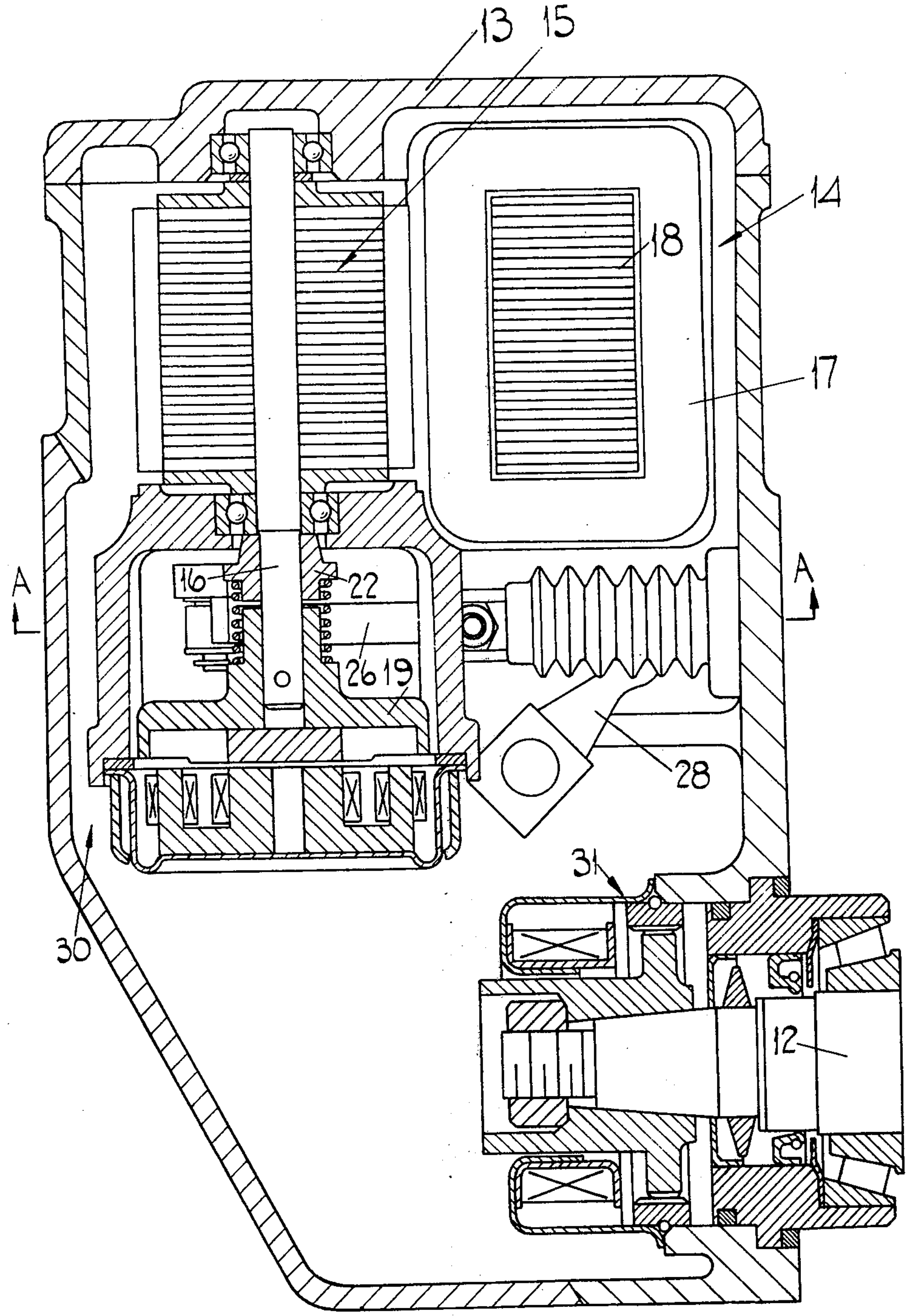


FIG. 1.

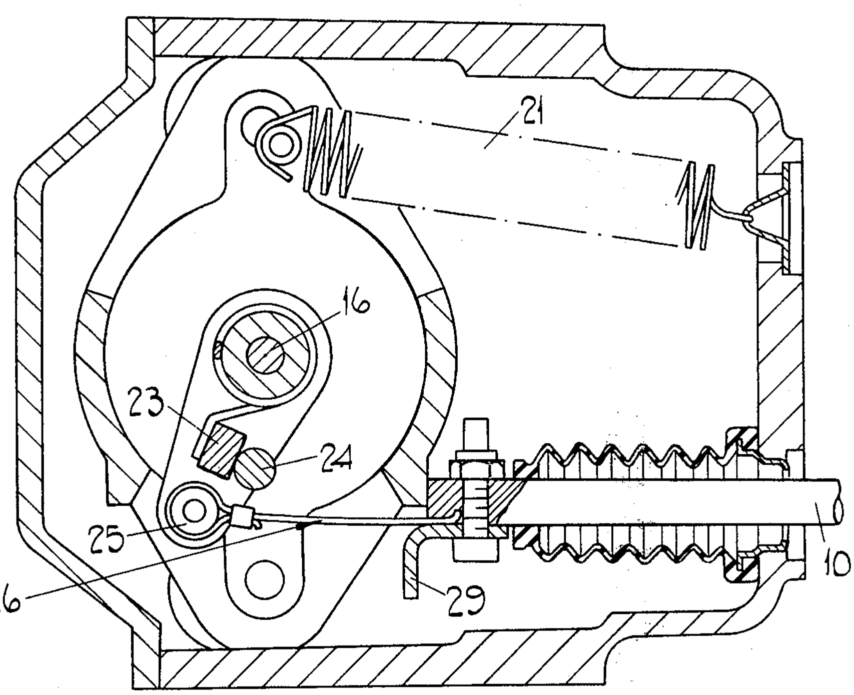


FIG. 2.

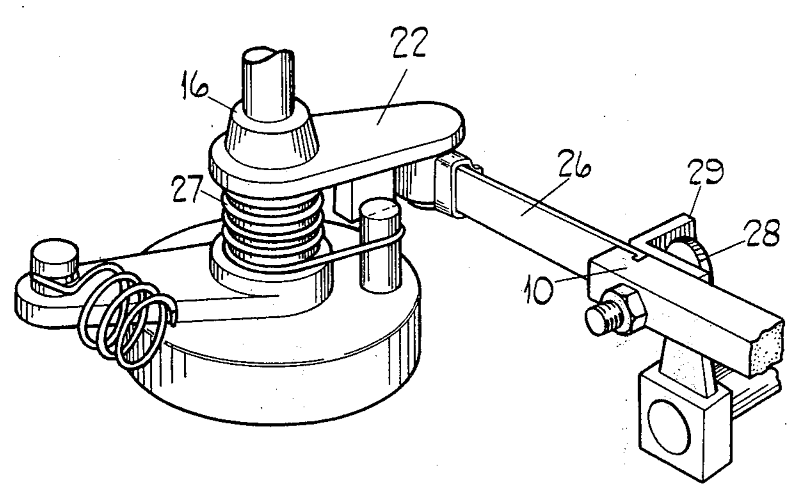


FIG. 3.

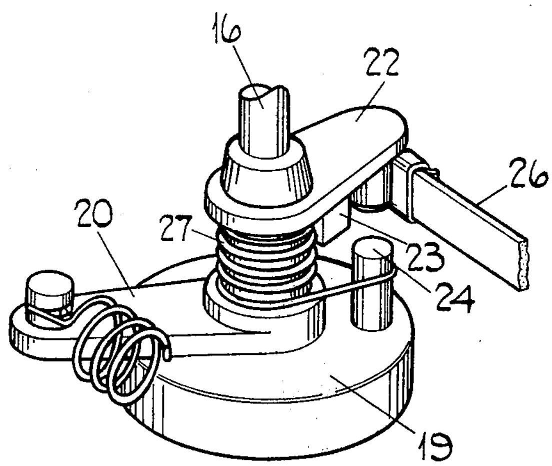


FIG.4.

ACTUATOR MECHANISM

This invention relates to actuator mechanisms for the fuel quantity control member of a fuel injection pump, the mechanism being of the kind comprising an electro-magnetic device for moving the control member to increase the quantity of fuel supplied by the pump against the action of resilient means.

The object of the invention is to provide such a mechanism in a simple and convenient form.

According to the invention, a mechanism of the kind specified comprises a radial arm angularly movable about an axis at or adjacent one end of said device, a link pivotally connected at or adjacent the other end of the arm, the link being rigidly mounted upon said control member, and the link being flexible to permit variation in the paths of movement of the ends of the link.

One example of an actuator mechanism in accordance with the invention will now be described with reference to the accompanying drawings in which:

FIG. 1 shows a sectional side elevation of the mechanism,

FIG. 2 shows a sectional inverted plan view on the line A—A of FIG. 1,

FIG. 3 shows a perspective view of the essential components shown in FIGS. 1 and 2, and

FIG. 4 shows part of the view seen in FIG. 3 with various parts in alternative positions.

Referring to the drawings, the actuating mechanism is shown as applied to the fuel control rod **10** of a fuel injection pump. The fuel injection pump includes a casing, a portion of which is seen at **11** and in which is supported a rotary shaft **12**. The shaft **12** carries cams for actuation of individual injection pumps in a manner well known in the art. The fuel control rod **10** is axially movable to adjust the amount of fuel supplied at each injection stroke by the injection pumps, and as shown in FIG. **2** of the drawings, movement of the control rod **10** towards the right effects an increase in the amount of fuel supplied at each injection stroke. The actuator mechanism is contained within a housing **13** which conveniently is secured to the housing **11** of the injection pump.

Located within the housing **13** is an electro-magnetic device generally indicated at **14** and which includes an angularly movable rotor **15** carried upon an output shaft **16**. The device also includes a field structure which comprises a winding **17** surrounding a core **18** of laminated construction. When electrical power is supplied to the coil **17**, a magnetic field is created which results in angular movement of the rotor **15**. As viewed in FIG. **2**, anti-clockwise movement of the rotor occurs when electrical power is supplied to the coil **17**, and this as will be described, effects an increase in the quantity of fuel supplied at each injection stroke of the injection pump.

As best seen in FIGS. **1**, **3** and **4**, the output shaft **16** is coupled to a disc **19** having a radially extending arm **20**, and this is connected to one end of a coiled tension spring **21**, the other end of which is secured to a part of the housing. Moreover, located about the shaft **16** is a radially extending arm **22** on the underside of which is a projection **23**. A further projection **24** is provided on the disc **19**, whilst a peg **25** at the end of the arm **22** is pivotally connected to one end of a link **26**, the other end of which is rigidly connected to the end of the control rod **10**.

The projections **23** and **24** are urged into engagement with each other by means of a spring **27** loosely engaged about a boss on the disc **19**. The ends of the spring are engaged around the projections **23** and **24** respectively, and as stated, the projections **23** and **24** are held in engagement with each other by the force exerted by the spring.

In operation, the spring **21** acts through the intermediary of the projections **23**, **24** to urge the control rod **10** towards a position of minimum fuel supply. When electric power is supplied to the coil **17**, angular movement is imparted to the shaft **16** and the disc **19** which is directly coupled to the shaft, also moves angularly. This movement is directly resisted by means of the spring **21**. The arm **22** is also moved angularly to effect movement of the control rod **10** to increase the quantity of fuel supplied to the engine, and during this movement the force required to effect movement of the control rod **10** is transmitted through the spring **27** which is pre-stressed by a sufficient amount that the projections **23**, **24** normally remain in contact with each other. Moreover, the movement of the control rod **10** is along its longitudinal axis, and the movement of the peg or pivot pin **25** is in the form of an arc about the axis of the output shaft **16**. The discrepancy in this movement is accommodated by flexure of the link **26** which is made suitably resilient for this purpose but is sufficiently stiff to ensure that the correct movement is imparted to the control rod **10**.

Variation in the electric current flowing in the coil **17** will effect variation in the setting of the control rod **10**, and the flow of electric current to the coil **17** is controlled by an electronic circuit which is responsive to driver demand and engine speed amongst other things. In the event that the spring **21** breaks, there will be substantially no restraining force on the angular movement of the rotor **15**. Moreover, the possibility exists that the shaft **16** may stick in some intermediate position and despite the fact that the supply of power to the coil **17** may be cut off, the spring **21** may be unable to effect the requisite angular movement of the shaft **16**.

There is therefore provided a stop lever **28** which is engageable with an abutment **29** carried by the control rod. The stop **28** is connected to linkage exterior of the apparatus so that in the event of an emergency, force can be applied to the control rod **10** to move it to the minimum or zero fuel position. When the stop level **28** is actuated, the link **26** effects angular movement of the arm **22**, and if the output shaft **16** is jammed, the force exerted by the spring **27** will be overcome and the projections **23** and **24** will move apart. Such a condition is shown in FIG. **4**. With the control in the minimum or zero fuel condition, then clearly the engine will either idle or stop. In the event that the output shaft **16** has not jammed, but the spring **21** has broken, then angular movement of the arm **22** will probably result in angular movement of the disc **19** and no separation of the projections **23** and **24** will occur. However, the control rod will still be moved to the minimum or zero fuel position.

As shown in FIG. **1**, the disc **19** forms part of a transducer **30** capable of providing an electrical signal indicative of the angular position of the shaft **16**, and therefore the axial position of the control rod. The output of the transducer is fed to the electronic control circuit previously described. In addition, the shaft **12** carries the rotor of a small generator **31** which provides an alternating current signal, the frequency of which varies in accordance with the speed at which the shaft **12** is driven. The shaft **12** is driven in timed relationship with the associated engine, and therefore the signal obtained from the generator can be utilised to provide a signal indicative of the speed of the engine. This signal is also fed to the electronic control circuit, previously mentioned.

I claim:

1. An actuator mechanism for the fuel quantity control member of a fuel injection pump, the mechanism comprising an electro-magnetic device having a radial arm extending from the device and being angularly movable about an axis proximal to one end of the device, a link pivotally connected proximal to the extended end of the arm, the link containing means for being rigidly mounted upon the control member of a fuel injection pump, and the link being flexible to permit variation in the paths of movement of the ends of the link so that when the link is connected to the control member of a fuel injection pump and the electro-magnetic device is activated for angular movement along with the radial arm connected thereto, the link will suitably flex and shift the control member in the desired manner.

2. An actuator mechanism for the fuel quantity control member of a fuel injection pump, the mechanism comprising an electro-magnetic device including an output member angularly movable about an axis and having a radial arm angularly movable about said axis adjacent one end of the output member, a link pivotally connected proximal to the extended end of the radial arm, the link having means for being rigidly mounted upon a control member of a fuel injection pump, and the link being flexible to permit variation in the paths of movement of the ends of the link so that when the link is connected to the control member of a fuel injection pump and the electro-magnetic device is activated for angular movement along with the radial arm, the link will suitably flex and shift the control member to the desired degree.

3. An actuator mechanism as claimed in claim **2** in which said arm is mounted about said output member and is angularly movable relative thereto.

4. An actuator mechanism as claimed in claim **3** including resilient means acting to transmit movement of the output member to the arm in a direction to increase the amount of fuel supplied by the pump.

5. An actuator mechanism as claimed in claim **4** including a pair of pegs with one peg mounted on the arm and the other peg mounted on a member movable with the output member, said pegs being held in engagement by said resilient means.

6. An actuator mechanism as claimed in claim **5** in which said resilient means comprises a helical spring with one end of the spring engaged with one peg and the other end of the spring engaged with the other peg.

7. An actuator mechanism as claimed in claim **6** including spring means acting on said member in opposition to the force exerted by said electro-magnetic device.

8. An actuator mechanism as claimed in claim **1** including a stop lever engageable with an abutment carried by the control member to move the control member in a direction to reduce the amount of fuel supplied by the pump.

9. An actuator mechanism as claimed in claim **8** in which said member forms part of a transducer for providing a signal indicative of the position of the control member of the pump.

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