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(54) **An internal combustion engine fuel injection pump regulating arrangement**

(57) The fuel injection pump lever (3) is provided with a stop (11) to determine the minimum quantity of fuel injected. The stop (11) comprises a rotatable profiled surface (12).

In order to effect adjustment of the minimum quantity of fuel injected, the stop (11) is adjustable by way of a pin (20) by means of a bimetal spiral (21) which is heatable by a heating element (27). A spiral spring (22) is also provided which opposes the movement of the stop (11) under the influence of the bimetal spiral (21).

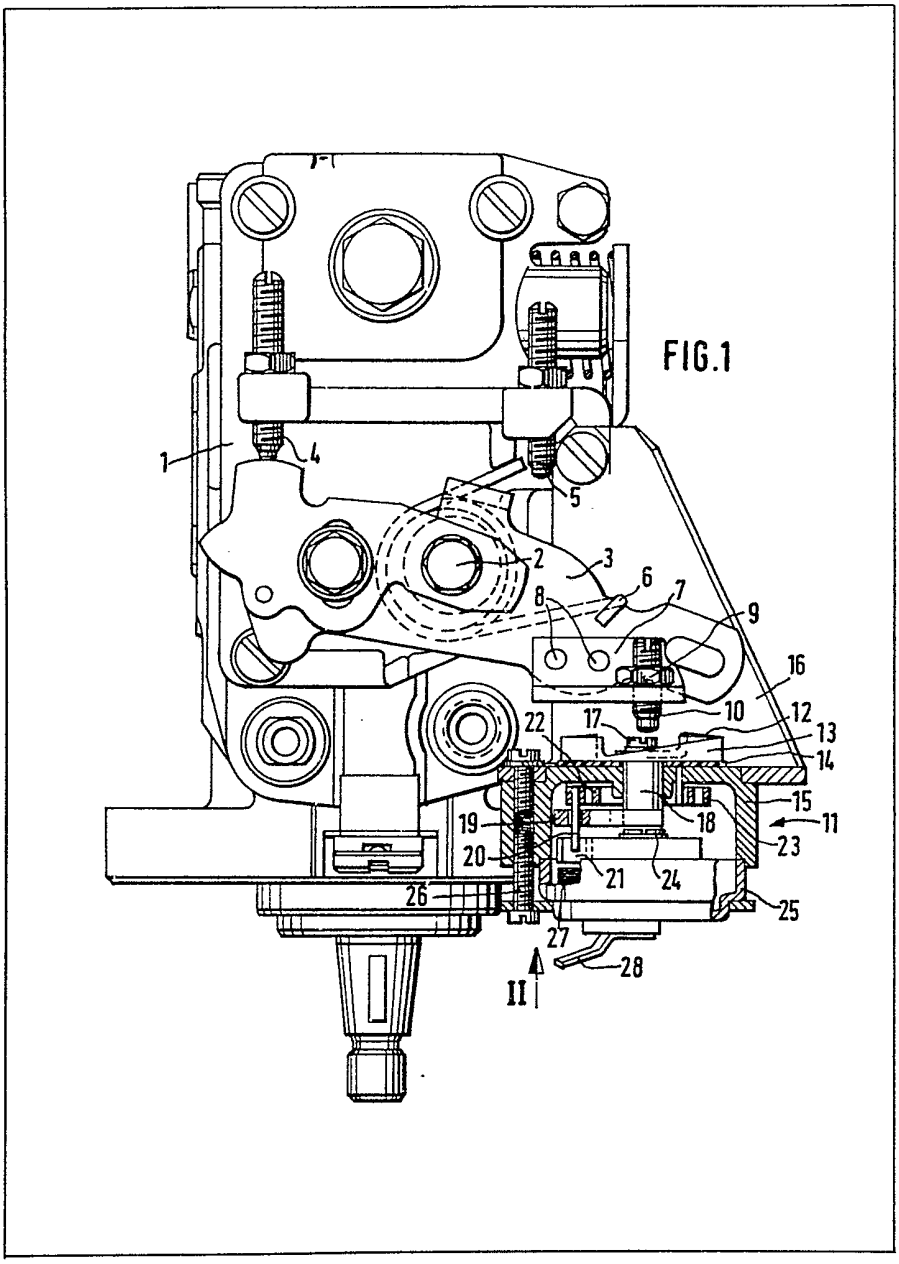

FIG.1

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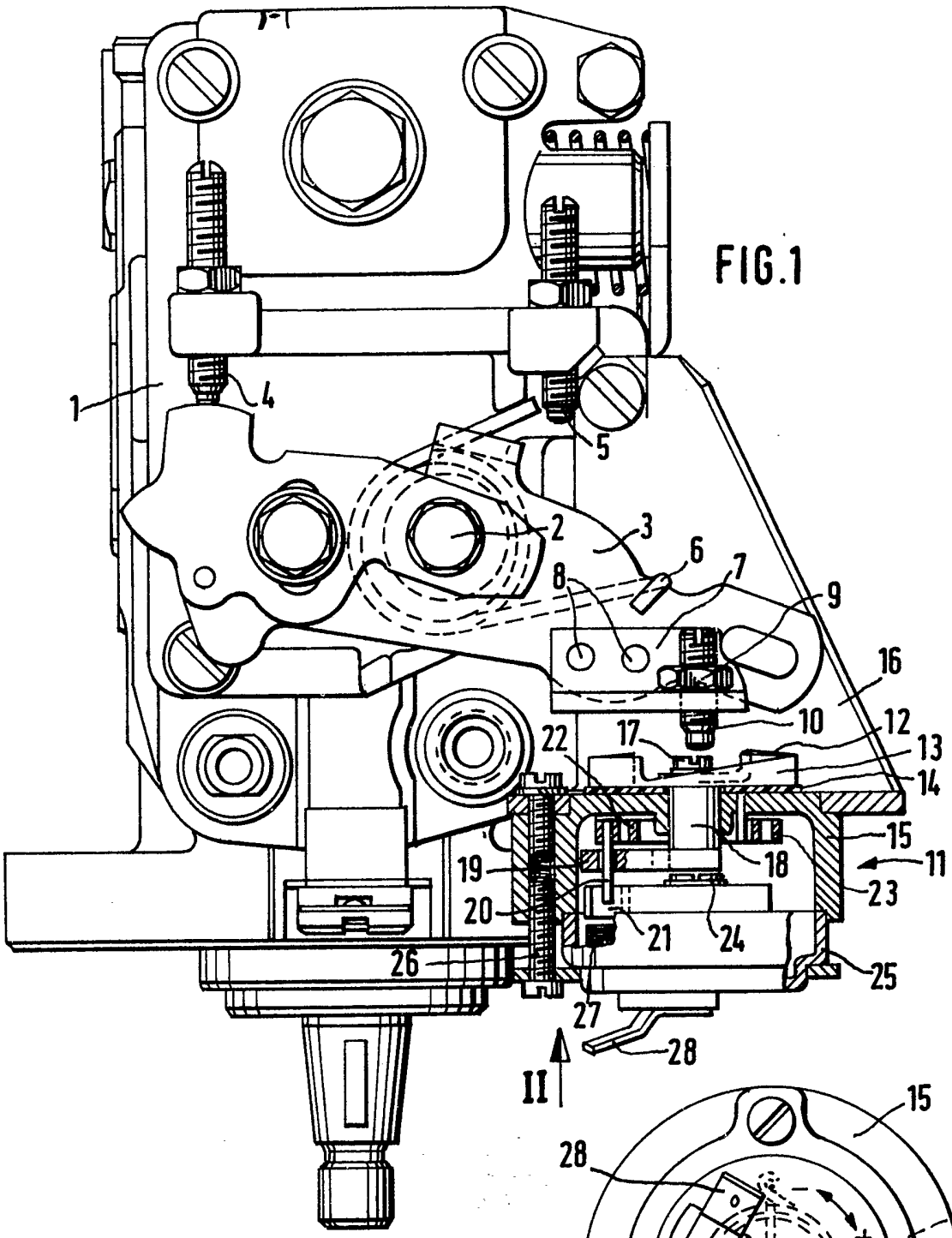
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FIG.1

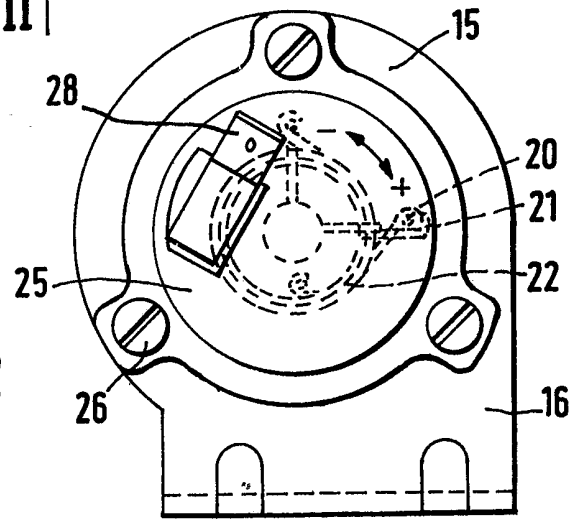
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FIG.2

SPECIFICATION

A fuel injection pump for an internal combustion engine

The invention relates to a fuel injection pump.

In particular the invention relates to a fuel injection pump having an adjustable lever for determining the quantity of fuel injected and a stop which determines the minimum quantity of fuel injected.

In a known fuel injection pump of this kind the stop comprises an adjustable screw which is lockable by a nut which serves as a stop for the minimum quantity of fuel injected, such as is required during idling. The larger injected quantity of fuel required during warming-up is then effected by means in the governor by which this minimum quantity cannot be arbitrarily varied or can only be varied with considerable difficulty.

According to the present invention there is provided a fuel injection pump for an internal combustion engine, having an arbitrarily operable adjusting lever for determining the quantity of fuel injected and an adjustable stop for the adjusting lever, which stop determines the minimum quantity of fuel injected or the idling speed, the stop being in the form of a rotatable profiled surface which is rotatable in a plane at right angles to the plane of travel of the lever, and which is adjustable by a bimetal spiral in dependence upon temperature, whereby to effect adjustment of the minimum quantity of fuel injected.

In contrast to the prior art, the fuel injection pump in accordance with the invention has the advantage that the minimum quantity of fuel is adjusted at low expense and in an arbitrarily controllable manner. The choice of the profiled surface can vary for each internal combustion engine and it can be fitted to a mass-produced pump in a unit-composed manner. It is an extremely simple matter to mount the profiled surface, tilting moments do not occur as a result of the axial application of forces, and the wear is extremely small owing to the large profiled surface. The basic setting of the device can be effected without thereby affecting the impressed characteristic of the pump governor.

The present invention will now be further described, by way of example only, with reference to the accompanying drawings, in which:—

Figure 1 shows an injection pump with the stop device illustrated in section; and

Figure 2 is a view of the stop device in the direction of the arrow II, although turned through 45°, and with a fragmentary illustration of the non-visible spirals.

An adjusting lever 3 is disposed on a shaft 2 in a fuel injection pump 1 for an internal combustion engine. The angular position of the adjusting lever 3 determines the quantity of fuel injected and is arbitrarily adjustable by the controller or driver of the internal combustion engine. An electrical governor can be controlled by the shaft 2 or, for example, the initial stress of the regulating spring can be varied as in the case of a mechanical governor. The angular position of the adjusting lever 3 is limited by stops of which a stop 4 basically limits the minimum quantity of fuel injected, and a stop 5 basically limits the maximum quantity of fuel injected. A return spring 6 displaces the lever into a position for the minimum delivery quantity normally required during idling.

The invention resides in determining the minimum quantity by a stop which is arbitrarily variable in dependence upon engine parameters or ambient quantities of the engine. For this purpose, an angled connecting bar 7 is secured to the lever 3 by fastening elements 8. A stop screw 10 threadingly engages in the connecting bar 7 and is lockable by a nut 9. This screw cooperates with a stop device 11 which has a profiled surface 12 which is directly towards the end of the screw 10 and acts as a stop for the latter. The surface 12 is rotatable in a plane extending at right angles to the plane in which the lever 3 pivots. For the sake of clarity, the profiled surface 12 is shown in Figure 1 in a position in which it is turned through 45°. When the surface 12 is in its actual position, the screw 10 would rest thereon. The profiled surface 12 is disposed on a plate-like part 13 which abuts against the end face of a sleeve 15 by way of a plastics disc 14, the sleeve 15 in turn being secured to the injection pump 1 by means of an angled retaining member 16. The part 13 is secured by means of a screw 17 to a shaft 18 which is journalled in the end wall of the sleeve 15 and which has a turning lever 19. The turning lever 19 is connected on the one hand to a bimetal spiral 21 and, on the other hand, to a spiral spring 22, by means of a pin 20. The inner end of the spiral spring 22 is rigidly connected to the sleeve 15 at 23. The inner end of the bimetal spiral is also rigidly connected to the sleeve 15 by securing its inner end to a cover 25 of the sleeve 15 by means of a screw 24, the cover 25 being screwed to the sleeve 15 by screws 26. A heating element 27 is disposed in the cover 25 and has an electrical connection 28 and its end face can heat the bimetal spiral 21.

Figure 2 shows the stop device 11 viewed from the end face in the direction of the arrow II. In order to be able to facilitate the explanation of the function, the spirals disposed in the sleeve 15, and which are not visible from the outside, are only indicated by broken lines. The spirals 21 and 22 act in opposite directions upon the pin 20 rigidly connected to the lever 19, the spiral 22 acting in the sense of a right-hand screw, whereas the bimetal spiral acts in the sense of a left-hand screw, in each case viewed from the side shown in Figure 2. Two positions of the pin 20 are shown in Figure 2. This angular difference results in a corresponding difference in the height of the stop, which implies a corresponding angular difference with respect to the adjusting lever 3 of the injection pump. The bimetal spiral 21 is heated to greater or lesser extent according to the desired stop value, so that the pin 20 can assume any

optional position between the positions illustrated, particularly when the ambient temperature is very low during starting. A further possibility of control is that of providing the profiled surface 12 of the part 13 with different pitches. Since adjustment is effected by heating, there is largely a free choice of the reasons for heating, such as for the warming-up of the internal combustion engine, or for other reasons such as a change in the pressure of the ambient air, or when operating an air-conditioning system. Thus, the idling speed can be increased or reduced as required, according to the direction of slope of the profiled surface 12.

CLAIMS

1. A fuel injection pump for an internal combustion engine, having an arbitrarily operable adjusting lever for determining the quantity of fuel injected and an adjustable stop for the adjusting lever, which stop determines the minimum quantity of fuel injected or the idling speed, the stop being in the form of a rotatable profiled surface which is rotatable in a plane at right angles to the plane of travel of the lever and which is adjustable by a bimetal spiral in dependence upon temperature whereby to effect adjustment of the minimum quantity of fuel injected.

2. A fuel injection pump as claimed in claim 1 or 2, in which the rotatable profiled surface is a three-dimensional cam.

3. A fuel injection pump as claimed in claim 2, in which a spiral spring acts upon the profiled surface for the purpose of equalization of forces or for restoring.

4. A fuel injection pump as claimed in claim 1, 2 or 3, in which the bimetal spiral is heatable by a heating element.

5. A fuel injection pump as claimed in any of the preceding claims, in which the core of the bimetal spiral is rigidly secured to a sleeve which accommodates the bimetal spiral and which is secured to the injection pump housing, and the free end of the bimetal spiral acts upon a turning lever of a turning shaft for the profiled surface.

6. A fuel injection pump as claimed in claim 5, in which the turning shaft is journalled in the end wall of the sleeve.

7. A fuel injection pump as claimed in claim 5 or 6 when appendent on claim 3, in which the compensating spiral spring is disposed in the sleeve and its free end acts upon the turning lever.

8. A fuel injection pump as claimed in any of claims 1 to 4 in which a friction-reducing plastics material is provided on or between a bearing surface of the stop and a sleeve which is fixed to the housing of the pump and in which the stop is rotatable.

9. A fuel injection pump constructed and adapted to operate substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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