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

(11) Publication number: **0 388 494 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **89105171.6**

(51) Int. Cl.5: **F02M 51/06**

(22) Date of filing: **22.03.89**

(43) Date of publication of application:
26.09.90 Bulletin 90/39

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

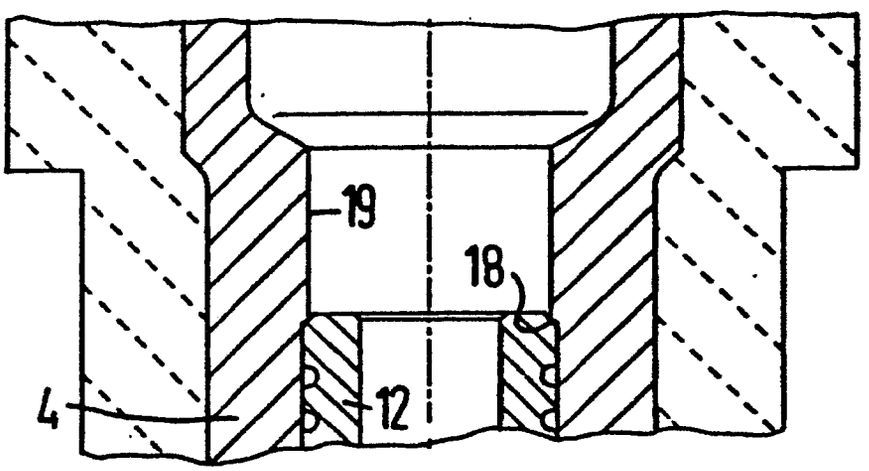
(71) Applicant: **Siemens Aktiengesellschaft**
Wittelsbacherplatz 2
D-8000 München 2(DE)

(72) Inventor: **Forapianti, Mauro**
Via Della Leccia 35
Livorno(IT)

(54) Electromagnetically operated injector.

(57) The calibration of the dynamic flow of a fuel injector is performed by adjusting a spring force by vertically positioning a spring adjusting bush 12. To prevent the spring 11 and the adjusting bush 12 from coming out of the injector before calibration an abutment shoulder 12 for the adjusting bush is created, so as to guarantee a minimum preload on the spring 11 on all phases following the assembly of the injector.

FIG 2



EP 0 388 494 A1

Electromagnetically operated injector

The invention relates to an electromagnetically operated injector for use in electronically controlled fuel injection systems of the type described in the pre-characterising portion of claim 1.

Such an injector is disclosed in our copending European patent application serial number 88 11 84 57.6 filed November 4, 1988.

The calibration of the dynamic flow of such a fuel injector is performed by adjusting a spring force by positioning a spring adjusting means. According to the above mentioned application the spring adjusting means is a bush, which is contained inside the central magnetic core. After the axial position adjustment it is fixed through mechanical deforming of the bush containing wall.

Whenever the injector must be operated before calibration, for example for a pre-calibration run-in, the spring must be loaded with some external device. Before moving the injector to the calibration stands this external device used during the run-in has to be disassembled. Subsequently the valving elements are no longer forced into a stable position by any spring load and the vibrations of the transport system could change the fuel feeding performance obtained during the run-in cycle.

Moreover by inaccurate handling of the injector after assembly and before calibration the bush could fall out of the injector. Thus the bush could get damaged or lost.

It is an object of the present invention to provide an injector which does not change its fuel feeding performance after the pre-calibration run-in even under rough transport conditions. The injector should also be protected against inaccurate handling.

Another object is to provide a pre-calibration run-in without any external device which requires less labor and thus reduces cost.

The invention is based on the idea to establish a minimum preload on the spring already present after the assembly of the injector before calibration.

By means of such a preloaded spring the injector can be operated during the pre-calibration run-in without an external preload device.

Also due to the preloaded spring the injector is protected against adverse consequences caused by rough handling or transportation because all the movable parts are in a stable position. Moreover, after assembly, the bush can't fall out of the injector and get damaged or lost.

According to the invention the preload on the spring is created by an abutment shoulder, which is provided inside the axial bore of the magnetic core whereon the adjusting bush reacts. The preload on the spring is much smaller than the load that will be established on the spring during the calibration procedure. Therefore the calibration procedure can be effected without modification, because the abutment shoulder only prevents a reduction of the load but does not prevent an increase.

These and other advantages of the invention will become more aparent from the following description of the drawings wherein:

FIG 1 is a longitudinal section through an electromagnetic injector constructed in accordance with the principles of the present invention,

FIG 2 is a view of the spring thrust bush and the relevant abutment shoulder before the calibration,

FIG 3, 4, 5, 6, 7 show alternate embodiments of the abutment shoulder for the spring adjusting bush.

With reference to FIG 1, an electromagnetic fuel injector, in accordance with this invention, includes an external body 1 formed from magnetizable material which houses an electric coil 2, wound on a spool 3, which surrounds a cylindrical magnetic core 4, also formed from magnetizable material.

The magnetic core 4 has a central bore 9 and is mounted on a bushing 5, made of non-magnetizable material, which acts as the longitudinal guide to a mobile armature 6 which, together with the body 1 and the core 4, forms the magnetic circuit.

The mobile armature 6 carries a plastic-made seating insert 7 which cooperates with the upper surface of a nozzle body 8 so to create a valving means for the fuel flowing through the axial bore 9 and cross-holes 10 in the central core 4. In the closing position, the valving means is kept closed by the force on the armature 6 from a spring 11 housed in the central core 4 and reacting on an adjusting bush 12.

In this embodiment the abutment shoulder 18 is obtained by means of a collar 19 inside the cylindrical magnetic core 4 and integral to it. FIG 2 shows the position of the bush 12 before calibration in a larger scale.

When the coil 2 is electrically energized through conductors 13, partially embedded in a plastic connector 14, the armature 6 is magnetically attracted towards the core 4 and, overwhelming the force of the spring 11, moves from the nozzle 8, so allowing the fuel to flow through the nozzle orifice.

During the calibration procedure the spring force is adjusted by axially positioning of the spring adjusting bush 12 to a position as shown in FIG 1.

To fix the adjusting bush 12 after the calibration a bore hole 16 is provided through which the wall of the magnetic core 4 can be deformed.

FIG 3 shows a second embodiment which allows the assembly of the adjusting bush 12 through the inlet chamber 20 of the injector. Bore holes 21 are provided on two sides of the magnetic core 4 through which the wall of the axial bore 9 can be deformed. The resulting deformation on the inside of the axial bore 9 creates an abutment shoulder $18'$.

According to FIG 4 an abutment shoulder $18''$ is created by deforming the rim of the wall of the cylindrical magnetic core 4 through the inlet chamber 20.

As also shown in FIG 4 the abutment shoulder can be obtained by plastic forming of a plurality of grooves 22 on the inside wall of the axial bore 9. The abutment shoulder is established by a plurality of little rims created by these deformations.

With reference to FIG 5 an abutment shoulder $18'''$ is obtained by means of an elastic ring 23. The ring 23 is fitted into a groove created on the inner wall of the axial bore 9. For assembly purposes the ring 23 has a notch so that it can be inserted into the cylindrical bore 9. The ring 23 can be made of metal or plastic.

The ring 23 can also be made of rubber. Due to the flexibility of this material there is no need of a notch and therefore an O-ring type can be used.

Another embodiment is shown in FIG 6 and 7. An abutment shoulder 18^{IV} is obtained by an annular element 24 pressed into the axial bore 9. Depending on the fitting and the flexibility of the material of the annular element 24, $24'$, it can be constructed with (FIG 7) or without a notch (FIG 6). The annular element 24, $24'$ can be made of some metallic material or of plastic.

Claims

1. Electromagnetically operated injector for feeding fuel to an internal combustion engine comprising
- a longitudinal axis (L),
- a body (1) housing an electric coil (2) surrounding a cylindrical magnetic core (4), the core (4) having an axial bore (9) coaxial to the longitudinal axis (L),
- an armature (6) movable along the longitudinal axis (L) as a part of a valving means,
- an adjusting means housed in the axial bore (9),
- an elastic means (11) reacting on the adjusting means, and forcing the armature (6) to a closing position,
-said adjusting means being **characterized by** an abutment shoulder (18) positioned as to ensure a minimum preload of the elastic means, sufficient for a secure closing of the valving means.

2. Injector according to claim 1, characterized by the fact that the abutment shoulder (18) is obtained by means of a collar (19) inside the cylindrical magnetic core (4) and integral to it.

3. Injector according to claim 1, characterized by the fact that the abutment shoulder ($18'$, $18''$) is obtained by a deformation of the terminal portion of the axial bore (9).

4. Injector according to claim 3, characterized by the fact that said deformation of the terminal portion of the axial bore (9) is obtained by a radial deformation of the tubular wall of the cylindrical magnetic core (4).

5. Injector according to claim 3, characterized by the fact that said deformation of the terminal portion of the axial bore (9) is obtained by plastic forming of a plurality of grooves (22).

6. Injector according to claim 1, characterized by the fact that the abutment shoulder ($18'''$) is obtained by means of an elastic ring (23) fitted into a groove created in the axial bore (9).

7. Injector according to claim 6, characterized by the fact that said elastic ring (23) is of metal and is being made resilient by means of a notch.

8. Injector according to claim 6, characterized by the fact that said elastic ring (23) is of plastic material and is being made resilient by means of a notch.

9. Injector according to claim 6, characterized by the fact that said elastic ring (23) is being constituted by a rubber sealing ring, O-ring type, fitted in said groove.

10. Injector according to claim 1, characterized by the fact that the abutment shoulder (18^{IV}) is obtained by fitting of an annular element (24) in the axial bore (9).

11. Injector according to claim 10, characterized by the fact that said annular element (24) is being made resilient by means of a notch.

12. Injector according to claim 10, characterized by the fact that said annular element (24, $24'$) is made of metallic material.

13. Injector according to claim 10, characterized by the fact that said annular element (24, $24'$) is made of plastic material.

FIG 1

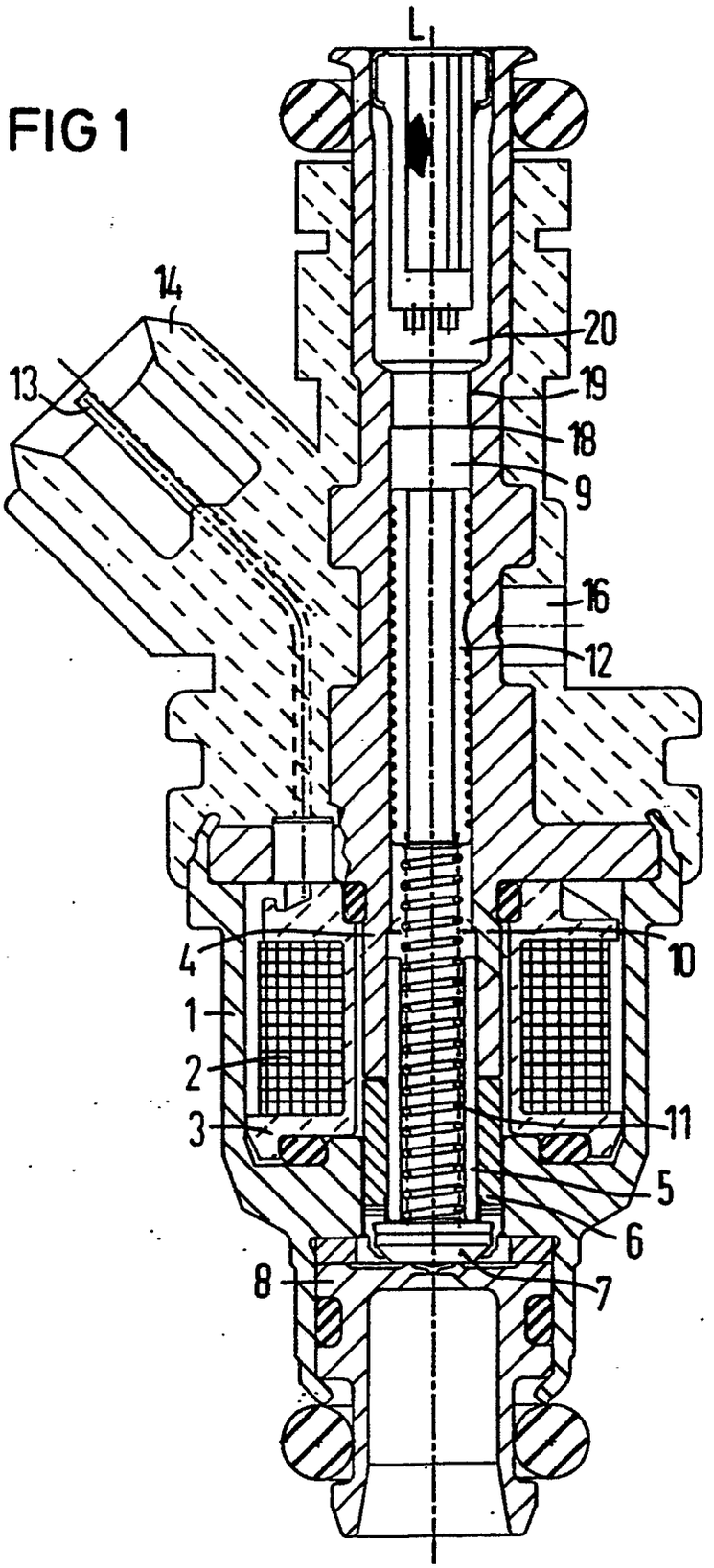


FIG 2

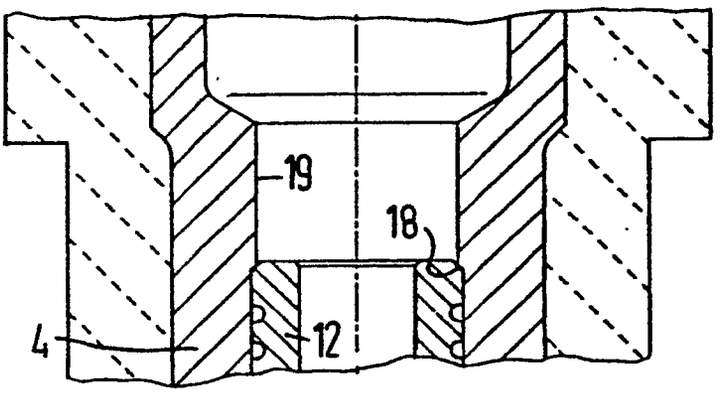


FIG 3

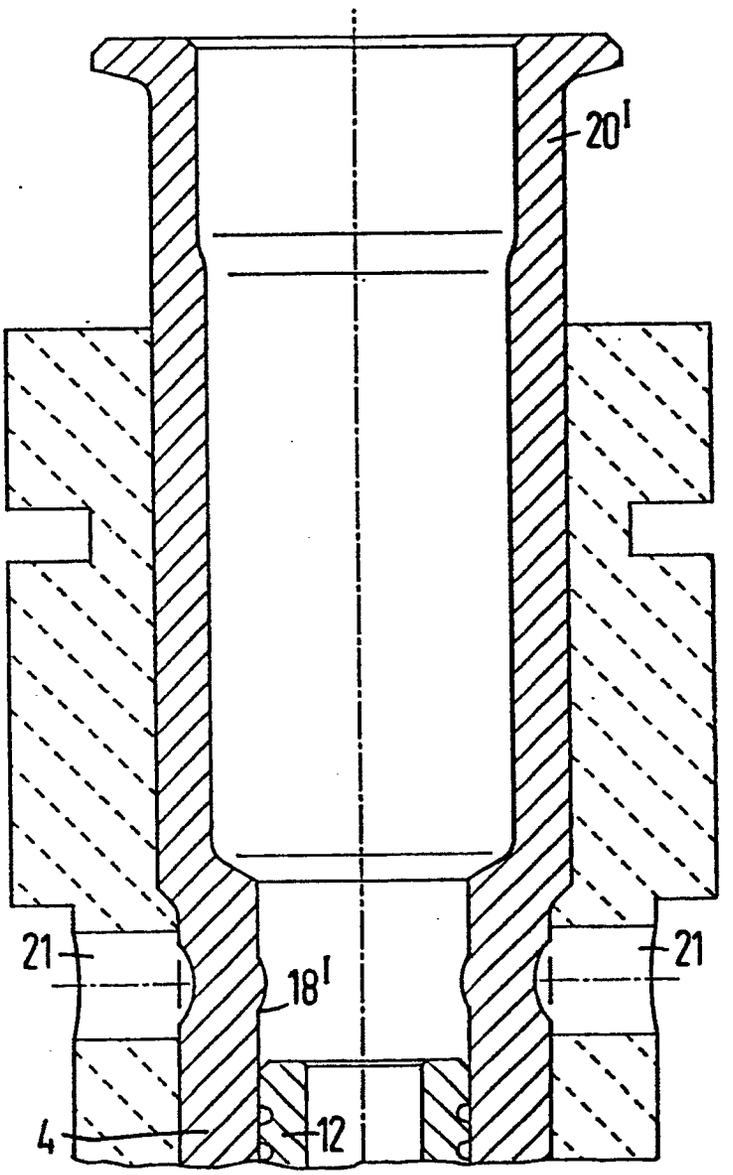


FIG 4

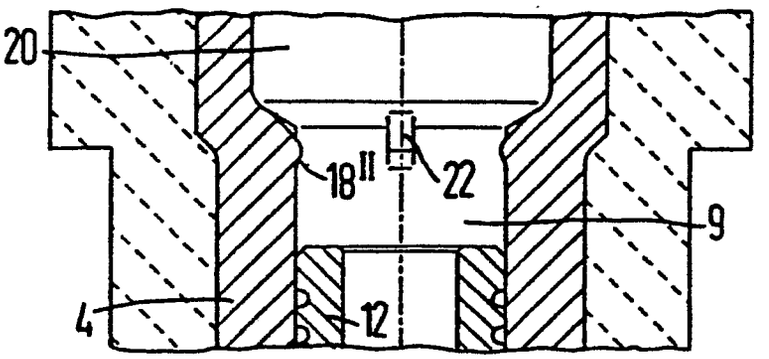


FIG 5

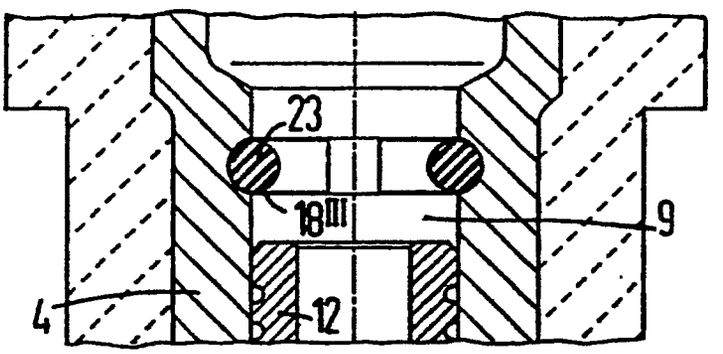


FIG 6

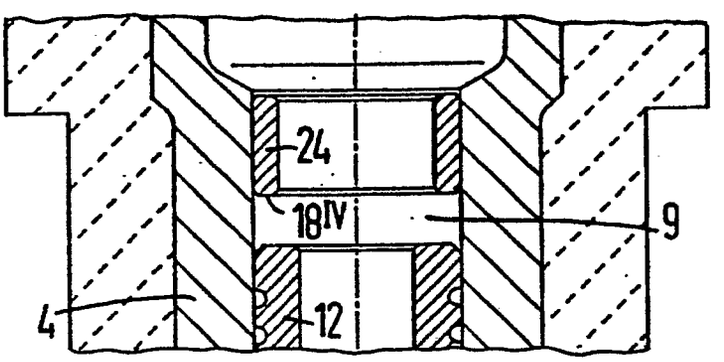
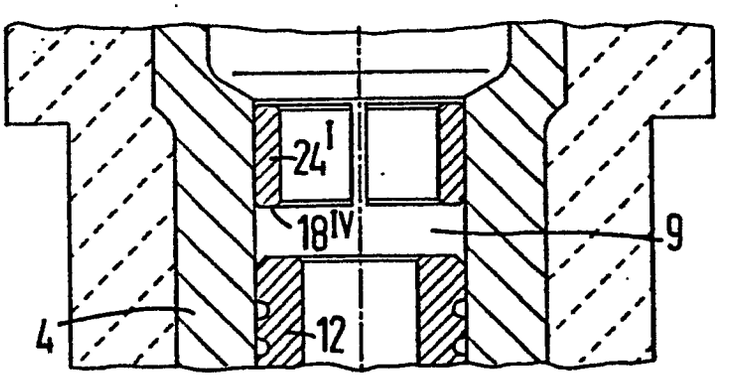


FIG 7



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 10 5171

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)
X	EP-A-0184124 (VDO ADOLF SCHINDLING) * page 5, lines 4 - 31; figure 1 *	1, 2	F02M51/06
A	EP-A-0301381 (NIPPONDENSO CO.) * column 3, line 40 - column 5, line 41; figure 1 *	1, 3, 4	
A	FR-A-2127146 (SOCIETE INDUSTRIELLE DE BREVETS ET D'ETUDES) * page 2, line 12 - page 4, line 5; figure 1 *	1, 10, 11	
A	FR-A-2276472 (LUCAS ELECTRICAL COMPANY) * page 2, lines 1 - 29; figure 1 *	1, 10	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	06 NOVEMBER 1989	FRIDEN C.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)

1