United States Patent [19]

Shipinski

[11] **3,820,723**

[45] **June 28, 1974**

[54] **FUEL INJECTION NOZZLE FOR INTERNAL COMBUSTION ENGINE AND THE LIKE**

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[73] Assignee: **Deere & Company,** Moline, Ill.

[22] Filed: **Mar. 21, 1973**

[21] Appl. No.: **343,225**

[52] **U.S. Cl.** **239/533**

[51] **Int. Cl.** **B05b 1/30**

[58] **Field of Search** 239/533

[56] **References Cited**

UNITED STATES PATENTS

3,391,871	7/1968	Fleischer	239/533
3,499,607	3/1970	Thomson	239/533
3,695,235	10/1972	Anderson	239/533 X

FOREIGN PATENTS OR APPLICATIONS

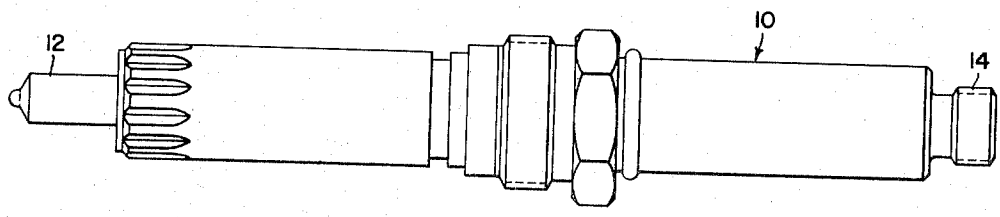
364,600	7/1930	Great Britain	239/533
1,117,256	2/1956	France	239/533

Primary Examiner—Lloyd L. King
Assistant Examiner—Andres Kashinkow

[57] **ABSTRACT**

A fuel injection nozzle of the type in which the needle valve and spring are eccentric and there is interposed between the needle valve and spring a low-mass hollow member having excellent bearing relation to the spring bore so as to prevent cocking and to enable the use of a spring of maximum diameter consistent with the diameter of the spring bore and the size of the needle valve.

9 Claims, 3 Drawing Figures



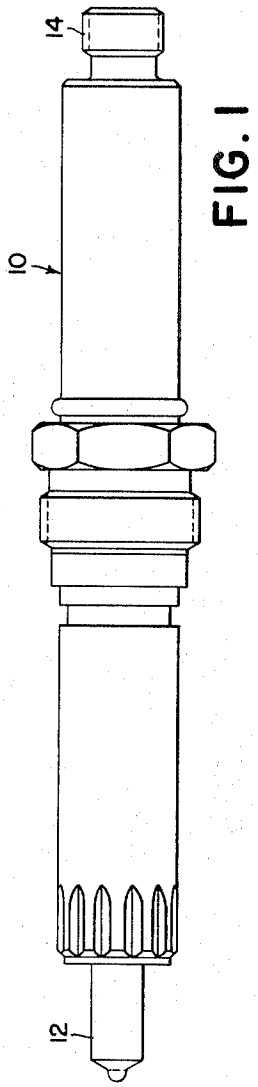


FIG. 1

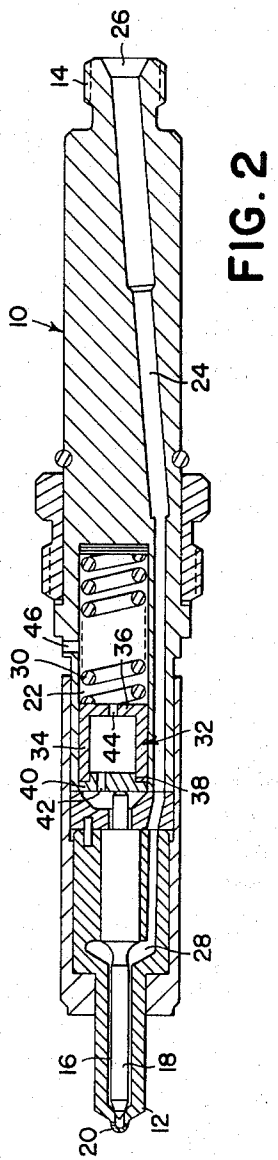


FIG. 2

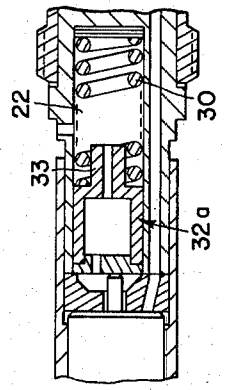


FIG. 3

FUEL INJECTION NOZZLE FOR INTERNAL COMBUSTION ENGINE AND THE LIKE

BACKGROUND OF THE INVENTION

Fuel injection nozzles of the "eccentric" type referred to above are well known, as in the U.S. Pat. to Thomson No. 3,499,607 issued Mar. 10, 1970, the principal advantage of this type being that the overall diameter of the nozzle may be made quite small because the eccentricity of the needle valve and spring enables the use of a fuel passage alongside the spring bore. A disadvantage is that the spring does not act in perfect axial alignment with the needle valve and "cocking" of the parts may result. This cocking result may be avoided, according to the Thomson patent, by providing substantial guiding surfaces on the needle valve, best exemplified in that patent at column 4, lines 54–75. Nevertheless, it has been found that the Thomson design materially increases the mass and thus the inertia of the needle valve, and commercial variations have resorted to the use of a cup having an annular wall affording the requisite bearing surface but at the expense of seating the spring within the cup, from which it follows that a spring of smaller diameter must be used and therefore spring force is sacrificed.

Fuel injection nozzles are in a highly competitive field and any savings in cost, etc. are a plus, especially if the new design includes increases in value in areas of efficiency, manufacture, replacement, servicing, etc.

SUMMARY OF THE INVENTION

According to the present invention, the above disadvantages are eliminated and many significant advantages are attained by a fuel injection nozzle of the "eccentric" type wherein there is interposed between the needle valve and spring a light-weight member that does not involve the reduction of spring diameter, nor does it entail increase in length, mass, etc., of the needle valve itself. Fundamentally, the member is hollow, light weight and has opposite ends abutting the spring and needle valve. No part of the spring-adjacent end of the member extends into the spring bore radially of the spring and thus the spring may be of a size that tolerably fits the bore; i.e., the spring may be of maximum diameter consistent with the spring bore diameter. Subsidiary features are thin-walled construction, bleed orifices, shouldered assembly, proportional design enabling selection of parts of optimum size, maximum efficiency, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevation of one form of the preferred nozzle.

FIG. **2** is a longitudinal section of the same.

FIG. **3** is a fragmentary section of a modification.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The nozzle chosen for purposes of illustration comprises a nozzle body **10** having an inner or injection end **12** and an outer or inlet end **14,** the former having a needle valve bore **16** in which is disposed a needle valve **18** of conventional type in general. The bore **16** is coaxial with the overall structure of the body **10,** and the nose end has outlets **20** that are opened and closed as the needle valve reciprocates in the bore **16.** A

spring bore **22** is generally an extension or elongation of the needle valve bore but is eccentric thereto by a small amount, as explained in the Thomson patent, which enables the use of a fuel passage **24** alongside the spring bore and having an inlet end **26** (connected to the usual supply line, not shown) and leading to a chamber **28** by means of which the high-pressure fuel acts on th needle valve in a not unconventional manner. All of this is well known, of course, and the present disclosure may be taken as typical of the fuel injection nozzle of the type characterized.

As the needle valve is intermittently displaced axially outwardly to inject fuel through the orifices or outlets **20** and into the typical combustion chamber, it must be rapidly returned to seated position by a spring, such as that shown at **30.** As already elaborated, the spring bore **22** is eccentric to th needle valve, and it is likely that a "cocking" action will result. This is supposed to be "solved" in the Thomson patent by providing significant guiding surfaces between the needle valve and needle valve bore. But this results in increasing the size, weight and mass of the needle valve, even though it enables the use of a "full-size" spring in the spring bore. The problem is that the spring cannot "match" the needle valve; i.e., the valve becomes so large that a suitable spring cannot be adapted to it without increasing the overall size of the nozzle body. To state the problem in a different way: with a fixed nozzle or needle valve size, the spring force must be such as to assure rapid closing of the valve so as to avoid the occurrence of fuel droplets and "dribble" at the end of injection, thus reducing the emission of soot, unburned hydrocarbons and carbon monoxide in the exhaust. Further, any increased length of the needle valve entails the possibility of bending it, and this would of course impair the efficient operation of the entire device. Increased length of the needle valve means of course increased mass and this leads to the requirement of a larger spring and this in turn requires enlargement of the entire body, which cannot be tolerated from the cost, etc., standpoints.

Now, according to the present invention, the above requirements are met in a simple and economical manner; namely, by use of a properly sized needle valve, a substantially large-diameter spring and retention of the overall size of the entire device within acceptable limits. This is largely achieved by the interposition of a member **32** between the outer end of the needle valve and the proximate end of the spring **30.**

This member is cylindrical and hollow and includes a cup-shaped part made up of an annular wall **34** and a closed end **36** against which the spring **30** abuts. The other end of the cup is internally shouldered at **38** and tightly receives an externally shoulder circular end part **40.** The cylindrical surface of the member is finely finished, as is the interior of the spring bore **22** so that the member is accurately guided in the bore as it moves axially back and forth in response to opening and closing of the needle valve. The axial length of the member, here preferably on the order of one-third to one-fifth that of the needle valve, is sufficient to preclude "cocking" or other misalignment of the member even though it is eccentric to the needle valve. Being hollow, the member has a small mass and thus low inertia. At the same time, its diameter, preferably on the order of four times that of the needle valve bore, is sufficiently large as to enable the use of a spring having a comparable diameter, all without using a spring of excessive length

and without requiring any increase in the overall size of the entire device. Preferably, the length of the spring is on the order of twice the axial length of the member **34.** The end **40** has a small bore **42** therethrough and a similar bore **44** is provided in the end **36.** Fuel leakage past the needle valve is accommodated by these bores in conjunction with a small hole **46** in the main body **10** so that fluid buildup within the spring bore is avoided.

In the modified form shown in FIG. **3,** a member **32***a*, like the member **32** except for an axial extension **33** that fits within the spring **30,** functions in the manner described above as respects the member **32.** The provision of the extension **33** does not entail the reduction of spring diameter as would an inverted cup of the type previously referred to herein as a variation of the design of the Thomson patent.

I claim:

1. A fuel injection nozzle of the type in which the axially reciprocatable needle valve is acted on by a spring contained in a spring bore that is eccentric to the needle valve, characterized in that there is disposed in the spring bore an axially reciprocatable member between the spring and needle valve, said member being of hollow cylindrical form and of substantial axial length so as to provide a good bearing surface with the spring bore to prevent cocking of the member in the bore, the member having axially spaced apart opposite ends, one of which abuts the needle valve and the other of which is abutted by the spring, the member being of relatively light-weight construction so as to reduce weight and mass and the spring being of such diameter as to tolerably fit the bore whereby to increase its force on the member and through the member to the needle valve.

2. The invention defined in claim **1** in which the member end abutted by the spring is free from axial extensions into the spring bore radially outwardly of the spring diameter.

3. The invention defined in claim **1** in which the member is in the form of a cup having an annular wall fitting the spring bore and an integral end abutted by the spring and a closure end abutting the needle valve.

4. The invention defined in claim **3** in which the ends of the member have orifices therein.

5. The invention defined in claim **1** in which the axial length of the member is on the order of one-third to one-fifth that of the needle valve.

6. The invention defined in claim **5** in which the spring is a coil spring having a normal length of approximately twice that of the member.

7. The invention defined in claim **1** in which the diameter of the member is approximately four times that of the needle valve at the injection end of said valve.

8. The invention defined in claim **1** in which the member has a relatively thin annular wall and relatively thin ends.

9. The invention defined in claim **2** in which the needle-valve proximate end of the cup-shaped member is internally shouldered and the closure is cooperatively externally shouldered to fit.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,820,723 Dated 28 June 1974

Inventor(s) John Henry Shipinski

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, Line 1 of Claim 9, change "2" to -- 3 --.

Signed and sealed this 19th day of November 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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