United States Patent [19]

Hofmann et al.

[11] **3,719,208**

[45] **March 6, 1973**

[54] **FUEL SHUTOFF DEVICE FOR MULTICYLINDER FUEL INJECTION PUMPS**

[75] Inventors: **Eberhard Hofmann**, Kirchberg/Murr; **Heinrich Staudt**, Markgroningen-Talhausen, both of Germany

[73] Assignee: **Robert Bosch GmbH**, Stuttgart, Germany

[22] Filed: **March 29, 1971**

[21] Appl. No.: **128,744**

[52] **U.S. Cl.** ..... **137/625.41**, 123/139 R

[51] **Int. Cl.** **F16k 11/00**

[58] **Field of Search** ..... 137/625.41, 625.48, 625.46, 137/608; 123/139 R

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Primary Examiner—Samuel Scott
Attorney—Edwin E. Greigg

[57] **ABSTRACT**

For arbitrarily cutting off the fuel supply to a fuel injection valve from a fuel injection pump during operation thereof, there is provided a fuel shutoff device through a channel of which the pressurized fuel passes. The device has a bore spaced from the channel and communicating therewith through a short-length port. Said bore communicates with a bypass conduit. A rotary valve plug disposed in the bore establishes or interrupts communication — dependent upon its angular position — between the channel and the bypass conduit.

1 Claim, 3 Drawing Figures

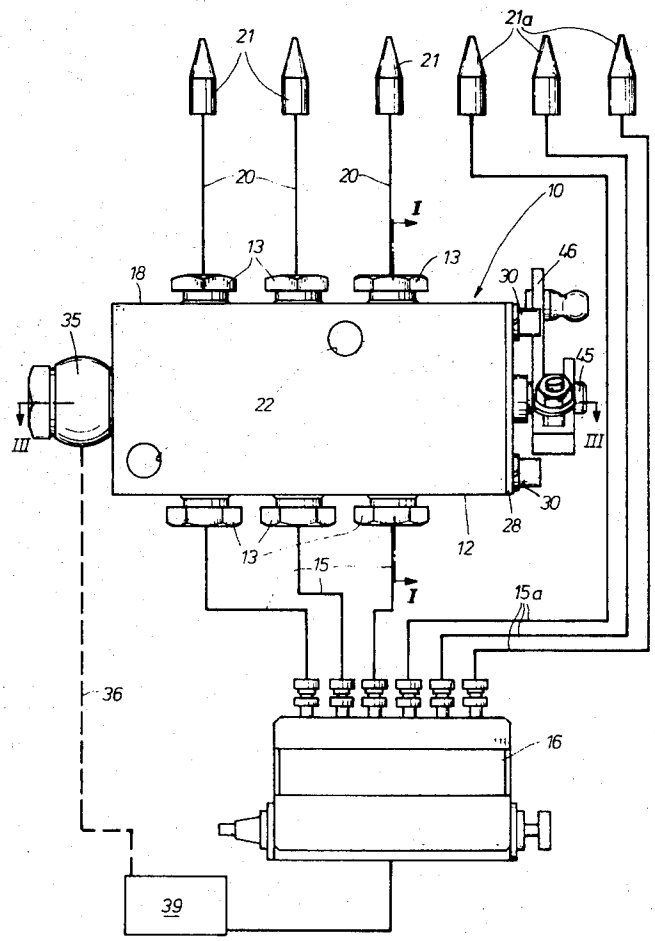
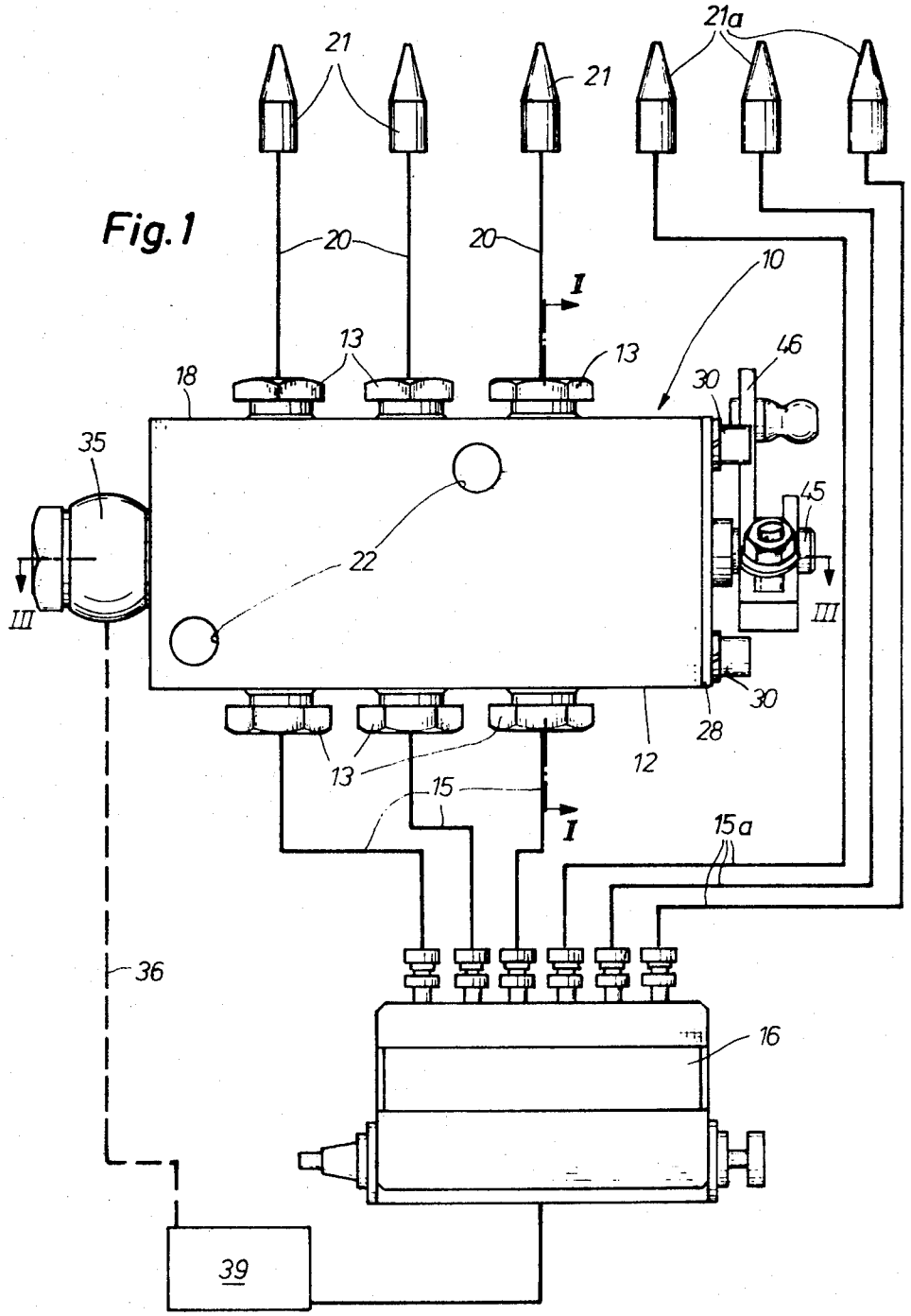


Fig. 1



INVENTOR.
Eberhard Hofmann
E. Heinrich Staudt
by:
Edwin E. Spiegg

Fig.2

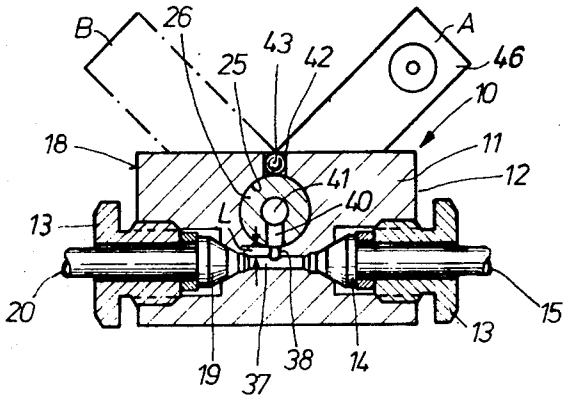

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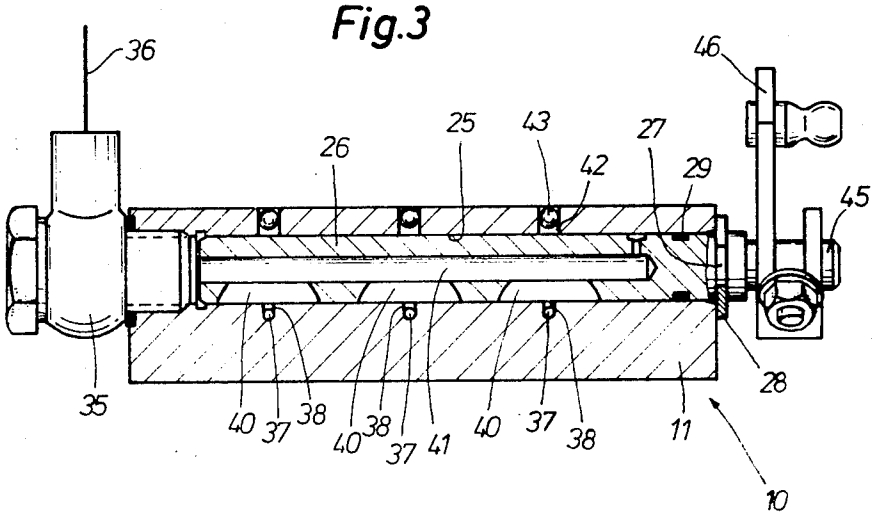
Fig.3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FUEL SHUTOFF DEVICE FOR MULTICYLINDER FUEL INJECTION PUMPS

BACKGROUND OF THE INVENTION

This invention relates to a device for the shutoff of individual pressurized fuel conduits of multicylinder fuel injection pumps associated with internal combustion engines. The device is of the type which is built into at least one pressure conduit leading from the fuel injection pump to a fuel injection valve and which has an arbitrarily operable control member. In one switching position of the latter the fuel may be drained from the pressure conduit.

Devices of the aforenoted type are required particularly in internal combustion engines of automotive vehicles for the purpose of rendering inoperative some of the engine cylinders by means of shutting off the fuel delivery to the associated fuel injection valves. Such an engine operation is desired particularly for the prevention of engine smoke due to the imperfect combustion in cold cylinders during idling. Such shutoff is further performed in engines, wherein one or more cylinders are to be utilized as air compressors. In the first instance, the unsupplied engine cylinders do not work and consequently, the others take on more load which has a favorable effect on the combustion of the operating cylinders. In the second instance, simultaneously with the fuel shutoff, a further valve arrangement is actuated to switch over the respective cylinders to compressor operation.

In a known device of the aforenoted type (as disclosed, for example, in German Pat. No. 304,142), by means of individual 3/2-way valves built into the pressure conduits, the fuel supply may be arbitrarily cut off to each individual engine cylinder by blocking, upon turning the valve member, the admission of fuel to the nozzle and simultaneously returning the delivered fuel into the suction chamber. In another known device of this type (disclosed, for example, in German Pat. No. 854,721), in addition to a first valve built into the fuel conduit between the pump and the fuel injection valve, there is provided a second valve in the fuel conduit leading to the fuel injection pump. The second valve is actuated simultaneously with the first valve but has to close shortly therebefore.

The first named device which has valve members built into the fuel conduit, has the disadvantage that during the switching of the valve, particularly in case of the present-day high rpm engines, it may momentarily assume a position in which the fuel injection pump delivers fuel against the closed valve. Such an occurrence would lead to the destruction of the conduit or other components.

The second device mentioned attempts to remedy this disadvantage by providing two valves for each conduit. Such a solution, however, is complex and expensive and is still not operationally safe under all circumstances.

OBJECT, SUMMARY AND ADVANTAGES OF THE INVENTION

It is an object of the invention to provide an improved fuel shutoff device of the afore-outlined type which is built into the fuel conduit and which, with a single control member prevents fuel delivery to selected engine cylinders in an operationally safe manner with adding only negligible dead space.

Briefly stated, according to the invention the control member of the fuel shutoff device is formed of a rotary valve plug which is disposed in a longitudinal bore next to a pressure conduit portion passing transversely through the device and is connected with said pressure conduit portion by a very short port, the length of which is determined solely by the strength of the wall between the said pressure conduit portion and said longitudinal bore.

The rotary valve plug disposed adjacent the pressure conduit portion does not block the pressure conduit in any switching position and further, the short length of the port ensures that only a negligible small dead space is added.

The invention will be better understood, as well as further objects and advantages of the invention will become more apparent, from the ensuing detailed specification of a preferred, although exemplary, embodiment of the invention taken in conjunction with the drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic external view of the device according to the invention including an illustration of the fuel circuits;

FIG. 2 is a sectional view along line II—II of FIG. 1; and

FIG. 3 is a sectional view along line III—III of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to FIG. 1, there is schematically shown a multicylinder fuel injection pump **16** which draws fuel from a tank **39** and delivers fuel under pressure to individual fuel injection valves **21**, **21a**.

In the example described, a fuel shutoff device generally indicated at **10** is associated with three fuel injection valves **21**, while three other fuel injection valves **21***a* are unaffected thereby. As it will be described hereinafter, the fuel shutoff device **10** controls the admission or the cutoff of fuel to the fuel injection valves **21**. In this example, the control affects the three valves **21** in unison.

The fuel shutoff device **10** comprises a housing block **11** having two opposed parallel longitudinal sides **12** and **18** and two mounting bores **22**.

With reference to FIG. 2, the housing block **11** is provided at side **12** with spaced threaded bores each receiving, by means of a hollow coupling screw **13** tightened thereto, the end of a pressure conduit portion **15** provided with a terminal enlargement **14**. Each pressure conduit portion **15** is associated with one cylinder (not shown) of the fuel injection pump **16** and with one fuel injection valve **21**.

The housing block **11** is provided at side **18** with spaced threaded bores each receiving, by means of a hollow coupling screw **13** tightened thereto, the end of a pressure conduit portion **20** provided with a terminal enlargement **19**. Each pressure conduit portion **20** is connected, at one end, with a fuel injection valve **21** and, at the other end, with one of the pressure conduit portions **15** by means of a pressure conduit portion **37** formed as a connecting channel extending within the housing block **11** between each two aligned bores at opposite sides **12** and **18** of the housing block **11**.

It is seen that each fuel injection valve **21** controlled by the fuel shutoff device **10** is connected to the fuel injection pump **16** by a three-part pressure conduit **15, 37, 20**, while each fuel injection valve **21***a* not affected by the device **10** is connected to the fuel injection pump **16** with a one-part pressure conduit **15***a*.

Referring now to FIGS. **2** and **3**, the housing block **11** is provided with a throughgoing longitudinal bore **25** extending spaced from and transversely to each channel **37**. The longitudinal bore **25** communicates with each channel **37** by means of a port **38**. The length L of each port **38** is as short as possible to ensure that practically no dead space is added to the associated pressure conduit **15, 37, 20**. For reasons of sufficient wall strength between a channel **37** and the longitudinal bore **25**, L (i.e. the wall thickness separating the bore **25** from a channel **37**) has to be so designed that the fuel pressure cannot cause deformations in the housing block **11**. The bores **42** disposed opposite the short ports **38** serve as access holes for the drilling thereof; they are hermetically closed off in a permanent manner by press-fitted balls **43**.

In the longitudinal bore **25** there is positioned a rotary valve plug **26** which serves as a control member. It is prevented from axial displacement by means of an external securing plate **28** which extends into a groove **27** of the plug **26** and which is affixed to the housing **11** by means of two screws **30**. The plug **26** is outwardly sealed at one end by means of a packing ring **29**. To the other end of the longitudinal bore **25** there are attached coupling means **35** for a fuel return conduit **36** terminating in fuel tank **39**.

To the terminus **45** of the valve plug **26** projecting from the housing block **11**, there is tightened an operating lever **46** which in either end position engages an abutment each formed of the head of a securing screw **30**.

In the switching position A of the valve plug **26** (as depicted in FIGS. **2** and **3**), the three pressure conduits, each formed of pressure conduit portions **15, 37, 20**, are connected through the fuel return conduit **36** with the fuel tank **39**. For this purpose the valve plug **26** is provided with radial slots **40** which merge into a longitudinal bore **41**. In this switching position no fuel is delivered to the three fuel injection valves **21**.

In FIG. **2** there is shown in dash-dot lines the position B of the operating lever **46** in which the valve plug **26** has been rotated about 90° with respect to the position A. In position B, the slots **40** of the valve plug **26** are entirely out of registry with each port **38**, so that no communication exists between any of the channels **37** on the one hand and the return or bypass conduit **36** on the other hand. Consequently, the fuel forced by the fuel injection pump **16** into the device **10** through pressure conduit portions **15** is not bypassed as in position A, but proceeds through channels **37** and pressure conduit portions **20** to the fuel injection valves **21** for normal operation.

WHAT IS CLAIMED IS:

1. In a fuel injection apparatus serving a multicylinder internal combustion engine, the combination comprising

A. a multicylinder fuel injection pump,

B. a plurality of fuel injection valves,

C. a plurality of pressure conduits leading from said fuel injection pump separately to each fuel injection valve, each said pressure conduit maintaining at all times an uninterrupted hydraulic communication between said fuel injection pump and the associated fuel injection valve,

D. a housing block,

E. at least one channel provided inside said housing block, each channel constituting separately one portion of at least one said pressure conduits,

F. a sole bore provided inside said housing block, said bore extending transversally to each channel and separated therefrom by a wall portion of said housing,

G. at least one port provided inside said housing block and connecting each channel with said bore,

H. a fuel return conduit,

I. a rotary valve plug fitted coaxially in said bore and having

1. a longitudinal passage extending within said rotary plug in the axial direction thereof, said longitudinal passage being in continuous hydraulic communication with said fuel return conduit,

2. a separate radial passage in the zone of each said port, each radial passage extending from said longitudinal passage and terminating in the lateral face of said rotary plug and

J. means for arbitrarily moving said rotary valve plug into a first position and into a second position, in said first position each said radial passage being out of registry with the associated port for entirely blocking hydraulic communication between the pressure conduit and the fuel return conduit, in said second position each said radial passage being in registry with the associated port for establishing hydraulic communication between the pressure conduit and the fuel return conduit, in said second position the fuel flowing from said fuel injection pump depressurized through said pressure conduit, said post, said radial passage, said longitudinal passage and to said fuel return conduit for bypassing the associated fuel injection valve.

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