Feb. 26, 1935. H. JUNKERS 1,992,622

FUEL INJECTION DEVICE FOR INTERNAL COMBUSTION ENGINES

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Fig.1

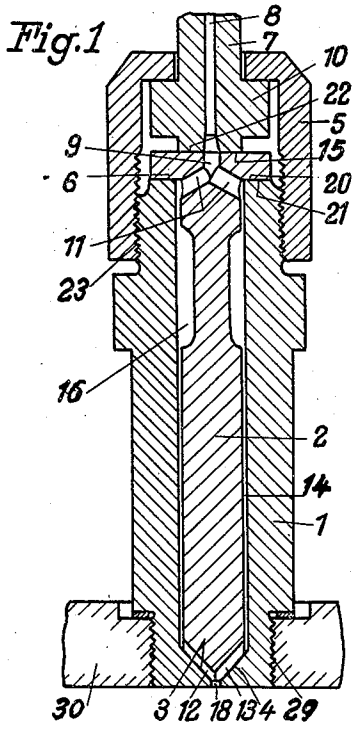


Fig.2

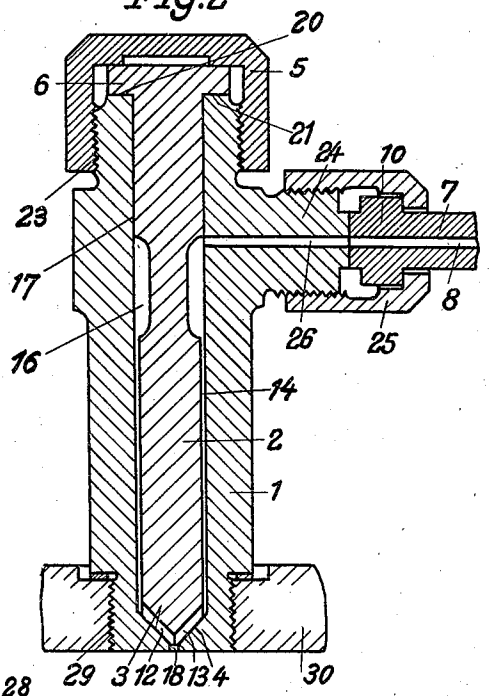
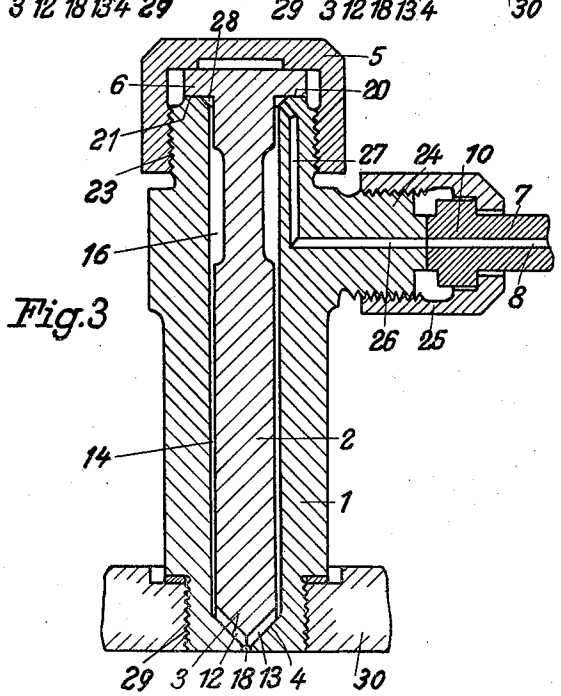


Fig.3



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FUEL INJECTION DEVICE FOR INTERNAL COMBUSTION ENGINES

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8 Claims. (Cl. 299—107.6)

My invention relates to fuel injection devices for internal combustion engines, and more particularly to solid injection fuel admitting devices of the kind described in my U. S. Patent No. 1,901,814 which are provided with a casing and a needle with a fuel passage inserted therein.

It is an object of my present invention to improve a device of the kind aforesaid. To this end, instead of a fuel passage in the needle, I provide a fuel passage between the needle and the inner wall of the casing, and I provide sealing faces on the coacting parts for tightly closing the passage at its outer end, as distinguished from the inner or discharge end.

In the device described in the specification of the prior patent the fuel passage or axial bore in the needle extends substantially as far as the inner end of the needle where the needle is seated in the casing and where the passage or bore in the needle is connected to fuel discharge grooves and an ejection opening.

It has been found that in some cases, and particularly in comparatively small engines, with a passage or bore in the needle whose inside diameter is small in proportion, it is difficult to machine the bore whose length is considerable even in small engines, as it is not shortened at the same ratio as the other dimensions of the engine. The consequence is that the relation of the length of the bore to its inside diameter becomes much more unfavorable than in larger needles. Obviously, however, the difficulty and the tendency of the drill to run out, increase as the inside diameter of the bore or passage decreases for a given length of the needle.

It has already been suggested to admit the fuel through a passage which is defined by the needle and the casing, instead of an axial passage or bore in the needle, but suitable means for closing tightly the outer end of the passage have never been suggested. In the case of a movable needle, the closing or packing means were designed as faces in sliding contact with each other and extending in parallel to the axis of the needle. It has been found, however, that such faces did not prevent creeping of the fuel, and conduits for returning the leakage had to be provided. Packing means resembling stuffing boxes have also been suggested but require extra structure, increasing the initial cost of the device and making it complicated. Apart from this, packing means which should hold tight against the normal injection pressures of several hundreds of kilogrammes per square centimetre, must not be of the stuffing-box type.

According to the present invention, I provide a passage defined by the needle and the inner wall of the casing, as described, but instead of the aforesaid unreliable and expensive packing means, I use sealing faces on the needle and the casing, for tightly closing the outer end of the passage. The sealing faces may be machined so as to fit tightly on each other, or packing means may be inserted between them, whereupon the faces are applied to each other or to the packing means, when the device has been assembled.

The annular fuel passage whose outer end is closed tightly by the sealing faces, may be so narrow, or may be subdivided into so many narrow individual passages, that the fuel flowing therein is filtered.

In the usual design of injection devices with a fixed needle and a bore or passage in the needle for admitting fuel, the fuel-supply pipe is connected directly to the outer end of the needle because, if the fuel-supply pipe is connected to the casing, it is difficult to obtain a structure which is satisfactory from the designer's point of view, and reliable in operation, in particular, because it is difficult to avoid clearances in which air collects, and to obtain a reliable closure throughout the cavities which are under the high injection pressure.

In this respect, it is another advantage of the present invention that it provides very simple and reliably operated means for connecting the fuel-supply pipe to the casing. This connection is frequently preferred because it permits removing the needle without disassembling the connection of the device to the fuel pipe.

In the drawing affixed to this specification and forming part thereof, three types of fuel injection devices embodying my invention are illustrated diagrammatically by way of example in axial section.

In the drawing

Fig. 1 illustrates a device in which the fuel-supply pipe is connected to the needle,

Fig. 2 illustrates a device in which the supply pipe is connected to the casing and opens into a recess in the needle, and

Fig. 3 illustrates a device in which the fuel-supply pipe is also connected to the casing but opens into a recess in the sealing or packing face on the casing.

Referring now to the drawing, the general design of the device is similar to that of the device described in my said prior patent. In all figures, 30 is a portion of the cylinder head, 1 is the casing which is inserted in the head 30 by a

thread 29 near its inner or lower end, and 2 is the needle. 3 is a tapered seating face at the inner end of the needle 2, and 4 is a corresponding face at the inner end of the casing 1. 12, 13 are fuel-discharge grooves extending through the tapered seating face 3 of the needle toward an ejection opening 18 at the centre of the casing 1.

23 is a thread at the outer end of the casing 1 and 5 is a cap nut on the thread.

14 is the fuel passage which the needle 2 defines with the inner wall of the casing 1, the passage being an annular clearance between the casing and the needle which is connected to the grooves 12 and 13 at its inner or lower end. 7 is the fuel-supply pipe with a bore 8.

Referring now particularly to Fig. 1, the fuel pipe has a flange 10 at its inner or lower end which is adapted to be engaged by the cap nut 5. 22 is a sealing face surrounding the opening of the bore 8 which is here shown with a taper, and 15 is a sealing face on a lug 6 at the upper end of the needle 2 to which the sealing face 22 is tightly applied by the thrust of the cap nut 5. 20 is a sealing face on the lug 6 and 21 is the corresponding sealing face at the outer end of the casing 1. The sealing faces 20 and 21 are ground or otherwise machined so as to make a tight fit on each other and to close the outer end of the fuel passage 14. It will be understood that the thrust of the cap nut 5 on the sealing or packing faces 22 and 15 is transmitted to the similar faces 20 and 21, so that the fuel pipe 7 fits tightly on the lug 6 and the lug 6 in turn fits tightly on the outer end of the casing 1. As mentioned, means such as packing washers or the like might be inserted between the faces 20 and 21, and obviously also between the faces 22 and 15. Such washers or the like have not been shown.

9 is a bore at the upper end of the needle 2 which is an extension of the bore 8 in the fuel-supply pipe 7 and may be tapered like the lower end of the bore, and 11 are two or more branches extending from the central bore or extension 9 to the fuel passage 14. By these means, the fuel is uniformly distributed in the passage 14 and if desired, the needle may be recessed at 16 so as to form a collecting chamber in the passage 14.

As mentioned, the co-axial arrangement of the fuel pipe 7 and the needle 2 has the drawback that it is necessary to disassemble the connection of the fuel pipe 7 to the device if it is desired to remove the needle. This inconvenience is avoided in the devices illustrated in Figs. 2 and 3 where 24 is a pipe which extends laterally from the casing 1 and the fuel supply pipe 7 is connected to the pipe 24 by its flange 10 and a cap nut 25.

Referring first to Fig. 2, the bore 26 of the pipe 24 is connected to the passage 14, and preferably to the recess or collector 16, as shown. In this case, the portion 17 of the needle 1 which extends from the outer or upper end of the recess or collector 16 to the face 20 on the lug 6, has the same diameter as the bore or cavity in the casing 1 so that the needle fits the inner wall of the casing and the formation of a clearance in which air collects, is avoided.

Referring now to Fig. 3, the pipe 24 is provided as described with reference to Fig. 3 but its bore 26 is not connected to the passage 14, or the recess 6 as illustrated in Fig. 2, but to a passage 27 which extends substantially in parallel to the axis of the device and opens into an annular recess 28 in the sealing or packing face 21 at the outer end of the casing 1. The recess 28 is connected to the fuel passage 14 and the fuel is uniformly distributed, similarly as in the device illustrated in Fig. 1, to the exclusion of clearances in which air might collect.

As described in my said prior patent, the needle 2 is made so long that, before the cap nut 5 is set, the sealing or packing faces 20 and 21 are spaced apart for a definite small distance which is so determined that by the resilient deformation of the needle and the casing under the thrust and pull of the cap nut 5, the faces 20 and 21 are moved into engagement after the pressure at the tapered faces 3 and 4 of the needle and the casing, respectively, has attained the limit. When the device has been assembled, the outer end of the passage 14 is closed tightly by the faces 20 and 21, and special packing means such as stuffing boxes or the like, are dispensed with. The fuel which is admitted to the upper or outer end of the passage 14 by the various means which have been described, flows toward the seat 4 and is finally ejected through the grooves 12 and 13 and the opening 18.

I wish it to be understod that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

I claim:—

1. A solid injection fuel admitting device for internal combustion engines comprising a casing, a needle inserted in said casing and defining a fuel passage with said casing, co-acting sealing faces on said needle and said casing for tightly closing the outer end of said passage, and means anchored on one of said members for exerting thrust on the other member so as to apply their sealing faces onto each other.

2. A solid injection fuel admitting device for internal combustion engines comprising a casing, a needle inserted in said casing and defining a fuel passage with said casing, means including a face on said needle fitting the inner wall of said casing, and co-acting sealing faces on said needle and said casing; for tightly closing the outer end of said passage, and means anchored on one of said members for exerting thrust on the other member so as to apply their sealing faces onto each other.

3. A solid injection fuel admitting device for internal combustion engines comprising a casing, a needle inserted in said casing and defining a fuel passage with said casing, co-acting sealing faces on said needle and said casing for tightly closing the outer end of said passage, means anchored on one of said members for exerting thrust on the other member so as to apply their sealing faces onto each other, and a fuel supply pipe connected to said passage in such manner that the fuel is distributed uniformly in said passage.

4. A solid injection fuel admitting device for internal combustion engines comprising a casing, a needle inserted in said casing and defining a fuel passage with said casing, co-acting sealing faces on said needle and said casing for tightly closing the outer end of said passage, means anchored on one of said members for exerting thrust on the other member so as to apply their sealing faces onto each other, a fuel supply pipe having a passage arranged axially with respect to said needle, and transverse passages connecting said axially arranged passage to the fuel passage defined by said needle and said casing.

5. A solid injection fuel admitting device for internal combustion engines comprising a casing,

a needle inserted in said casing and defining a fuel passage with said casing, co-acting sealing faces on said needle and said casing for tightly closing the outer end of said passage, means anchored on one of said members for exerting thrust on the other member so as to apply their sealing faces onto each other, a fuel supply pipe having a passage arranged axially with respect to said needle, an extension of said axially arranged passage in said needle, and transverse passages, also in said needle, connecting said extension to the fuel passage defined by said needle and said casing.

6. A solid injection fuel admitting device for internal combustion engines comprising a casing, a needle inserted in said casing and defining a fuel passage with said casing, co-acting sealing faces on said needle and said casing for tightly closing the outer end of said passage, means anchored on one of said members for exerting thrust on the other member so as to apply their sealing faces onto each other, a fuel supply pipe having a passage arranged axially with respect to said needle, an extension of said axially arranged passage in said needle, transverse passages, also in said needle, connecting said extension to the fuel passage defined by said needle and said casing, and co-acting seating faces on the inner end of said pipe and the outer end of said needle, said last mentioned seating faces surrounding said passage in said pipe and its extension in said needle and being adapted to be applied to each other by said thrust-exerting means.

7. A solid injection fuel admitting device for internal combustion engines comprising a casing, a needle inserted in said casing and defining a fuel passage with said casing, means including a face on said needle fitting the inner wall of said casing, and co-acting sealing faces on said needle and said casing; for tightly closing the outer end of said passage, means anchored on one of said members for exerting thrust on the other member so as to apply their sealing faces onto each other, and a fuel supply pipe connected to said casing and opening into the fuel passage between the needle and the casing at the inner end of said face which fits the inner wall of said casing.

8. A solid injection fuel admitting device for internal combustion engines comprising a casing, a needle inserted in said casing and defining a fuel passage with said casing, co-acting sealing faces on said needle and said casing for tightly closing the outer end of said passage, means anchored on one of said members for exerting thrust on the other member so as to apply their seating faces onto each other, and a fuel supply pipe connected to said casing and opening into a recess in one of the sealing faces on said casing which recess is connected to the fuel passage defined by said needle and said casing.

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