May 1, 1956 R. L'ORANGE 2,743,961

NEEDLE NOZZLE FOR INTERNAL COMBUSTION ENGINES

Filed Oct. 29, 1951

FIG. 1

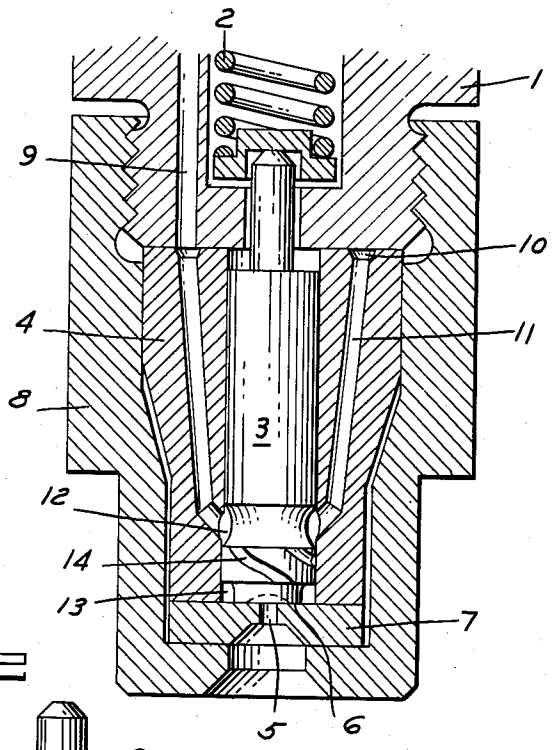


FIG. 2

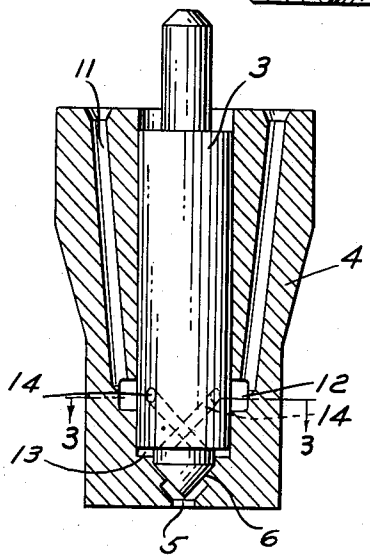
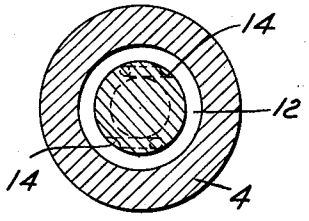


FIG. 3



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NEEDLE NOZZLE FOR INTERNAL COMBUSTION ENGINES

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1 Claim. (Cl. 299—107.6)

This invention relates to internal combustion engines, and refers more particularly to improvements in fuel injection means for such engines.

The combustion chamber of internal combustion engines, especially Diesel engines having precombustion or postcombustion chambers, frequently requires the injection of the fuel in a jet which widens into a relatively oblique conical surface. For this purpose there have been provided on the nozzle needles small pins which extend into the atomization bore and form, possible in cooperation with recesses, edges or the like provided in the nozzle bore, an annular gap through which the injected jet is expanded to a certain conical angle. This construction, however, affords difficulty in manufacture; especially due to the necessity of an absolutely accurate centering of the small pin with the seat. Furthermore the annular gap, which must have a width of a few hundredths of a millimeter, is exposed to the danger of contamination, especially upon the stopping of the engine. These contaminations are mostly flushed away during the operation of the motor; but in the meantime, however, they encumber the starting of the engine by poor atomization.

The object of the present invention accordingly is to create a needle injection nozzle of the same manner of operation for various cone angles, which is not subject to these difficulties. The solution of the problem is effected in accordance with the present invention thereby that the entrance of the fuel coming from the injection pump into the annular space which is arranged directly in front of the seat of the needle takes place over cross sections which are tangentially directed in such a manner that a rotational motion is produced in this annular space below the shoulder of the needle in front of the needle seat. Depending on the intensity of this rotary motion, in combination with the selection of the diameter of the atomization opening, the length of the atomization opening and the stroke of the needle, there is then produced a wider or narrower atomization cone. In this connection there can also be produced nozzles of the same size atomization cone angle, in connection with which however the penetrating power varies, depending on the influence of the said factor. The admission cross sections which bring out the rotation in the annular space below the needle shoulder can be arranged in the needle guide itself, penetrating inwards to the needle guide bore from the outside. Such constructions can be realized in a particularly good manner in connection with needle seats which are separated from the cylindrical needle guides. From the point of manufacture, particularly practicable solutions result if these admission cross sections are hollowed out of the needle. In this case the annular space, which is ordinarily arranged around the needle, must be removed somewhat from the needle seat. The connection of this annular space to the annular space existing under the needle shoulder is then formed by the channels, the discharge of which into the annular space in front of the needle seat produces the rotation. These connecting channels can be hollowed out in the form

of helical grooves to the corresponding lower inlet amount. A particularly advantageous solution, both for manufacture and operation, results if these connections consist of bores which lead, outside of the axis of the needle and at an inclination to same, from the annular space in the needle guide to the space below the needle shoulder. The invention can therefore be applied to needle nozzles, the seat of which is developed in the customary manner as a conical valve, as well as to the known shapes of plane, flat or annular seats in the valves; in which connection, of course, in the latter case, the influence of the passage of the fuel through the needle seat must be counted with greater weight among the factors determining the atomization shapes than in the former case.

Although the present invention is primarily intended for the injection shapes described in the preamble in a jet or cone lying in the needle axis; and therefore with an atomization bore lying in the needle axis, it is particularly applicable in special cases when the atomization bore is inclined to the needle axis; or when several atomization bores are present. The influence of the measures in accordance with the present invention will, in such case, primarily act to impart to the corresponding nozzle jets a strong breaking-up and lesser penetrating force. In addition to this one improvement which the present invention can impart to all such nozzle needle valves, is an improved protection of the needle seat from dirt particles, inasmuch as such particles are flushed away in a somewhat better manner; as well as, in those designs in which tangential cross sections are recessed out of the needle, an improvement of the life of the needle seat due to a continuous rotation of the needle seat.

The attached drawings show a number of embodiments by way of example, without it being intended by this to exhaust the posssibility of the variants.

Referring to Fig. 1, there can be noted the lower end of the nozzle holder 1, the coil spring 2 of which acts against the nozzle needle 3. The nozzle needle 3 fits tightly in the needle guide 4; and, toward the combustion chamber, seals off the way to the inlet opening 5 with the needle seat 6 developed as a flat seal. The atomization bore 5 is arranged in the nozzle plate 7, which in its turn is pressed, together with the needle guide 4, against the nozzle holder 1 by the screw coupling 8. During the feed stroke of the injection pump, the fuel passes through the fuel pressure path 9 out of the nozzle holder into the annular distribution space 10 of the needle guide. From the annular distribution space 10, the fuel is fed, via one or more fuel channels 11, to the upper annular space 12, which is produced by a corresponding groove in the nozzle needle 3 opposite the cylindrical wall of the needle guide 4.

The fuel can now only pass from the upper annular space 12 into the lower annular space 13 below the shoulder of the needle 3 through the helical grooves 14, so that it is rotated more or less forcibly, depending on the cross section and the direction of these helical grooves in the lower annular space 13. If the fuel pressure during the feed stroke of the injection pump rises so greatly below the needle shoulder in annular space 13 that the closing pressure of the coil spring 2 is overcome, needle 3 will rise and the seat 6 of the needle will open the path to the injection opening 5. The atomization jet, which emerges from the atomization bore into the combustion chamber, has its shape decided on the one hand by the spring 2, the size of the needle shoulder above the annular space 13, the diameter of the needle 3 and the quantity delivered per unit of time by the injection pump; and also on the other hand, in accordance with the dimensions of the atomization bore 5 and the direction and velocity of the fuel rotating in the an-

nular space 13. The greater the velocity and energy of the rotating components of the fuel, the wider the fuel cone will be.

In Figure 2 there is shown an embodiment which differs from the one already described thereby that on the one hand instead of a flat seat needle, there is used a needle having a conical seat; and that further, the connecting paths between the upper annular space 12 and the annular space below the needle shoulder 13, which produces the rotation of the fuel, are brought about by tangential bores passing through the needle.

Figure 2 thus shows a needle nozzle element consisting of the needle guide 4 and the nozzle needle 3. Also in this case the fuel enters the upper annular space 12 through one or more atomization bores, said upper annular space being produced in the present embodiment as a groove in the needle guide 4. The connection of this annular space 12 with the lower annular space 13 below the needle shoulder is effected by two tangential bores 14 which conduct the fuel with greater or lesser rotation into the annular space 13. This embodiment has the advantage that the cylindrical surface of the needle, with the exception of the small entrance places of the tangential bores 14, is not interrupted, which is of particular advantage for the bringing about of the best possible fit of the needle 3 in the needle guide 4, particularly between the upper annular space 12 and the lower annular space 13. The seat 6 of needle 3 is arranged in this embodiment as a conical seat directly in the needle guide 4. Similarly, the atomization bore 5 is produced in the needle guide 4 itself.

Figure 3 is a section through the nozzle element according to Figure 2 at the height of the upper annular space 12 and of the tangential bores 14.

What I claim as my invention is:

A fuel injection nozzle for internal combustion engines, comprising a holder having a fuel passage therein, an elongated needle guide projecting outwardly from said holder and having a longitudinal bore extending to the outer end of said needle guide, a nozzle plate extending across the outer end of said needle guide and having a fuel atomizing port communicating with said bore and an annular seat surrounding said port, an annular groove in the inner end of said needle guide communicating with the fuel passage in said holder, circularly arranged fuel passages in said needle guide communicating with said annular groove and terminating in intake ports communicating with the bore at a point spaced axially inwardly of the bore from the outer end thereof, a needle having a sliding fit in the bore and having a portion between said intake ports and said fuel atomizing port closely fitting the bore, said needle having a reduced outer end portion provided with an end surface engageable with said annular seat to close said fuel atomizing port and forming an annular chamber around said reduced end portion at the outer end of said bore, a fuel passage in said needle extending from said intake port to said annular chamber and being in the form of a groove in the outer surface of said needle extending helically with respect to the axis thereof, and means for clamping together said needle guide, nozzle plate and holder comprising a coupling sleeve surrounding said needle guide and having an outer end turned radially inwardly to overlie and abut the outer end of said nozzle plate, and a releasable connection between the outer end of said holder and the inner end of said sleeve.

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