

Dec. 6, 1960

W. G. JACOBITZ ET AL

2,963,282

FUEL NOZZLE

Filed May 2, 1957

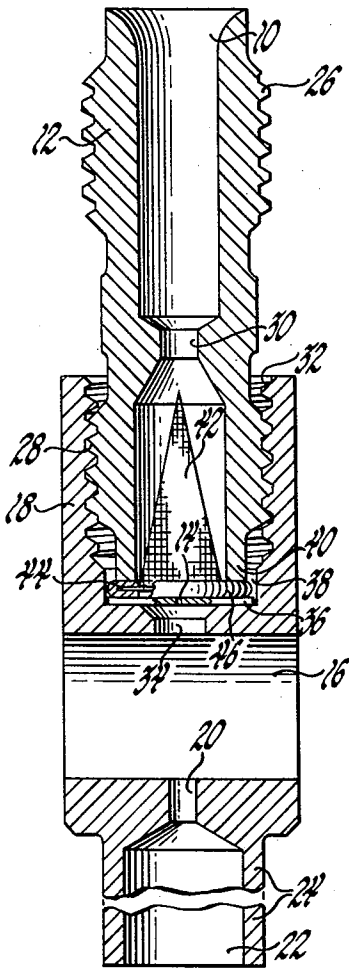


Fig. 1

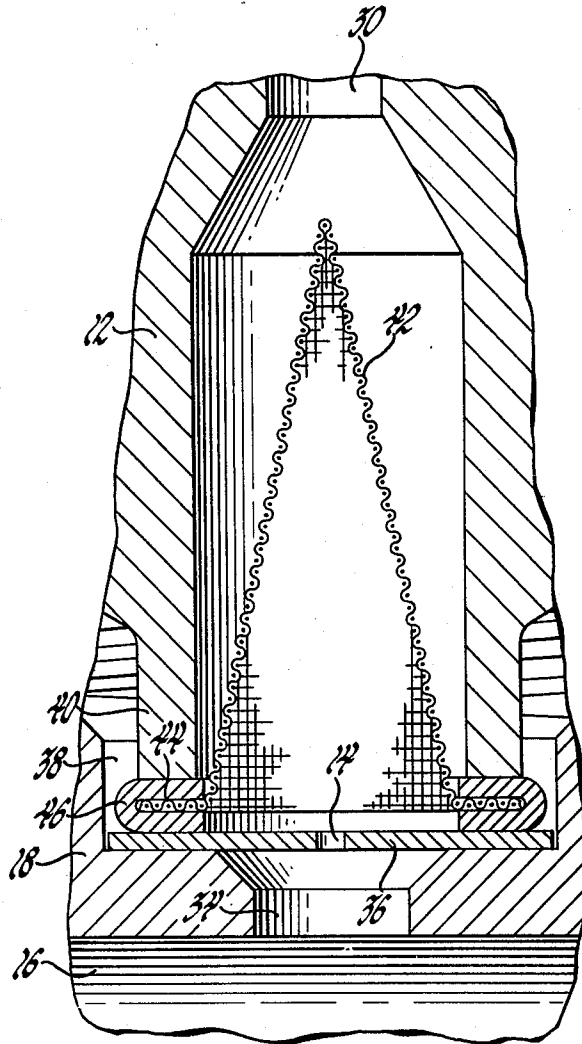


Fig. 2

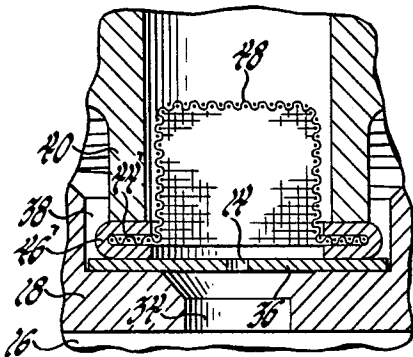


Fig. 3

INVENTORS
*William G. Jacobitz &
Elias W. Scheide*
BY
R. T. Barnard
ATTORNEY

1

2,963,282

FUEL NOZZLE

William G. Jacobitz and Elias W. Scheibe, Grand Rapids, Mich., assignors to General Motors Corporation, a corporation of Delaware

Filed May 2, 1957, Ser. No. 656,719

2 Claims. (Cl. 261—4)

The present invention relates to an atmospheric type fuel nozzle for a fuel injection system. More particularly, this invention is an improvement over the atmospheric nozzle shown and described in copending application Serial No. 512,175, Homfeld et al., filed May 31, 1955, now abandoned.

Atmospheric fuel nozzles of the type shown in the aforementioned copending application have presented a problem in actual use in that it has been difficult to provide a set of such nozzles with uniform flow characteristics. These atmospheric nozzles involve the use of extremely small orifices as a consequence of which any slight variation in size or configuration of an orifice can perceptibly alter the flow through the nozzle as compared with another nozzle used in the same system. The obvious result of these varying flow characteristics is an uneven disposition of fuel to the various cylinders of the engine. On the other hand, for the sake of economy of manufacture it has not been feasible to utilize nozzles having identical flow characteristics. As a consequence, it has been necessary to compromise and utilize nozzles within a given but theoretically undesirably large range of flow characteristics. The inability to produce in commercial quantities more acceptable nozzles led to the development of the present nozzle construction.

The present atmospheric nozzle represents an improved construction whereby atmospheric nozzles may be economically manufactured in a way which will insure that the flow characteristic of the nozzles will be much more uniform than has heretofore been possible.

To achieve this end, the present atmospheric nozzle is of a fabricated or built-up design in which the critical or fuel metering orifice is formed in a separate easily worked upon element which has enabled greater uniformity of nozzle flow and, further, which permits the salvaging of the major portion of the nozzle in the event the fuel orifice requires replacement.

It is also an object of the present invention to provide an atmospheric type nozzle in which it is possible to achieve a much more uniform flow versus pressure curve and further which curve has the characteristic of an orifice meter. The orifice meter type flow curve is desirable in that it insures a slight enrichment at idle or low fuel flows. On the other hand, the previous type atmospheric nozzles have a characteristic flow curve similar to a venturi meter as a consequence of which they have tended to lean out fuel flow under idling conditions which is undesirable.

The present nozzle provides the fuel metering orifice in a thin plate member which is clamped in axially spaced relation to the atmospheric metering orifice and which orifice plate in addition to providing much improved flow characteristics results in a better targeting of the fuel stream through the atmospheric metering nozzle than has been achieved with the earlier designs.

In view of the small orifice sizes utilized in such atmospheric nozzle the problem of clogging has been extremely serious. With the present nozzle it has been possible

2

to combine a fuel filter therewith in such a way as to insure non-clogging operation of the orifices.

The details and other objects and advantages of the subject nozzle will be apparent from the description which follows.

In the drawings:

Figure 1 is a sectional view of the subject atmospheric nozzle;

Figure 2 is a fragmentary enlargement showing the nozzle in greater detail; and

Figure 3 is a modified filter configuration.

In general the atmospheric nozzle functions in the same manner as set forth in the aforementioned Homfeld application. Briefly, the nozzle includes a fuel inlet passage 10 formed in a member 12 which is adapted to flow fuel through a fuel metering orifice 14 across a relatively large atmospheric passage or space 16 formed in a member 18 and target the fuel stream through a relatively larger orifice 20 in member 18. The orifice 20 is of such a size as to meter the quantity of air flowing therethrough but to have no metering effect on the fuel stream. The air metering orifice 20 communicates with an enlarged passage 22 in the lower end 24 of nozzle member 18 and which end is adapted to suitably project within the induction passage leading to a cylinder of the engine.

As described in detail in the copending Homfeld application the reference air space 16 normally communicates with the atmosphere and in this way isolates the fuel metering function from variations in manifold depression which are acting on end 24 of the nozzle member 18. In this way fuel supplied through orifice 14 is adapted to be accurately controlled by suitable forces elsewhere in the injection system.

In the past the fuel nozzle has either been of an integral construction as a consequence of which any intolerable variations in the size of the fuel metering orifice has resulted in the complete loss of the entire nozzle or a major part thereof. In other types of atmospheric nozzles the orifice may have been formed in a member detachable from the entire nozzle but in all instances the orifices have been formed in relatively large members which have been difficult to accurately machine and, further, which in the event of a defective nozzle have still meant the replacement of a considerable portion of the entire nozzle. To overcome these disadvantages and insure more uniformly functioning nozzles, supra, the present nozzle is fabricated from a plurality of parts in such a way that the component containing the fuel metering orifice is capable of easy handling, accurate machining as well as simple replacement at very little cost.

In the present device member 12 includes axially spaced threaded portions 26 and 28 on the exterior surface thereof. Fuel passage 10 formed in member 12 includes a relatively large orifice 30 intermediate the ends thereof which performs an initial fuel metering function.

Member 18 includes an internally threaded bore 32 which terminates in a relatively large orifice 34 in open communication with the transversely formed atmospheric air passage 16. The air metering orifice 20, as already described, is axially aligned and spaced from fuel metering orifice 14 and communicates with the enlarged fuel-air mixture passage 22.

The threaded portion 28 of member 12 is adapted to be threaded within bore 32 of member 18. A plate member 36 is disposed within a non-threaded portion 38 of bore 32 and positioned therewithin. To insure proper radial alignment of the fuel metering orifice 14 formed in plate 36 with orifices 20 and 34, the plate or disc 36 is substantially radially coextensive with bore portion 38. The inner end of member 12 terminates in a cylindrical sleeve portion 40 which is adapted to axially clamp plate 36

within the bore portion 38 and make a complete atmospheric nozzle assembly.

As thus far described, it will be apparent that the relatively large orifices or restrictions 20, 30 and 34 are formed in the large members 12 and 18. These orifices, being considerably larger than the fuel metering orifice 14, are more easily machined and do not have to be maintained to the same degree of accuracy required of the fuel metering orifice.

On the other hand, the fuel metering orifice 14 is formed in a relatively thin circular disc or plate 36 which may be easily drilled and if formed beyond tolerable limits may be disposed of with relatively little loss. To illustrate the manufacturing advantage of using orifice plates it may be appreciated that a stack of such plates, at least consisting of those to be utilized in the same system, may be clamped together and drilled as a unit insuring substantial uniformity of formation. In addition to the inherent advantage of utilizing an orifice plate to provide the desired fuel flow characteristics through the nozzle, the ability to commonly form a plurality of such orifices, as described, further insures that the range of flow characteristics between the nozzles in a given system will be held to an absolute minimum.

To better appreciate the economy realized by the present construction, it is well to note that the plate 36 is in the nature of .005 of an inch thick. In addition to insuring uniformity of orifice formation, it is apparent that with discs of such thinness it is preferable that they be drilled in a stack for mutual reinforcing purposes. Further, in assuring greater flow uniformity it has been found advantageous to flow fuel through the orifices in the same direction in which they were drilled. For this purpose it is possible to suitably mark, as by vapor blasting, one side of the plate from which the discs are formed to insure that they will be assembled within the nozzle in the right direction.

The fabricated construction of the present nozzle has made it possible to conveniently incorporate a filter element proximate the fuel metering orifice 14 where such location was not feasible with earlier types of construction. To this end, a preferably metal mesh filtering element 42 having a radial flange 44 is adapted to be clamped between the orifice plate 36 and the sleeve portion 40 of member 12. In order to rigidify and thereby strengthen the filtering element an annular U-shaped rim 46 is clamped about the filter flange 44. In this way as the member 12 is threaded within the member 18 the metal rim 46 supports the filter element 42 and facilitates clamping of the orifice plate 36 within the bottom of bore portion 38.

The filter element may be of various configurations as the conical version of Figures 1 and 2. However, for reasons of strength and ease of formation, the dome shaped filter element 48 of Figure 3 has been found to be preferable. In this case a flange 44' and rim 46' are still provided.

It is apparent that the present nozzle construction is such that either or both the orifice plate 36 and the filtering element 42 or 48 may be easily replaced in the event either becomes defective for any reason.

We claim:

1. A fuel injection nozzle comprising a plug member having a fuel inlet in one end thereof and a longitudinal fuel passage therein, an open ended tubular sleeve portion on the other end of said plug member, a fuel metering orifice of reduced diameter in said longitudinal fuel

passage intermediate the ends of said plug member, socket retaining means on said plug adjacent said tubular sleeve portion, a socket member having a longitudinal passage therethrough, plug member engaging means in one end of said longitudinal passage of said socket member to cooperatively accommodate said socket retaining means on said plug member, a portion of said longitudinal passage of said socket member extending longitudinally from said plug member engaging means, a seat terminating said portion and extending radially inwardly thereof, a further portion of said longitudinal passage of said socket member extending longitudinally from said seat and defining a fuel inlet orifice and communicating with a transverse air passage, an air-fuel orifice formed in the other end of said longitudinal passage of said socket member and coaxially aligned with said fuel inlet orifice and extending from said air passage, a thin disc member removably retained on said seat by said tubular sleeve portion, a fuel metering orifice in said disc formed by a hole drilled from the inlet to the outlet side of said disc member, and said fuel metering orifice in said disc member being aligned and spaced from said air-fuel orifice to direct fuel thereinto through said air passage.

2. A fuel injection nozzle comprising a plug member having a fuel inlet in one end thereof and a longitudinal fuel passage therein, an open ended tubular sleeve portion on the other end of said plug member, a fuel metering orifice of reduced diameter in said longitudinal fuel passage intermediate the ends of said plug member, socket retaining means on said plug member adjacent said tubular sleeve portion, a socket member having a longitudinal passage therethrough, plug member engaging means in one end of said longitudinal passage of said socket member to cooperatively accommodate said socket retaining means on said plug member, a portion of said longitudinal passage of said socket member extending longitudinally from said plug member engaging means, a seat terminating said portion of said longitudinal passage of said socket member and extending radially inwardly thereof, a further portion of said longitudinal passage of said socket member extending from said seat and defining a fuel inlet orifice and communicating with a transverse air passage, an air-fuel orifice formed in the other end of said longitudinal passage of said socket member and being coaxially aligned with said fuel inlet orifice and extending from said air passage, a thin disc member removably retained on said seat by said tubular sleeve portion, a fuel metering orifice in said disc member aligned and spaced from said air-fuel orifice to direct fuel thereinto through said air passage, a filtering element disposed within said tubular sleeve portion and having a radially outwardly extending flange portion, and an annular rim surroundedly fixed to said flange and adapted to be clamped between said disc member and said tubular sleeve portion.

References Cited in the file of this patent

UNITED STATES PATENTS

2,210,846	Aghnides	Aug. 6, 1940
2,316,832	Aghnides	Apr. 20, 1943
2,420,795	Phillips	May 20, 1947
2,483,951	Watson	Oct. 4, 1949
2,511,213	Leslie	June 13, 1950

FOREIGN PATENTS

944,697	Germany	June 21, 1956
527,491	Belgium	Apr. 15, 1954