Oct. 17, 1967 E. J. SVOBODA 3,347,470

FUEL INJECTION NOZZLE

Original Filed May 24, 1963

Fig. 1

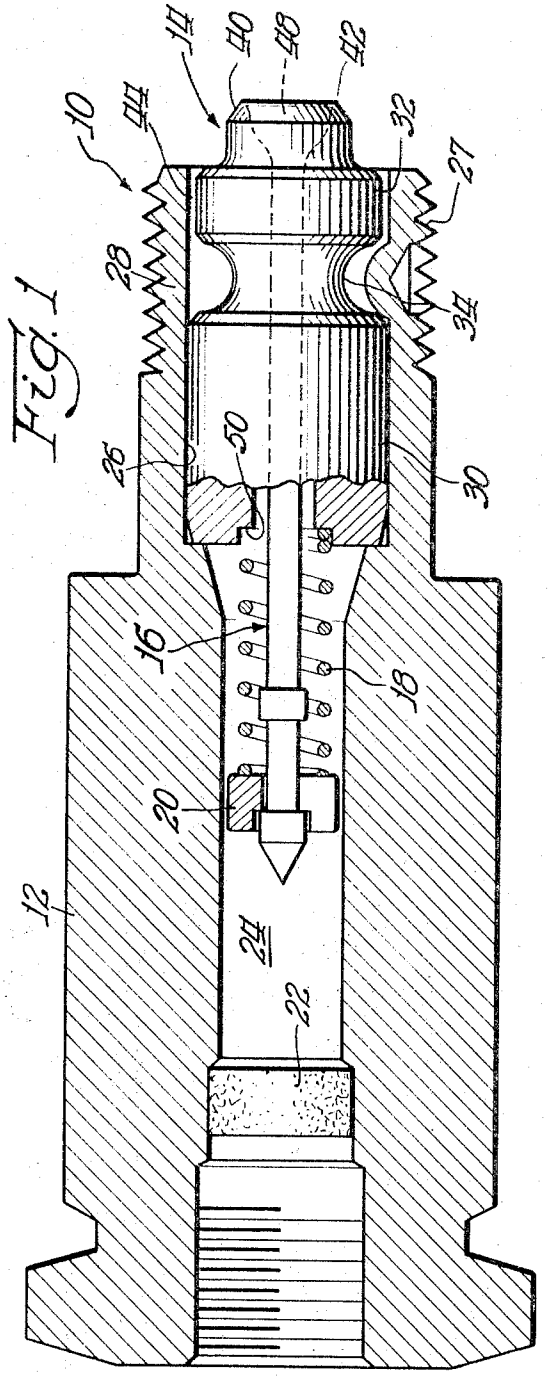


Fig. 2

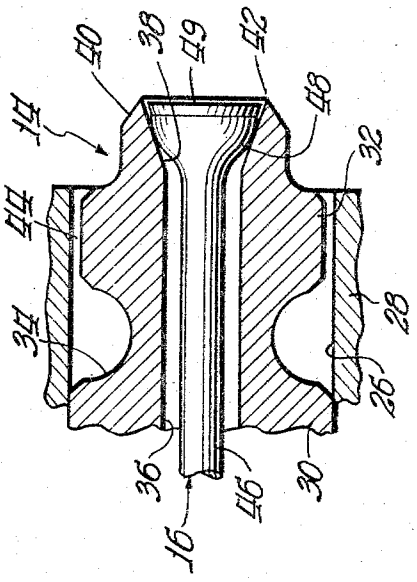
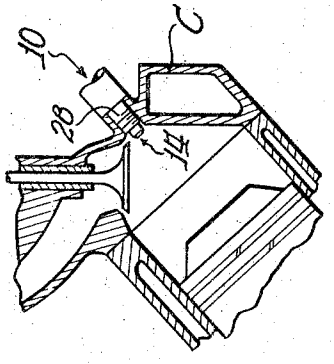


Fig. 3



Inventor:
Edward J. Svoboda

By: Frank R. Thienpont Atty.

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FUEL INJECTION NOZZLE

Edward J. Svoboda, Decatur, Ill., assignor to Borg-Warner Corporation, a corporation of Illinois

Continuation of application Ser. No. 282,934, May 24, 1963. This application Apr. 7, 1965, Ser. No. 449,364
1 Claim. (Cl. 239—453)

This application is a continuation of application Ser. No. 282,934, filed May 24, 1963, now abandoned, and assigned to the assignee of the present application.

This invention relates to an improved fuel injection nozzle for use in an internal combustion engine and more particularly to a fuel injection nozzle for use in direct cylinder injection.

One of the problems encountered in the past in direct cylinder injection as distinguished from manifold injection is that there is a greater tendency in the former environment for carbon deposits to form on the nozzle tip. This contributes to greater valve wear and progressive decreasing of the efficiency of the nozzle in spraying fuel into the fuel cylinder.

Accordingly, a principal object of this invention is to provide a structure particularly useful in direct cylinder injection constructed in a manner to minimize carbon deposits on the nozzle tip.

Another object is to provide a nozzle tip formed with a knife-like edge to preserve the efficiency of the fuel injection nozzle by minimizing the surface available for carbon deposits to accumulate.

Other and more particular objects, advantages, and uses of my invention will become apparent from a reading of the following specification taken in conjunction with the accompanying drawings which forms a part thereof and wherein:

FIGURE 1 is a longitudinal sectional view of the improved fuel injection nozzle of the present invention;

FIGURE 2 is an enlarged view of a portion of the nozzle tip shown in relation to the nozzle body member and the valve member;

FIGURE 3 is an illustration of the nozzle of FIGURE 1 as it is positioned in a cylinder head of an internal combustion engine.

Like characters of reference designate like parts in the several views.

Referring now to FIGURE 1 the illustrated nozzle **10** comprises an elongated tube-like nozzle body **12**, a nozzle tip **14**, a valve member or pintle **16**, a spring **18**, a spring retainer member **20**, and a filter **22**.

The body member **12** is formed with a longitudinal bore **24** providing a fuel passage therethrough. The filter **22** is positioned at the inlet end of the bore **24**. The nozzle body member is also formed with a cylindrical bore **26** opposite the inlet end, the bore **26** being an enlarged extension of a portion of bore **24** adapted to receive the nozzle tip **14**. The nozzle body **12** is threaded at **27** for insertion into the cylinder block C as shown in FIGURE 3, and is formed with a skirt portion **28** which extends over a portion of the outer end of the nozzle tip the purpose of which is hereinafter further explained.

The nozzle tip **14** comprises a first portion **30** and a second portion **32**. The first portion **30** is adapted to be press fitted into the cylindrical bore **26** of the nozzle body. The first and second portions **30** and **32** are separated by circumferential groove **34**. The purpose of the groove **34** is hereinafter more fully explained. The nozzle tip **14** is formed with a longitudinally extending cylindrical bore **36** defining a fuel passage therethrough which is in communication with the bore **24**. At the outer end of the bore **36** there is formed a frusto-conical opening defining a valve seat surface **38** for the valve member **16**. The end of the nozzle tip is chamfered at **40** so that

a knife edge **42** is formed by the intersection of the valve seat surface **38** and the chamfer **40**. The purpose of this knife edge will be hereinafter more clearly explained. The second portion of the nozzle tip **14** is of a smaller diameter than the bore **26** to provide a radial clearance **44** between the skirt portion **28** of the bore **26** and the second portion **32**. Depending on certain conditions of cylinder design the distance the nozzle tip protrudes into the cylinder is of critical importance to obtain optimum efficiency of the combustible mixture in the cylinder. In certain instances a relatively short protrusion of the nozzle tip into the cylinder is required. Under those conditions the threaded skirt portion **28** must extend well toward the end of the nozzle tip as shown in FIGURE 1. It is then that it becomes necessary to have the clearance **44** between the inner periphery of the skirt **28** defined by the extension of bore **26** and the outer periphery of the second portion **32** of the nozzle tip.

The valve member or pintle **16** comprises a valve stem **46** and an enlarged substantially hemispherical head **48** formed on one end thereof. The head **48** is adapted to be seated on the valve seat surface **38**. The head **48** is of such a size that in a seated position the outer face **49** of the head **48** is almost flush with the surrounding knife edge **42**. The valve member is held in a seated position by means of the spring **18** surrounding the valve stem **46**, the spring being seated at one end in a recess **50** formed on the inner end of the first portion **30** of the nozzle tip **14** and at the other end against the retainer **20**. This assembly of the nozzle tip, spring, valve member and spring retainer is similar to that disclosed in copending application, Ser. No. 248,551, filed Dec. 31, 1962.

A suitable filter **22** is disposed in the longitudinal passage **24** to filter fuel before it is injected into the engine through the nozzle tip **14**.

The purpose of the knife edge **42** is to minimize the surface available on the nozzle tip **14** for accumulation of carbon deposits. Carbon deposits will tend to form on a nozzle tip when it is positioned in direct communication with cylinder of the internal combustion engine as shown in FIGURE 3. These carbon deposits result from un-burned fuel. If a substantial surface is available these deposits tend to be rather substantial and will tend to clog up the end of the nozzle tip. This contributes to the wear of the valve head and the nozzle tip and brings about uneven fuel spray patterns, thereby reducing the efficiency of the nozzle. Accordingly, I have reduced the surface available for the formation of these carbon deposits by providing on the nozzle tip end a knife edge **42**, which, as shown in this preferred embodiment, can be easily formed by providing a chamfer **40** which will intersect the valve seat surface **38**. Thus in conjunction with the knife edge **42** the wash of fuel flowing through the passages **24** and **36** further reduces the tendency for formation of carbon deposits.

It will be noted that I have provided a radial clearance **44** between the second portion **32** of the nozzle tip and the cylindrical bore **26**. This has been done in order to avoid the necessity of press fitting the second portion **32** of the nozzle tip into the cylindrical bore **26** which would tend to set up stresses which could be transmitted to the valve seat surface **38**. The circumferential groove **34** is also a stress relieving feature which prevents stresses set up when the first portion **30** is press fitted into bore **26** from being transmitted to the valve seat **38**.

Thus there are provided in my nozzle tip the combination of two features to serve a stress relieving function. These stress relieving features are the circumferential groove **34** and the clearance **44** between the cylindrical bore **26** and the second portion **32** of the nozzle tip **14**.

Thus provision of stress relieving features to prevent distortion of the valve seat surface **38** and provision of the knife edge **42** on the nozzle tip **14** to prevent accumulation of carbon deposits both contribute to a more effective valve seating arrangement by minimizing distortion within the tip itself and clogging of the tip from an outside source, namely, un-burned carbons within the cylinder.

While I have shown and described a certain specific structure as comprising a preferred embodiment of my invention it is to be understood that this is by way of example and that my invention is to be defined by the appended claim.

I claim:

A fuel injection nozzle comprising, an elongated body member having a longitudinal passage extending therethrough including an enlarged generally cylindrical bore, a nozzle tip secured to said body member having a longitudinal passage extending therethrough, said passage in said tip including a generally cylindrical portion in communication with said passage of said body member and a generally frusto-conical portion diverging from said cylindrical portion and terminating in an enlarged outer open end, said tip including a first portion surrounding a portion of said cylindrical portion of said passage and a second portion surrounding said conical portion thereof, said first portion of said tip including a generally cylindrical outer surface press fit into said enlarged generally cylindrical bore of said body member and said second portion being disposed substantially within said enlarged cylindrical bore and including a generally cylindrical outer surface spaced from said bore to define an annular space therebetween, said first and second portions of said tip being connected by a reduced portion defining an annular open groove intermediate said portions effective to reduce the transmission of stresses from said first portion to said second portion, said tip further including an external generally conical chamfered portion joining in an acute angle with said conical portion of said passage at said outer open end to define a knife edge therearound, and said nozzle further including a movable valve member disposed within said passage within said tip having an enlarged generally hemispherical head portion disposed entirely within said conical portion of said passage, said head portion being urged into sealing engagement with said conical portion of said passage internally of said knife edge and said head including an outer end disposed approximately flush with said knife edge when said head and said conical portion of said passage are in said sealing engagement.

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EVERETT W. KIRBY, *Primary Examiner.*