March 10, 1970 A. DREISIN 3,499,605

NOZZLE HOLDER

Filed Dec. 22, 1967 2 Sheets-Sheet 1

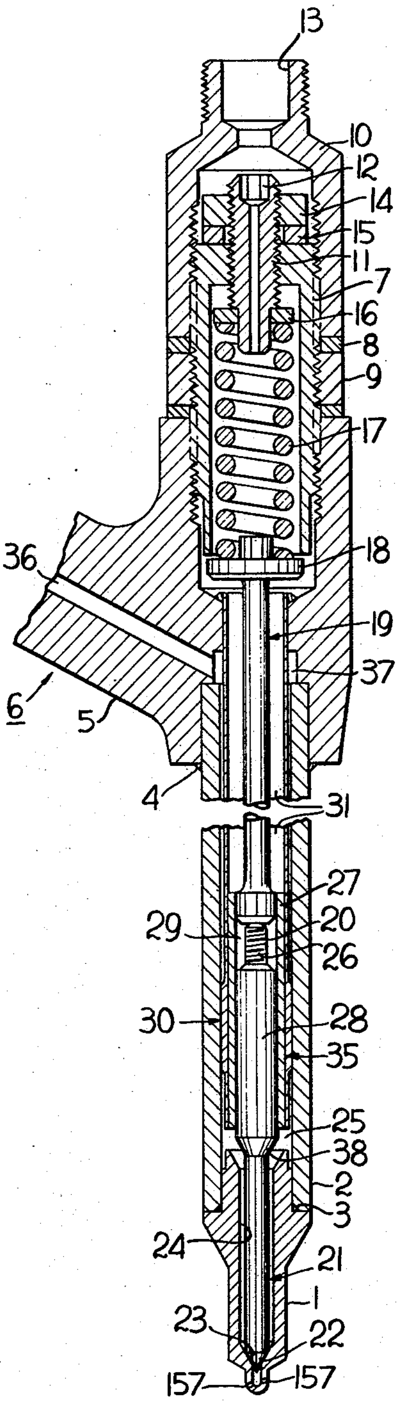


Fig. 1


Fig. 2

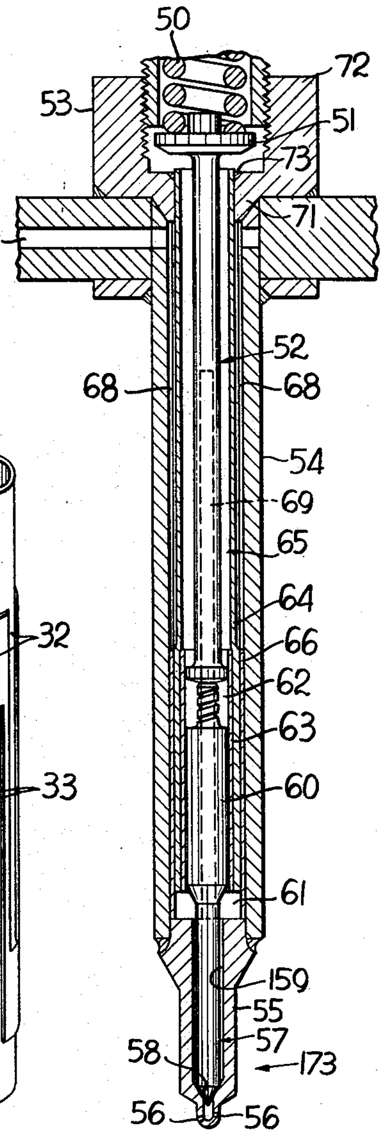


Fig. 3

Inventor
Alexander Dreisin
By
Attorney

March 10, 1970 A. DREISIN 3,499,605

NOZZLE HOLDER

Filed Dec. 22, 1967 2 Sheets-Sheet 2

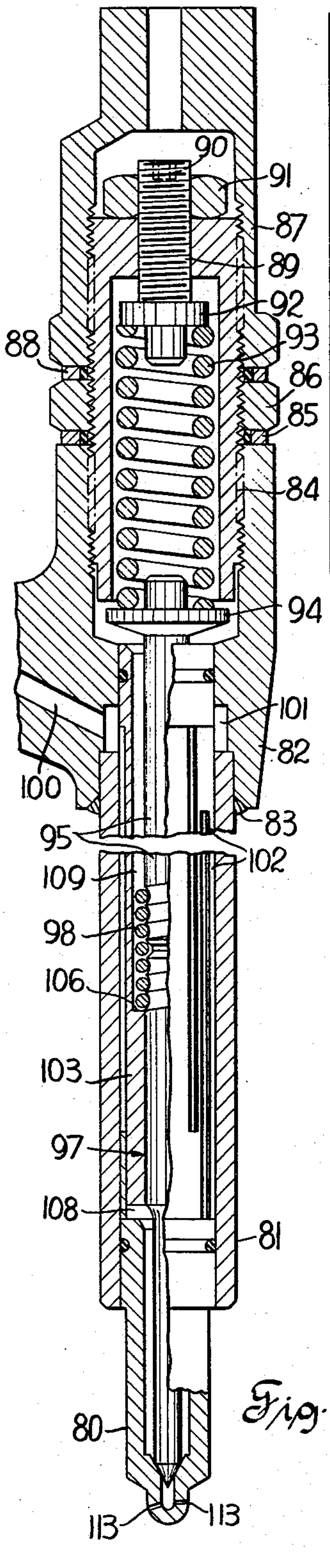


Fig. 4

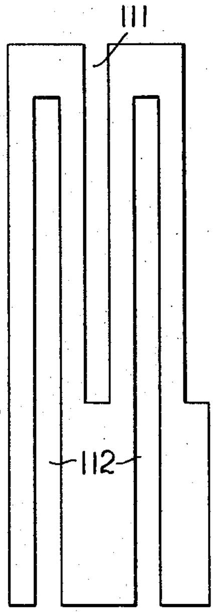


Fig. 8

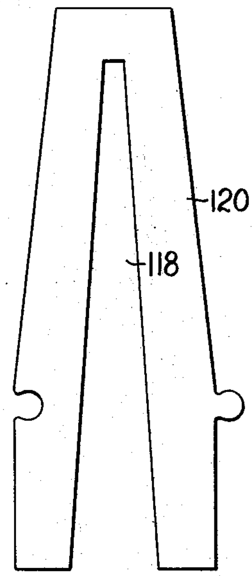


Fig. 9

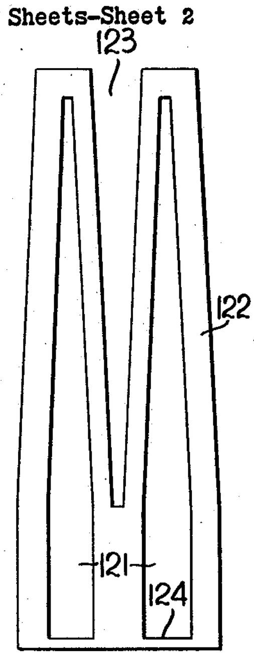


Fig. 10

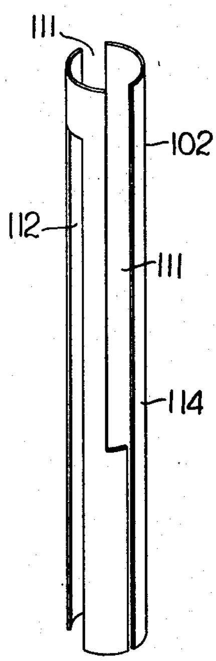


Fig. 5

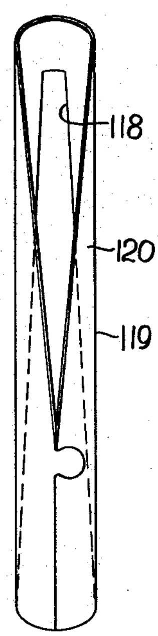


Fig. 6

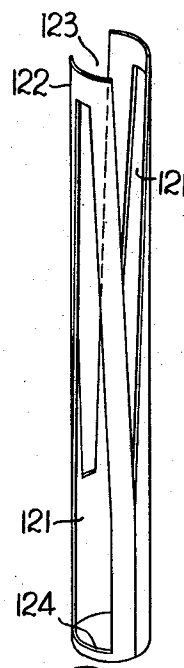


Fig. 7

Inventor
Alexander Dreisin
By
Attorney

United States Patent Office

3,499,605

Patented Mar. 10, 1970

1

3,499,605

# NOZZLE HOLDER

Alexander Dreisin, Olympia Fields, Ill., assignor to Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Filed Dec. 22, 1967, Ser. No. 692,879
Int. Cl. F02m 55/00
U.S. Cl. 239—86 6 Claims

## ABSTRACT OF THE DISCLOSURE

A nozzle and holder for fuel injection on a diesel engine.

This invention relates to a fuel injector and more particularly to a fuel injection nozzle and holder assembly.

The operation of the diesel engine requires injection of fuel into the engine combustion chamber at the time the air in the chamber is under compression. This may be accomplished in various ways. One of the means for injection of fuel into the combustion chamber is by the use of a single injection pump and a distributor which distributes the pressurized charge of fuel sequentially to a plurality of engine combustion chambers through atomizing nozzles. To reduce the unit cost, the size of the nozzle should be reduced but reliable operating conditions should be maintained.

This invention is designed to provide the advantages of an inexpensive nozzle assembly which provides dependable operation and has the space saving features of a small nozzle assembly. The nozzle assembly provides a sealed unit having means for adjusting the differential valve opening pressure, a filter in the unit positioned in the proximity of the valve, and a means of providing a reliable inexpensive unit.

It is an object of this invention to provide a compact nozzle having a lapped seal on the pressure adjusting end of the nozzle assembly and a built-in filter between the fuel supply and discharge nozzle.

It is another object of this invention to provide a nozzle assembly with opening pressure adjusting means remote from a short differential valve in the nozzle end with means for transmitting force from the nozzle pressure adjusting means to control the differential valve opening pressure.

It is a further object of this invention to provide a fuel injection nozzle assembly having a differential valve and fuel filter in a small diameter nozzle.

It is a further object of this invention to provide a hydraulically operated nozzle having a lapped sealed end on the valve opening pressure adjusting end controlling the opening pressure of the differential valve with an edge filter positioned intermediate the fuel supply and the discharge end of the nozzle.

The objects of this invention are accomplished by providing a small diameter sealed unit whereby a differential valve is positioned in the discharge end of the nozzle with a spindle or similar means extending from the remote end of the nozzle assembly to control the hydraulic pressure required to open the differential valve. The spindle extends from the remote end and has means for guiding it through an axial movement to control the opening pressure of the differential valve. Means define a fuel supply passage in the nozzle assembly with an edge filter positioned intermediate the differential valve and the supply passages. The nozzle assembly is hydraulically sealed externally and transmits high pressure fuel from the injection pump through the edge filter which is near the differential valve and is discharged from the nozzle.

The preferred embodiments of this invention will be described in the following paragraph and illustrated in the attached drawings.

2

FIG. 1 illustrates a cross section view of a nozzle assembly;

FIG. 2 illustrates a three dimensional view of a sleeve for forming an edge filter in the nozzle shown in FIG. 1;

FIG. 3 illustrates a modification of an injection nozzle wherein an additional sleeve having longitudinal slots is used on a base sleeve to form the edge filter;

FIG. 4 is a cross section view of a modification of a nozzle using a sleeve similar to that illustrated in FIG. 5;

FIG. 5 illustrates a three dimensional view of an edge filter sleeve;

FIG. 6 illustrates a modification of a sleeve which is formed sheet metal;

FIG. 7 illustrates a modification of a sleeve formed of sheet metal with slots formed to define an edge filter;

FIG. 8 illustrates the sleeve shown in FIG. 5 prior to its positioning about the periphery of a base sleeve;

FIG. 9 illustrates the sleeve shown in FIG. 6 before it is formed into the sleeve; and

FIG. 10 illustrates slotted sheet metal for forming a sleeve.

Referring to FIG. 1, the nozzle tip **1** is brazed to the casing **2** by brazing **3** which may be accomplished by localized heating. The casing **2** is also brazed at **4** to the holder **5**. In this manner the housing is unitized to form a high pressure seal as well as strengthen the housing structure.

The tip **1** is formed with a plurality of orifices **157** in the tip of discharge pressurized fuel into the combustion chamber. The housing **6** threadedly engages the connector **7** and retains the gasket **8**, nut **9** intermediate the cap **10** and the housing **6**. The connector **7** then encloses a pressure adjusting screw **11** which may be rotated by a wrench in the socket **12** in the end adjacent the opening **13**, in cap **10**. The adjusting screw **11** is locked by means of the nut **14** and washer **15** which engages the upper end of screw **11**. The lower end of the screw **11** engages a spring seat **16** compressing the spring **17** on the head **18** of the spindle **19**. By adjusting the axial position of the screw **11**, the compression on the spring **17** is adjusted and the thrust transmitted through the spindle **19** to the stem end **20** of the needle **21** is controlled. The needle **21** extends into the tip **1** and forms the cone **22** of the needle **21** which is received within a mating valve seat **23** to close the nozzle from discharging fluid until a predetermined pressure is present within the cylindrical opening **24** defined by the tip and the chamber **25** within the casing **2**. The needle **21** is constructed with a threaded portion **26** which is adapted for engagement with a tool to extract the needle **21** from the housing **6** in case of repairs.

The spindle **19** extends into a bushing **27** and is guided on its external periphery. Its motion is an axial movement within the housing. The needle **21** also has a lapped portion **28** which forms a fluid seal between the chamber **25** and chamber **29** above the lapped portion **28** of the needle **21**. The bushing **27** is received within the sleeve **30** with an interference fit which also forms a fluid seal between the chambers **25** and chamber **29**. The portion of the sleeve **30** surrounding the lapped portion of bushing **27** is fitted tightly into housing to assure accurate alignment of needle **21** with the seat **23** in tip **1**. The external periphery of the sleeve **30** has formed on its peripheral facing axial grooves which effectively form an edge filter. The axial grooves do not extend the full length of the sleeve **30**. The inlet grooves **32** extend a portion of the length of the external facing of the sleeve **30**, the outlet grooves **33** extend upwardly from the lower portion of the sleeve **30**, and are not connected to the downwardly extending grooves **32**. The diameter of the lower portion of sleeve **30** is stepped down to a smaller dimension than the diameter of the sleeve as shown on the middle portion. Communication between the downwardly extending grooves 32 and the upwardly extending grooves 33 is provided by placing the sleeve 30 within the casing 2 which has a larger internal diameter than the smaller external diameter of the sleeve 30 extending for the length of grooves 32. In this manner any burrs, filings, or foreign material cannot pass from the downwardly extending grooves 32 to the upwardly extendnig grooves 33. An edge filter is provided in the nozzle assembly at a point adjacent to the differential valve 35. An inlet passage 36 is formed in the holder 6 to supply fuel under pressure to the peripheral recess 37 in the nozzle holder 6. The pressurized fuel passes through the edge filter through the chamber 25 and the injection pressure operating on the conical portion 38 lifts the needle 21 and the conical valve surface 22 unseats from its mating seat 23 and high pressure fuel is discharged through the plurality of orifices 7 in the tip 1. The high pressure fuel in chamber 25 is prevented from passing into the spring chamber 40.

Referring to FIG. 3, a modification of a nozzle assembly is shown in cross section. The adjustment of the opening pressure for the differential valve is provided substantially as illustrated in FIG. 1 which controls the downward thrust by the adjusting spring 50 operating on the head 51 of the spindle 52. The holder 53 supports the casing 54 which is brazed to the tip 55. The lower end of the tip 55 is formed with discharge orifices 56 for discharging fuel into the combustion chamber.

The spindle 52 biases the needle 57 downwardly on its mating seat 58 to close communication between a cylindrical passage 159 and the discharge orifices 56. An additional sleeve is used in this assmbly by comparison to the nozzle assembly as shown in FIG. 1, the lapped portion 60 of the needle 57 provides a seal between the chamber 61, and chamber 62. The needle reciprocates within the bushing 63. The bushing 63 is received within the sleeve 64 by a ringing fit which in turn provides a fluid tight seal between the chamber 61 and chamber 62. The filter sleeve 66 has a looser fitting tolerance between itself and the casing 54 except in the portion around the lapped portion. In this portion sleeve 64 is enlarged sufficiently to provide a tight fit between it and filter sleeve 66 and casing 54 to assure accurate alignment of the needle on its seat 58. A filter sleeve 66 is similar to the rolled metal as shown in FIG. 5 which essentially forms a sleeve when assembled in a nozzle assembly. The filter sleeve may be formed of a piece of sheet metal as shown in FIG. 5 or may be a single piece of tubing with axial slots cut to form an edge filter.

The inlet passage 59 feeds fuel into the inlet axial slot 68 which extends downwardly from the inlet passage 59 for a length shorter than the total length of the filter sleeve 66. Similarly cut outlet slots 69 extend upwardly from the lower end of the sleeve but do not extend the full lentgh of the sleeve 66. The loose fitting tolerance between the filter sleeve 66 and the internal dimension of the casing 54 permit fluid passage between the slots 68 and the slots 69 and provides an edge filter intermediate the passage 69 and the chamber 61.

The upper end of the sleeve 64 is received within a peripheral ridge 71 of the housing 72 and is also brazed at 73 to form a high pressure fluid seal at the upper end of the sleeve 64.

The differential valve 173 operates in response to pressurized fluid acting on the valve whereby the injection pressure acting on the needle 57 biases the valve to an open position against the downward thrust of the spring 50. The high pressure fluid entering the inlet passage 59 provides the pressure to open the differential valve.

The assembly as shown is fabricated to show welding or brazing of a plurality of parts which form the unitized housing of the assembly.

Referring to FIG. 4, another modification is illustrated wherein the tip 80 is received within a casing 81 and brazed to form a fluid tight assembly. The casing 81 is received within the holder 82 and brazed at 83 to unitize the holder with casing 81 and tip 80.



The holder 82 threadedly receives a connector 84 and is retained in this position by the washers 85, 88, and lock nut 86. The connector 84 extends upwardly within the cap 87. The adjusting screw 89 may be removed by using a suitable wrench in the socket 90. The adjusting screw is locked in position by the lock nut 91 when properly adjusted. The lower portion of the adjusting screw 89 is formed with a head 92 which engages an adjusting spring 93. The adjusting spring 93 is compressed between the head 92 and the spring retainer 94 on the upper end of the spindle 95. Passage 96 is a leakoff passage for fluid leakage during the operation of the injection nozzle.

A spindle 95 extends downwardly and engages the stem end of the needle 97. A spring 98 is received within the mating helical grooves on the external periphery of the stem and of needle 97 and the lower end of the spindle 95. The spring 98 merely provides a means for extracting the needle 97 for disassembly of the unit.

The supply passage 100 feeds into the annular recess 101 within the holder 82. A filter sleeve 102 is positioned radially intermediate the casing 81 and the bushing 103. The bushing 103 is formed with an enlarged opening to receive the spring 98.

The lower portion and reduced diameter portion of bushing 103 is lapped to form a mating surface for the needle 97 to form a fluid tight seal between the chamber 108 and chamber 109. The bushing 103 is received within the filter sleeve 102. The filter sleeve 102 may be constructed in a manner as shown in FIG. 5, 6 or 7. FIGS. 8, 9 and 10 show a means of construction this sleeve out of a piece of sheet metal. The construction may be any manner such as a stamping which is stamped and rolled onto a spindle to form a sleeve construction as illustrated in FIGS. 5, 6 and 7.

Essentially, the sleeves as formed define inlet slots 111 extending downwardly from the angular recess 101 but do not extend for the full length of the sleeve 102. Similarly, slots 112 extend upwardly from the lower end of the sleeve 102 but do not extend the full length of the sleeve. Communication between the inlet slot 111 and the outlet slot 112 is provided by permitting the sleeve 102 to fit with the desired clearance over a portion of its length so that passage is provided between the two sets of slots whereby the pressurized fluid passes in its movement from the inlet passage 100 to the discharge orifices 113.

Referring to FIGS. 5 and 8, the sheet metal element 114 is cut with slots 111 and 112 and is rolled on a spindle to form the sleeve 114 as shown in FIG. 5. This formation of a sleeve 114 is then assembled within the casing 81 about the periphery of the bushing 103.

FIGS. 6 and 9 illustrate a modification wherein tapered slots 118 and 119 are formed on an element 120. Only a single inlet slot 119 and a single outlet slot 118 are shown but any number may be formed.

FIGS. 7 and 10 illustrate a modification whereby outlet slots 121 are formed in a sheet metal element 122 and also inlet slots 123 are formed in the element 122. The slots 121 do not extend the total length of the sheet metal element 122. The sheet metal element 122 is then rolled onto a spindle to form a sleeve as indicated in FIG. 7.

The preferred embodiments of this invention have been described in the preceding paragraphs. Their operation is generally similar and will be described in the following paragraphs.

Referring to FIG. 1, the differential valve 35 operates within the nozzle end of the nozzle assembly. Its closing pressure is regulated by the downward thrust of spring 17 which in turn is controlled by the axial adjusting of the adjusting screw 11. By increasing the thrust of spring 17 the thrust on the needle 21 increases the opening pressure required on the needle valve. The hydraulic fluid entering passage **36** passes downwardly into the chamber **25** and acts upon the conical portion **38** of the needle **21** to bias the needle valve to an open position against the force of spring **17**. The alignment of the needle **21** on seat **23** is assured during manufacture and is not dependent upon the aligned movement of the spindle **19**. The bushing **27** and filter sleeve **30** maintain axial alignment of the needle **21**. The portion **28** of the needle **21** is lapped to form a fluid tight seal and an accurate guide for reciprocal movement of the needle **21**. The conical portion **22** of needle **21** is thus maintained in concentric alignment with the conical seat **23** in the tip **1**.

The diameter of the assembly is of a small dimension and requires only enough cross sectional area to permit passage of high pressure fluid from inlet passage at **36** to the chamber **24**. The construction is unitized to provide rigidity and maintain alignment of the moving elements within the assembly. The adjusting means in the remote end of the nozzle assembly controls the opening pressure of the valve. The thrust responsive to the compression force of spring **17** is transmitted through the spindle **19** and the spindle's movement need not be accurately aligned because the needle valve movement is accurately controlled by a lapped and guided portion.

An edge filter is formed by the sleeve **30** in the assembly which is located with its lower portion adjacent the needle valve **35**. This eliminates any possibility of burrs, filings, etc., from contaminating the nozzle tip and preventing reliable operation.

As high pressure fluid enters passage **36**, it surrounds the sleeve **30** in the annular recess **37** and moves downwardly through the grooves. The fluid then passes across the lands between the grooves **32** and **33** and down grooves **33** to chamber **25**.

The passage of fluid from grooves **32** to **33** provides an edge filter filtering out any burrs, filings or impurities of a larger size than the clearance between sleeve **30** and the casing **2**. The high pressure fluid in the chamber **25** operates against the conical section **38** of the needle **21** biasing the needle valve **21** to an open position permitting discharge of high pressure fluid through the discharge orifices **157** into the combustion chamber. When the pressure of the inlet passage **36** is reduced to a predetermined level, the thrust of spring **17** is sufficient to overcome the force of the fluid acting against the conical sections **38** and **22** on the needle **21** thereby forcing the differential valve to a closed position and injection is terminated.

FIGS. 3 and 4 illustrate similar nozzle assemblies which operate in substantially the same manner. The edge filters as shown in FIGS. 3 and 4 are of a different construction. Basically the difference is that the peripheral facing on the filter sleeve is not formed with axial grooves but in contrast is formed with axial slots and a second sleeve is received within this filtering element. Essentially its operation is the same and it operates to filter fluid before it is permitted to pass into the differential valves or be discharged from the discharge orifices.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

**1.** A fuel injection nozzle comprising a housing, a differential valve operating in response to the hydraulic pressure within the housing, a valve opening pressure regulating means in said housing remote from said differential valve for producing a valve closing force, spindle means transmitting the force from said regulating means to said differential valve to bias said valve to a normally closed position, means defining fuel supply passage means for supplying pressurized fuel to said housing, a fuel filter means intermediate said supply passage means and said differential valve including a



bushing extending axially within said housing aligning said differential valve, a filter sleeve receiving said bushing and having a portion loose fitting with a portion of said housing, said filter sleeve defining inlet slots extending a lesser dimension downwardly from the upper end of said filter sleeve than the length of said filter sleeve and defining outlet slots angularly spaced relative to said inlet slots extending upwardly a lesser dimension than the length of said filter sleeve, filtering passages defined by the clearance between said housing and the external periphery of said filter sleeve to thereby control the filtering of fuel from the inlet passage means to said nozzle.

**2.** A fuel injection nozzle as set forth in claim **1** wherein said differential valve includes a needle, said bushing aligns said needle of said valve, said pressure regulating means includes a spring received within said housing, an adjusting screw controlling the compression of said spring, said spindle means defines a spindle extending a substantial distance through said housing and engaging said valve for transmitting the compressive force of said spring to said differential valve to control the opening pressure of said differential valve.

**3.** A fuel injection nozzle as set forth in claim **1** wherein said valve includes a short differential valve needle, a long spindle extends axially within said housing from said regulating means and engages said differential valve needle, said bushing aligning said needle to thereby control the alignment of said differential valve.

**4.** A fuel injection nozzle as set forth in claim **1** wherein said differential valve includes a needle having a lapped portion received within said bushing, said bushing and said filter sleeve defining a tight fit surrounding said needle, said filter sleeve and said housing defining a tight fit surrounding said needle to assure positive closing of the differential valve regardless of the concentricity and axial movement of the spindle means.

**5.** A fuel injection nozzle as set forth in claim **1** wherein said filter sleeve includes portions tightly fitted with said housing axially above and below said supply passage means, a needle of said valve having a lapped portion received in said bushing, said bushing within said filter sleeve defining a tight fit to thereby provide sealing of said nozzle and concentrically maintaining alignment of said differential valve.

**6.** A fuel injection nozzle as set forth in claim **1** wherein said differential valve includes a needle, a lapped portion about the external periphery of said needle, said bushing having a lapped internal portion mating the lapped portion of said needle to provide a fluid seal, a base sleeve tightly receiving said bushing, said filter sleeve fitted with a loose fitting with said housing for a portion of said filter sleeve and a tightly fitted portion surrounding said needle, said filter sleeve including an element wrapped in a peripheral manner about said base sleeve to form the clearance between said filter sleeve and housing to thereby control the filtering action of said filter means.


**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 1,633,320 | 6/1927 | Franchetti | 239—86 |
| 1,990,875 | 2/1935 | Mock | 239—86 |
| 2,067,131 | 1/1937 | Schlaupitz | 239—86 |
| 3,342,422 | 9/1967 | Millington et al. | 239—533 |



M. HENSON WOOD, Jr., Primary Examiner

M. Y. MAR, Assistant Examiner

U.S. Cl. X.R.

138—43; 210—488; 239—453, 590.5