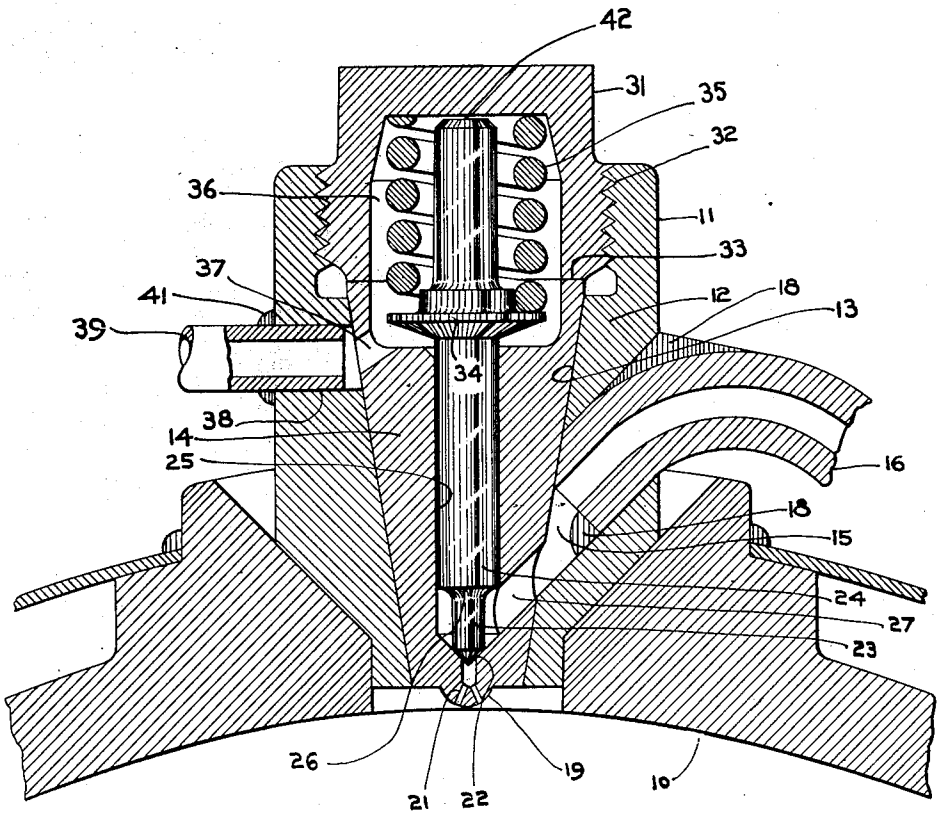
Dec. 1, 1931. H. T. HERR 1,834,058

INJECTION NOZZLE

Filed Nov. 16, 1928



WITNESSES:
E. Lutz.

INVENTOR
H.T. Herr.
BY A. B. Reavis
ATTORNEY

Patented Dec. 1, 1931 1,834,058

UNITED STATES PATENT OFFICE

HERBERT T. HERR, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

INJECTION NOZZLE

Application filed November 16, 1928. Serial No. 319,983.

My invention relates to injection nozzles, particularly to nozzles for injecting fuel into the cylinders of internal combustion engines and more particularly to nozzles which are especially suitable for use with fuel injection systems of the solid type, that is, systems wherein the fuel is injected into the engine cylinder by mechanical means, such as a plunger pump at a relatively high pressure and an extraordinarily rapid rate, and my invention has for an object to provide apparatus of the character designated which shall be small and compact in construction, composed of a minimum number of parts, and be capable of effecting thorough atomization and injection of fuel into the engine cylinder.

It has for still another object to provide a form of injection nozzle which shall be capable of periodically injecting the desired amount of fuel into the engine cylinder and which shall be capable, during the times intervening between such injection periods, of maintaining a fluid tight seal in order to prevent dribbling of fuel into the engine cylinder.

It has for still another object to provide a form of injection nozzle wherein all of the wearing parts such as, for example, the valve, valve seat and spray nozzle, may be readily removed from and replaced in the nozzle body without disturbing the fuel conduit or conduits connecting with the injection nozzle body.

It has for still another object to provide a form of construction for an injection nozzle which shall permit of ready removal of the valve and valve seat from the nozzle body and replacement of the same without affecting, to the slightest degree, the original and proper alignment of the valve with the valve seat.

It has for still another object to provide a form of construction for injection nozzles of the character heretofore designated wherein the parts subject to the most wear may be embodied in a separate removable element so that the material composing the same may be made relatively hard in comparison with the remaining portions of the nozzle in order that the life of the nozzle may be prolonged and in order that the parts subject to wear may be replaced without requiring replacement of the entire nozzle.

It has for still another object to provide a form of injection nozzle wherein the valve or movable portion may be entirely confined within the nozzle housing in order to dispense with the requirements for a stuffing box and it has for a further object to provide a very effective form of seal for minimizing leakage of fuel from the injection nozzle as well as to provide in the nozzle adequate facilities for conserving any fuel leakage which may take place.

It has for still another object to provide an injection nozzle of such form and construction that it can be rapidly and inexpensively manufactured.

These and other objects are effected by my invention, as will be apparent from the following description and claims taken in connection with the accompanying drawing, forming a part of this application, in which the single figure is a view, in sectional elevation, of one form of injection nozzle arranged in accordance with my invention.

In my copending application, serially numbered 306,244, filed Sept. 15, 1928 entitled "Injection nozzle" and assigned to the Westinghouse Electric & Manufacturing Company, I disclose and claim a form of injection nozzle wherein the valve seat as well as the guide walls for the valve stem, rather than being located in separate nozzle parts, are both embodied directly in the valve body, which is a single, unitary element. By means of such an arrangement, the valve may be readily removed from the nozzle body and replaced therein without disturbing its proper and original alignment with the valve seat, the reason being that the guide for the valve stem and the seat for the valve are both embodied in a single, unitary piece and hence it is impossible to disturb their alignment. In addition, the valve and its guide cooperate directly with the nozzle body, all intervening parts together with the necessary fitting clearances being eliminated. As a consequence, such a form of injection nozzle remains fluid-tight because the valve, no mat-

ter how often it is removed from the nozzle body and thence replaced therein, always resumes its original and proper alignment with its seat. Consequently, dribbling of fuel into the engine cylinder, even though the engine be operated for extended periods of time and the injection valve be removed and replaced in the nozzle body many times during such operating periods, is effectively prevented.

I have now conceived of another form of injection nozzle which is similar to that disclosed in my aforesaid copending application in that it embodies all of the advantageous features thereof but which possesses additional advantages. In accordance with my present invention, I divide the nozzle body into two interfitting portions, one of which is made of relatively hardened material and embodies all of those surfaces which are subject to wear such as, for example, the valve seat, nozzle passages, valve stem guide etc., and the other portion of which is secured to the cylinder and connects with the fuel piping and is preferably not hardened. It will be apparent that such an arrangement possesses numerous advantages in that the portion embodying the wearing surfaces, being relatively hard, possesses an exceptionally long life. In addition, should it eventually become necessary to replace the nozzle, only the portion embodying the wearing surfaces must be renewed, as the remaining or other portion of the nozzle body which is not subject to wear may be continued in use. Furthermore, as it is generally the practice to secure the fuel conduits to the nozzle body by some heating process such as, for example, welding, the securing process may be accomplished before the assembly of the two body portions together so that the welding process cannot affect the hardening. In addition, by making one portion of the nozzle body relatively harder than the other, the two, when retained in abutting relation, more readily effect an absolute fluid-tight joint.

Referring now to the drawing, for a detail description of my invention, I show an internal combustion engine cylinder 10 provided with an injection nozzle having a body 11. The body 11 includes an outer member 12 provided with a frusto-conical bore 13 having fitted therein an inner body or plug member 14.

The outer body member 12 is provided with a fuel inlet 15 having communicating therewith a fuel conduit 16 which is secured to the outer body member 12 in any improved manner, such as by welding or brazing at 18.

The inner body member 14 contains all of the surfaces which are subject to maximum wear and I therefore provide in the lower portion of the inner body member 14 a tip portion 19 having disposed therein a single or plurality of diverging, restricted passages 21 for injecting and atomizing fuel into the engine cylinder 10, in a manner wall understood in the art. The tip portion 19 is provided with a valve seat 22 having cooperating therewith a valve 23. The valve 23 has a stem portion 24 fitting a suitable bore 25 provided in the inner body member 14. It is also provided with a piston face 26, which communicates, through an angularly disposed passage 27, with the fuel inlet 15 and conduit 16. The piston face 26 is so disposed relative to the passage 27 that the inlet pressure is effective to lift the valve 23 from its seat 22.

The outer end portion of the body 12 is provided with a fluid-tight cap 31 preferably secured thereto by threads 32 and making a fluid-tight joint with the inner body member 14 by means of the annular joint 33 which is preferably lapped or so treated as to insure a perfect metal-to-metal joint and fluid-tightness. The cap 31 also serves to secure the inner body member 14 in the bore 13 of the outer body member 12 and to effect a fluid-tight joint between the two body members.

The valve stem 24 is provided with a shoulder portion 34; and, interposed between the shoulder portion 34 and the cap 31, is a compression spring 35 for biasing the valve 23 to a closed position. The cap 31 defines with the inner body portion 14 a fuel leak-off chamber 36 for receiving any fuel which may escape between the bore 25 of the inner body member 14 and the stem portion 24 of the valve 23. In order that the fuel accumulating in the leak-off chamber 36 may not interfere with the freedom of the movement of the valve 23, a suitable outlet 37 is provided in the inner body member 14 which communicates, through a passage 38, with a leak-off conduit 39 secured to the outer body member 12 in any approved manner, such as by welding or brazing at 41. The upper end 42 of the valve stem 24 is so formed in relation to the cap 31 that the latter acts to limit the upward movement of the valve, as illustrated in the drawing, so that quick closing of the valve is assured once the fuel pressure in the inlet 15 drops.

From the foregoing description, the operation of my injection nozzle will be apparent. Fuel is periodically supplied at a relatively high pressure to the inlet 15, whereupon the pressure of the fuel acts upon the piston face 26 to lift the valve 23 from its seat 22. The relatively high pressure fuel is thus permitted to pass through the passages 21 and is atomized or injected into the engine cylinder in a manner well understood in the art. The arrangement is such that the upper portion 42 of the valve abuts against the cap 31 and thus the upward or opening movement of the valve is limited to that required for proper fuel injection. As a result, a rapid closing action of the valve is assured. Upon the pressure in the inlet 15 dropping, the spring 35 exerts sufficient force to return the valve

23 to its seat 22 and prevents the further passage or dribbling of any fuel into the engine cylinder. In other words, the valve 23 opens momentarily in response to fuel pressure to permit periodic injection of fuel into the engine cylinder and thereafter, during the remainder of the engine cycle, effects a fluid-tight seal in order to prevent leakage or dribbling of any fuel remaining in the nozzle body or the connection pipe lines.

Preferably, the inner body portion 14 is hardened by some process, such as heat treating, so that the material thereof is relatively very hard compared with the material of the outer body portion 12 which may not be subjected to any heat treating process. Inasmuch as the inner body portion 14 embodies most of the wearing surfaces, such as the atomizing passages 21, the valve seat 22 and the valve stem guide 25, it will be apparent that it will be very durable and remain serviceable for a very long period of time. In this way, the service and life of the entire injection nozzle is very materially prolonged. It will be further apparent that, should the nozzle ultimately become defective due to excessive wear, it is not necessary to renew the outer body portion 12 because, owing to the fact that none of its parts are subject to wear, this may be retained in use. This is advantageous because the fuel conduits 16 and 39, which generally are fixedly connected thereto, need not be broken or disconnected. Furthermore, as the manufacturing cost of the outer body portion 12 is generally more than that of the inner body portion 14, maintenance costs are materially lessened.

By dividing the body portion into inner and outer members, as illustrated, additional advantages are provided in that the fuel conduits 16 and 39 may be welded to the outer body member 12 while the inner body member 14, valve 23 etc. are removed therefrom so that the application of heat incident to the welding processes cannot affect or alter the hardened condition of the inner body member. Furthermore, as the outer and inner body members are of relatively different degrees of hardness, a fluid-tight joint at 13 is assured.

In addition to the foregoing advantages, this form of injection nozzle also possesses the advantages present in the injection nozzle disclosed in my aforesaid application in that the bore or guide 25 for the valve stem as well as the valve seat 22 are both embodied in a single, unitary part of my injection nozzle so that, although the valve 23 be frequently removed from the nozzle body, nevertheless, upon being replaced therein, it will effect a fluid-tight seal with the valve seat 22 because disassembly cannot disturb the relative alignment of the valve seat 22 and the bore or guide 25. It will be further apparent that leakage of the high pressure fuel entering the nozzle body through the inlet 15 is greatly restricted because of the absence of numerous interfitting parts, there being only one possible means of egress, which is between the valve stem 24 and the bore or guide wall 25. However, this leakage is greatly restricted because of the very accurate fitting of the valve stem in the bore 25 and because of the sealing action created by the opening and closing movements of the valve. Any fuel which may escape between the valve stem 24 and the guide 25 is received in the leak-off chamber 36 and is readily drained therefrom through the outlet conduit 39 so that freedom of movement of the valve 23 is not retarded or interfered with in any way.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In a fuel injection device for an internal combustion engine, the combination of complementary first and second parts, said second part comprising a tapered unitary, hardened, metallic element, means for retaining said first and second parts in fluid-tight engagement and defining with the second part a fuel leak-off chamber, said second part having a valve guide bore communicating with said chamber; a valve seat provided in the second part and located at the end of the bore remote from said chamber; atomizing means carried by the second part and arranged at the discharged side of said seat; a supply passage provided in the first and second parts and communicating with the bore adjacent to the seat; a valve having a stem closely fitting said guide bore and provided with a reduced portion terminating in a valve for cooperating with said seat; and a spring in said leak-off chamber and held under compression between said closure and the stem to urge the valve towards said seat.

2. In a fuel injection device for an internal combustion engine, the combination of a body having a bore extending axially therethrough and tapered for a considerable portion of its length, a removable, one-piece, tapered plug fitting the bore of the body and provided with an axially extending bore, a removable, one-piece, closure member secured to the body and forming with the plug a fluid-tight, fuel leak-off chamber, said closure member being arranged to retain the plug in fluid-tight engagement with the tapered bore of the body, fuel inlet means ex-

tending through the body and through the plug and terminating in the bore of the plug adjacent the small end of the plug, atomizing means provided in the small end of the plug, a valve seat embodied in the plug between the fuel inlet means and the atomizing means, a valve cooperating with the valve seat in the plug and having a diametral portion extending throughout the greater portion of the length of the plug and directly and slidably engaging the bore of the plug so as to retain the valve in accurate axial alignment with the valve seat, a piston provided on the valve and effective to move the valve from the valve seat in response to fuel inlet pressure, a spring disposed in the leak-off chamber between the valve and the closure member for biasing the valve toward the valve seat, and fuel outlet means connecting with the fuel leak-off chamber.

In testimony whereof, I have hereunto subscribed my name this 7th day of November, 1928.

HERBERT T. HERR.