United States Patent

Sample, Jr.

[15] **3,662,959**

[45] **May 16, 1972**

[54] **FUEL INJECTION NOZZLE**

[72] Inventor: **Harry Sample, Jr.,** Novelty, Ohio

[73] Assignee: **Parker-Hannifin Corporation,** Cleveland, Ohio

[22] Filed: **Aug. 7, 1970**

[21] Appl. No.: **61,969**

[52] **U.S. Cl.** **239/533**

[51] **Int. Cl.** **B05b 1/30**

[58] **Field of Search** 137/469, 541; 239/533, 401; 60/39.74

[56] **References Cited**

UNITED STATES PATENTS

2,959,360	11/1960	Nichols	239/533
2,592,111	4/1952	Bischof	239/533
3,029,029	4/1962	Webster	239/404
3,131,866	5/1964	Cummins et al.	239/533
3,154,095	10/1964	Cleminshaw et al.	239/410 X
3,379,374	4/1968	Mekkes	239/533 X
3,387,790	6/1968	De Luca	239/533 X

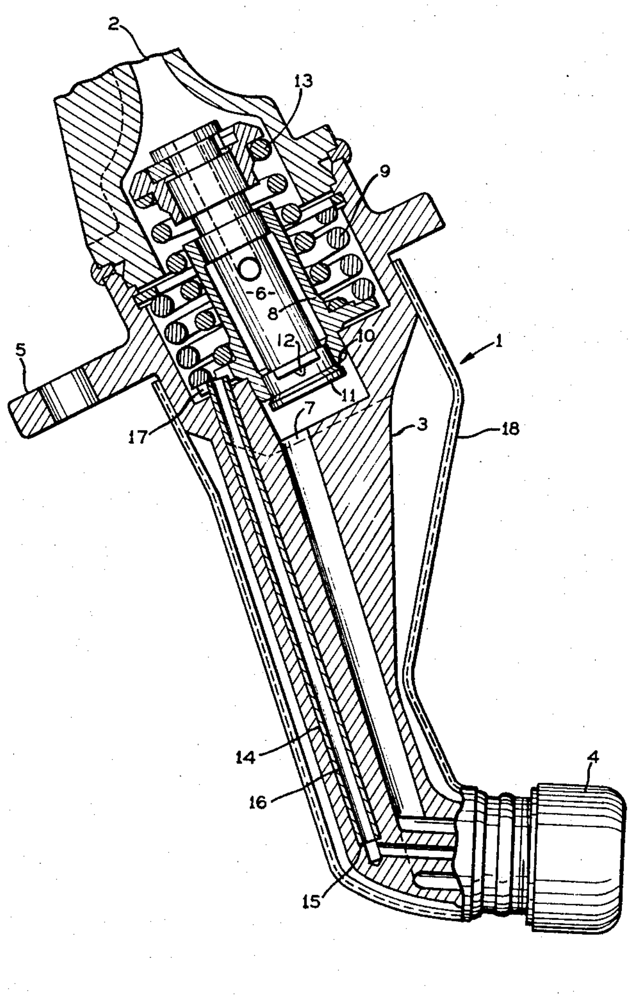
Primary Examiner—Lloyd L. King

Attorney—Oberlin, Maky, Donnelly & Renner

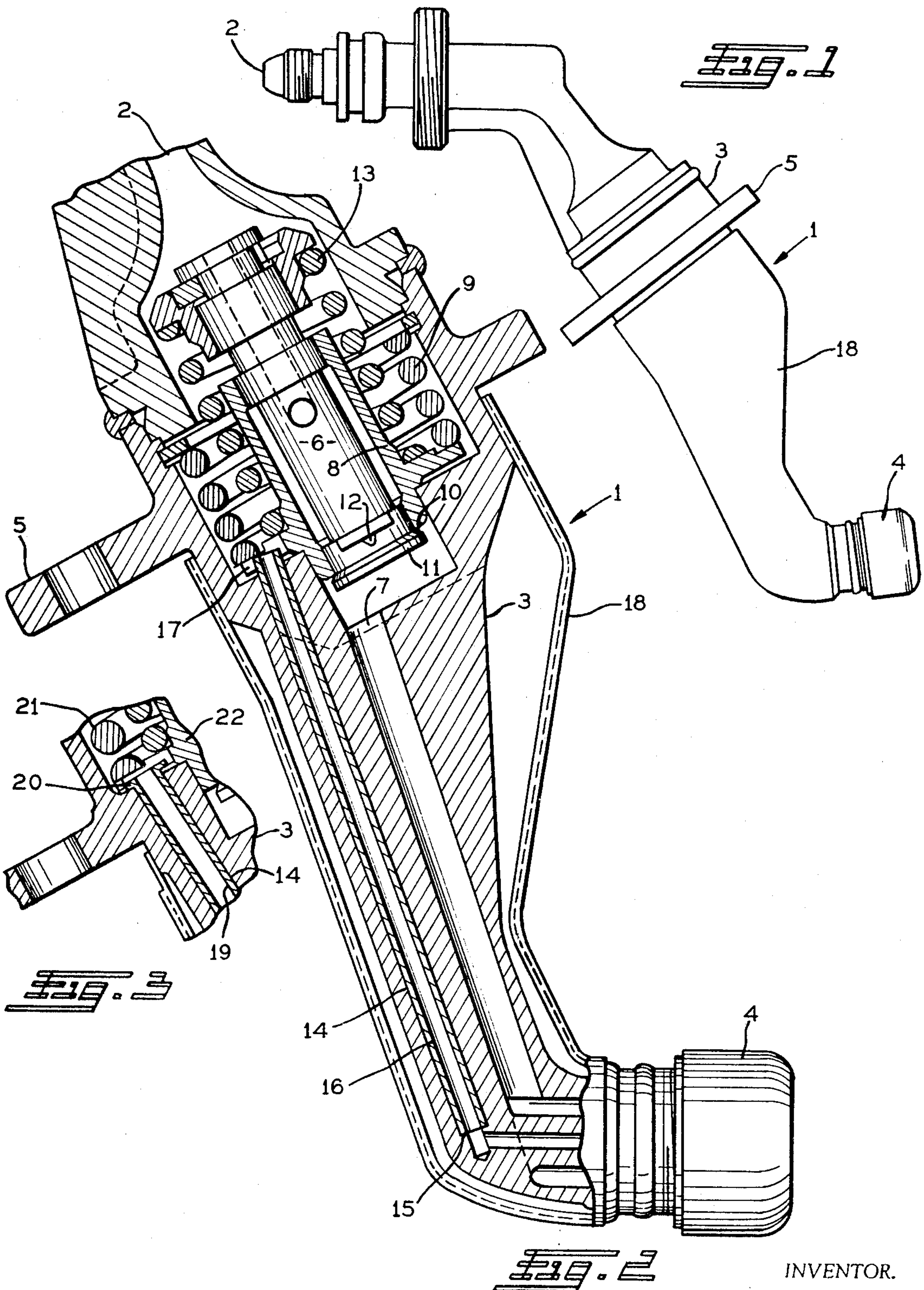
[57] **ABSTRACT**

A fuel injection nozzle of the dual orifice type characterized in that the elongated primary fuel passage in the nozzle housing is constituted by a length of tube which is thermally isolated from the housing whereby the flow of fuel through the tube maintains the interior wall thereof at a temperature below that at which carbonizing of the fuel would occur.

5 Claims, 3 Drawing Figures



Patented May 16, 1972 3,662,959



INVENTOR.
HARRY SAMPLE, JR

BY

Oberlin, Maky, Donnelly & Renner
ATTORNEYS

FUEL INJECTION NOZZLE

BACKGROUND OF THE INVENTION

Dual orifice fuel injection nozzles for gas turbines and the like generally comprise an elongated housing having a fuel inlet port and flow divider at one end and a spray nozzle at the other end, said one end being flanged for mounting as on the wall of the combustion chamber. Between the fuel inlet port and flow divider and the spray nozzle the housing is provided with elongated primary and secondary passages which respectively communicate with the fuel inlet port upstream and downstream of the flow divider and lead to the primary and secondary discharge orifices of the nozzle. As shown, for example, in the U.S. Pat. to Cleminshaw et al. No. 3,154,095, granted Oct. 27, 1964, the intermediate portion of the housing is defined by elongated primary and secondary tubes which extend alongside each other and which are brazed at their ends to the flow divider body and to the nozzle body. Furthermore, in some cases as shown for example in the U.S. Pats. to Webster et al. No. 3,013,732, granted Dec. 19, 1961, and Moebius et al. No. 3,159,971, granted Dec. 8, 1964, there may be a heat shield around the aforementioned primary and secondary tubes. In another known construction (Webster U.S Pat. No. 3,029,029, granted Apr. 10, 1962), the nozzle housing is of unitary form, a forging for example, in which the elongated secondary passage is in the form of a drilled hole, and the primary passage is the bore of a primary tube which extends in spaced relation through the secondary passage and which has its ends brazed in place to communicate with a fuel inlet port which is upstream of the secondary flow control valve and with the primary discharge orifice.

In the known constructions wherein the primary and secondary tubes are exposed, the interior wall of the primary tube may become overheated owing to the limited cooling rate of the low primary flow rate thus to permit carbonizing of the fuel with consequent flaking or breaking off of such carbon deposits and resultant plugging of the primary discharge orifice and/or the primary swirl passages. Even when a heat shield is disposed around the primary and secondary tubes, as aforesaid, the air space around said tubes may become highly heated so that the low primary fuel flow rate may not be able to maintain the wall of the primary passage below fuel carbonizing temperature. Moreover, the tubes are in good heat conducting relation with the nozzle housing where their ends are brazed in place.

From an operational standpoint, the nozzle of U.S. Pat. No. 3,029,029 may be satisfactory insofar as maintaining the temperature of the wall of the passage in the primary tube at less than fuel carbonizing temperature because of the cooling effect of the secondary fuel flow therearound, and the cooling effect of the primary fuel flow through the primary tube. However, the location and shape of the primary tube entails difficult and expensive assembly operations in view of the angular construction of the nozzle end of the housing with insertion thereinto, prior to brazing of the primary tube, of a nozzle insert containing both the primary and secondary passages whereby brazing of that end of the primary tube to the insert is difficult, and moreover, the other end of the primary tube is bent to fit into an angular passage in the housing.

SUMMARY OF THE INVENTION

Contrary to the foregoing, the elongated primary passage in the nozzle housing is in the form of a straight tube which loosely fits in a drilled hole in the housing without any brazed or like connections which would form good heat transfer points between the housing and the primary tube, whereby the flow of fuel through the primary passage from the fuel inlet port to the primary orifice has sufficient cooling effect on the interior wall of the primary tube which is thermally insulated from the housing. This prevents overheating of the wall of the primary tube to the point where carbonizing of the fuel would occur.

Other objects and advantages of the present invention will appear hereinafter.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevation view of a dual orifice fuel injection nozzle embodying the present invention;

FIG. 2 is an enlarged fragmentary cross-section view showing the elongated primary tube which is thermally insulated from the nozzle housing; and

FIG. 3 is a fragmentary cross-section view similar to FIG. 2 except illustrating a modification in the primary tube.

DETAILED DESCRIPTION OF THE INVENTION

The fuel injection nozzle herein comprises a housing and nozzle assembly **1** having a fuel inlet port **2** at one end of the housing **3**, a dual orifice injection nozzle **4** at the other end, and a mounting flange **5** between the ends for mounting the assembly **1** as on the wall of a combustion chamber of a gas turbine or the like.

In the intermediate portion of the housing **3** adjacent the flange **5** is a flow divider or variable area valve **6** which controls the flow of fuel from the fuel inlet port **2** to the secondary discharge orifice (not shown) of the nozzle **4** via the elongated secondary passage **7** downstream of the flow divider **6**.

As herein shown, the flow divider **6** comprises a sleeve **8** which is held in place by the hold-down spring **9** and which provides a seat **10** for the spring biased valve spool **11**, the valve spool **11** having one or more metering slots **12** to control the flow of secondary fuel to the nozzle **4** as the valve spool **11** is urged downwardly by fuel pressure overcoming the bias of the spring **13** acting on the valve spool **11**.

Alongside the aforesaid secondary fuel passage **7**, the housing **3** is provided with an elongated drilled hole **14** which, adjacent its lower end, has a stop shoulder **15**. Disposed in said hole **14** is a metallic primary tube **16** which is, for example, of 0.001 to 0.006 inch smaller diameter than the diameter of the drilled hole **14**, the lower end of the tube **16** being engaged with the shoulder **15** and the upper end of the tube **16** extending up into a slot **17** in the flange of the flow divider sleeve **8**. The lower end of the hold-down spring **9** radially overlaps the upper end of the tube **16** to limit axial movement of the latter. The upper open end of the tube **16** communicates with the fuel inlet port **2** upstream of the flow divider **6** so that the nozzle **4** will be supplied with primary fuel through the tube **16** whether the flow divider **6** is in closed or open position.

Surrounding the housing **3** is a heat shield **18** to form an air space to decrease heat transmission from the combustion chamber to the housing **3**.

In a typical dual orifice nozzle **4** with an inlet pressure of say, 400 psi, the flow of fuel through the primary orifice (not shown) may only be 100 lbs./hr. whereas the flow of fuel through the secondary orifice may be 600 lbs./hr. Accordingly, generally no problem of carbonizing of fuel on the wall of the elongated secondary passage **7** is encountered in view of the relatively great cooling capacity of the secondary flow. However, because the primary flow is of such low magnitude, the wall of the elongated passage **14** is apt to reach a temperature, of say, 600° F., which would cause carbonizing of the fuel on the wall with consequent flaking or breaking off of the carbon deposits with consequent danger of plugging of the primary discharge orifice.

In the present case, the primary flow is through the elongated metallic tube **16** which is insulated from the housing passage **16** by reason of the loose fit of the tube **16** in the drilled hole **14** in the housing **3**. There is no region of good heat transfer contact between the tube **16** and housing **3** whereby, even through the primary flow rate is of low magnitude, it will nevertheless be sufficient to cool the primary tube **16** to maintain its interior wall temperature less than that which will cause carbonizing of the fuel.

In the modification illustrated in FIG. **3**, instead of the stop shoulder **15** in the drilled hole **14** of the housing **3** shown in FIG. **2**, the primary insulating tube **19** has a flared or flanged upper end **20**, the hold-down spring **21** for the flow divider sleeve **22** radially overlapping the upper end **20** of said tube **19** to prevent axial displacement thereof.

In summary, it can be seen that the primary tube **16** or **19** is loosely disposed in a bore **14** in the housing **3** so that it is thermally isolated from the housing **3**. Furthermore, it is preferred that the upper end of the primary tube **16** or **19** be axially spaced from the hold-down spring **9** or **21** to avoid firm contact of the lower end of tube **16** with the stop shoulder **15** or of the flange **20** of tube **19** with the housing **3**. In the example herein, (tube **16** or **19** of 0.001 to 0.006 in. diameter smaller than bore **16**) the tube **16** or **19** is effectively thermally insulated from the housing **3** and substantially the entire primary fuel flow contacts the interior wall of the tube **16** or **19** to cool it below fuel carbonizing temperature.

I, therefore, particularly point out and distinctly claim as my invention;

1. In a dual orifice fuel injection nozzle assembly wherein an elongated housing has primary and secondary fuel supply passages therein leading to the respective primary and secondary discharge orifices of a dual orifice nozzle at one end of said housing operative to spray fuel into the combustion chamber of a gas turbine or the like, the improvement which comprises an elongated open ended metallic tube loosely disposed in a bore in said housing and constituting a substantial portion of the length of the primary fuel supply passage; said tube being thus thermally isolated from said housing whereby primary fuel flowing through said tube cools the interior wall thereof to prevent carbonizing of the fuel flowing in contact therewith.

2. The fuel injection nozzle assembly of claim **1**, wherein said housing has a flow divider therein for flow of fuel therethrough into said secondary fuel supply passage.

3. The fuel injection nozzle assembly of claim **1**, wherein said housing has means radially overlapping one end of said tube to limit axial movement thereof in said bore.

4. The fuel injection nozzle assembly of claim **3**, wherein said bore has a stop shoulder adjacent the other end of said tube.

5. The fuel injection nozzle assembly of claim **3**, wherein said one end of said tube, adjacent to the end of said bore, is enlarged to a diameter greater than that of said bore.

* * * * *