(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 128 805**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **84401086.8**

(22) Date of filing: **28.05.84**

(51) Int. Cl.³: **F 23 D 11/10**

(30) Priority: **03.06.83 US 500897**

(43) Date of publication of application: **19.12.84**
Bulletin 84/51

(84) Designated Contracting States: **DE FR GB IT NL**

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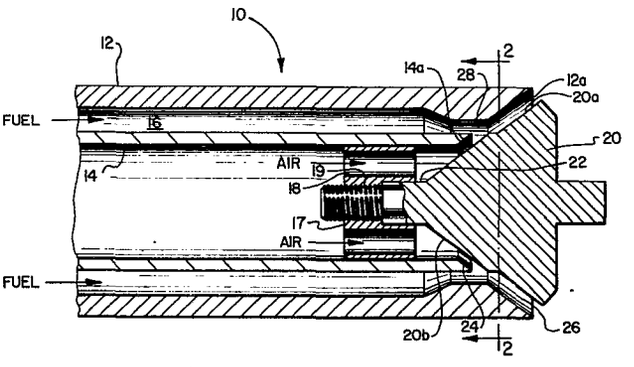
(54) Twin fluid atomizer.

(57) An atomizer for mixing a compressible fluid such as air or steam with a liquid fuel to atomize the latter, in which a pair of tubular members are disposed in a concentrically-spaced relationship with the compressible fluid being introduced to the inner-tubular member and the liquid fuel being introduced in the annular space between the two members. A mixing chamber is provided for receiving the fuel and the fluid, and is in communication with a continuous annular discharge passage for discharging the atomized fuel.



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TWIN FLUID ATOMIZER

BACKGROUND OF THE INVENTION

This invention relates to an atomizer, and more particularly, to an atomizer for mixing a compressible fluid with a liquid fuel to atomize the latter before it is discharged into the furnace section of a boiler or the like, for combustion. The burners associated with most industrial boilers utilize some type of twin fluid atomizer which functions by utilizing the stored energy in a compressible fluid, such as air or steam, to achieve the atomization. In most twin fluid atomizers in use today, a liquid fuel, such as a fuel oil, is injected into a mixing chamber through slots in a distributor plug or the like. High pressure air or steam is passed down a central tube and through a set of orifices in the distributor plug into the mixing chamber and impinges on the atomizing fluid. The emulsion formed in the mixing chamber is then accelerated out of the atomizer through a plurality of exit orifices formed through an orifice plate. A problem exists in these type of atomizers since the orifice plate and, more particularly, the orifice walls, even when manufactured from hardened tool steel, wear rather rapidly when firing dirty fuels and especially slurry fuels such as coal-oil or coal-water mixtures. To minimize this rate of wear, it was suggested to operate the atomizer with as low a pressure and exit velocity as possible. However, this tends to compromise the overall performance of the atomizer. Another suggested solution to minimize this wear is to fabricate the orifice plate of extremely hard materials or, alternatively, apply a surface hardening

technique to the wall portions defining the orifices. However, in view of the relatively small inner diameters involved, it is difficult to precision drill the relatively hard material or surface harden the orifice walls. This, of course, considerably adds to the expense of the atomizer and is, in some cases, economically unfeasible.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an atomizer which can handle relatively dirty fuel such as coal-water mixtures, and yet enjoys an extended life span.

It is a further object of the present to provide an atomizer of the above type which eliminates the need for precision drilling or surface hardening of the discharge orifices and yet is immune to undue wear by the dirty fuel.

Toward the fulfillment of these and other objects, the atomizer of the present invention includes a pair of tubular members disposed in a concentrically-spaced relationship to define an annular passage therebetween for receiving a liquid fuel. A compressible fluid, such as steam or air, is introduced into the inner tubular member. A mixing chamber is provided for receiving the fuel and the fluid, and is in communication with a continuous annular orifice for discharging the atomized fuel.

BRIEF DESCRIPTION OF THE DRAWINGS

The above brief description as well as further objects, features and advantages of the present invention will be more fully appreciated by reference to the following detailed description of presently preferred but nonetheless illustrative embodiments in accordance with the present invention when taken in conjunction with the accompanying drawings wherein:

Figures 1 is a horizontal cross-sectional view depicting the atomizer of the present invention;

Figure 2 is a vertical cross-sectional view taken along the line 2-2 of Figure 1;

Figure 3 and 5 are views similar to Figure 1 but depicting alternate embodiments of the atomizer of the present invention; and

Figure 4 is a vertical cross-sectional view taken along line 4-4 of Figure 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The atomizer of the present invention is shown in general by the reference 10 in Figure 1 and includes an outer tubular member 12 having an inner tubular member 14 disposed therein in a concentrically spaced relationship to define an annular chamber 16 therebetween. It is understood that the outer tubular member 12 and the inner tubular member 14 can form the inner and outer barrels of a burner assembly, including a fuel gun, which introduces the liquid fuel to the passage 16, and an air source which introduces air to the inner tubular member 14.

The discharge end portion of the outer tubular member has an increased wall thickness to define a tapered discharge opening 12a. The corresponding discharge end portion of the inner

tubular member 14 extends axially inwardly from the opening 12a and is also tapered, as shown by the reference 14a. It is understood that the inner tubular member is mounted relative to the outer tubular member in any conventional manner such as by set screws (not shown), or the like.

A distributor plug 17 is disposed within the inner tubular member 14 in a slightly spaced relationship to the end portion 14a. Four angularly spaced through passages 18 and a threaded central bore 19 are formed through the distributor plug 17 for reasons that will be described later.

A discharge plug, shown in general by the reference 20, extends within the discharge ends 12a and 14a of the tubular members 12 and 14, respectively, and has a stem portion 22, the end portion of which is threaded and in engagement within the threaded bore 19 of the distributor plug 17.

The outer tapered wall portion of the discharge plug 20 is stepped as shown to form a first wall portion 20a which extends parallel with the tapered end portion 12a of the outer tubular member 12, and a second portion 20b which extends parallel with the tapered end portion 14a of the inner tubular member 14. Thus, an annular passage-discharge orifice 24 is defined between the end portion 14a of the inner tubular member 14 and the corresponding wall portion 20b of the discharge plug 20, while a second annular passage-discharge orifice 26 is defined between the end portion 12a of the outer tubular member 12 and the wall portion 20a of the discharge plug 20. A mixing chamber 28 is defined by the inner and outer tubular members 12 and 14, respectively, and the discharge plug 20, and is located just downstream from the passage-discharge orifice 24 and upstream from the passage-discharge orifice 26.

In operation, liquid fuel, such as oil or a mixture of coal and water, is introduced into the annular passage 16 and passes into the mixing chamber 28. A compressible fluid, such as air or steam, is introduced into the inner tubular member 14 and passes through the orifices 18 before passing through and exiting from the annular passage-discharge orifice 24 and into the mixing chamber 28, where it impinges upon, or shears, the fuel. The emulsion formed in the mixing chamber 28 is then accelerated out of the atomizer through the passage-discharge orifice 26 and the atomization is complete.

It can be appreciated that the tubular members 12 and 14, or at least their end portions 12a and 14a, along with the discharge plug 20 can be manufactured of a very hard material that will withstand the wear attendant with the use of dirty fuel such as coal-water mixtures, while eliminating the need for precision drilling or surface hardening of any orifices, or the like. Furthermore, the respective sizes of the passage-discharge orifices 24 and 26 can be selectively varied by simply adjusting the position of the discharge plug relative to the distributor plug 17.

Another alternate embodiment of the atomizer of the present invention is shown in general by the reference 30 in Figs. 3 and 4, and includes an outer tubular member 32 extending over, and in a concentric spaced relationship to, an inner tubular member 33 to define an annular passage 34. The inner tubular member extends over a distributor plug 36 and is secured thereto in any known manner. Four angularly-spaced through passages 38, along with a threaded central bore 39 are formed through the distributor plug 36. The distributor plug 36 includes an extended diameter, flanged portion 36a, which has eight circumferentially spaced

through passages 40 formed therethrough.

A discharge plug 41 is provided which has a conical portion 42 and a stem portion 43, the end portion of which is externally threaded for extending in the threaded bore 39 of the distributor plug 36.

A sprayer plate 44 is disposed in an abutting relationship with the front face of the flanged portion 36a of the distributor plug 36, and defines therewith a radial passage 46. The sprayer plate has a tapered wall portion 44a defining a discharge opening, and a central bore portion 44b both of which, together with the outer surface of the conical plug 40 define a continuous annular discharge passage 52.

The orifices 38 and the radial passage 46 communicate with a mixing chamber 54 defined by the distributor plug 36, the discharge plug 41 of the sprayer plate 44 and which, in turn, communicates with the discharge passage 52. A tip nut 56 is in threaded engagement with the outer tubular member 32, extends over the distributor plug 36 and the sprayer plate 44, and has a flanged portion 56a extending over a cooperating flange portion of the sprayer plate 44 to secure the components in the position shown.

In operation, fuel is introduced into the annular passage 34 where it passes through the passages 40, through the radial passage 46 and to the mixing chamber 54. Air introduced to the inner tubular member 33 passes through the passages 38 before entering the mixing chamber 54 where it impinges on, or shears, the fuel in the latter chamber forming an emulsion which is then accelerated out of the atomizer 30 via the discharge passage 52.

It will be apparent that the embodiment of Figure 3 enjoys the advantages of the embodiment of Figure 1, to wit, the

elimination of a plurality of individual, relatively small, orifices which are difficult to drill or surface harden, as described above.

Another alternate embodiment of the atomizer of the present invention is shown in general by the reference 60 in Fig. and includes an outer tubular member 62 extending over, and in a concentric spaced relationship to, an inner tubular member 64 to define an annular passage 66. The inner tubular member 64 extends over a distributor plug 68 and is secured thereto in any known manner. Four angularly-spaced through passages 70 (two of which are shown in the drawing), along with a threaded central bore 72, are formed through the distributor plug 68. The distributor plug 68 includes an extended diameter, flanged portion 74, which has a plurality of through passages 76 formed therethrough and registering with the annular passage 66. The passages 76 extend a a slight angle to the horizontal as viewed in Fig. 5 and, although only two are shown in the drawing, it is understood that a plurality, such as eight, are angularly spaced around the axis of the distributor plug 68.

A discharge plug 78 is provided which has a conical portion 80 and a stem portion 82, the end portion of which is externally threaded for extending in the threaded bore 72 of the distributor plug 68.

The flanged portion 74 of the distributor plug 68 has a stepped, tapered discharge end portion 84 which, together with the outer surfaces of the discharge plug 78 define a continuous annula discharge passage 86. A mixing chamber 88 is defined at the area where the passages 76 communicate with the discharge passage 86.

A tip nut 90 is in threaded engagement with the outer

tubular member 62, extends over the flanged portion 74 of the distributor plug 68, and has a flanged portion 90a abutting the front face of the latter flanged portion to secure the components in the position shown.

In operation, fuel is introduced into the annular passage 66 where it passes through the passages 76 and to the mixing chamber 88. Air introduced to the inner tubular member 64 passes through the passages 70 before entering the mixing chamber 88 where it impinges on, or shears, the fuel in the latter chamber, forming an emulsion which is then accelerated out of the atomizer 60 via the discharge passage 86.

It will be apparent that the embodiment of Fig. 5 is formed by relatively few components, enjoys the advantages of the embodiments of Figs. 1 and 3, to wit, the elimination of a plurality of individual, relatively small, orifices which are difficult to drill or surface harden, as described above.

Other modifications, changes and substitutions are intended in the foregoing disclosure and in some instances some features of the invention will be employed without a corresponding use of other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the spirit and scope of the invention therein.

WHAT IS CLAIMED IS:

1. An atomizer comprising an inner tubular member for receiving a compressible fluid, an outer tubular member extending in a concentrically spaced relation to said inner tubular member to define an annular passage between said members for receiving a liquid fuel, a plug member extending within the corresponding ends of said members and defining therewith a first continuous annular discharge orifice for the fluid exiting from said inner tubular member and a second continuous annular discharge orifice for the fuel exiting from said outer member, said end of said inner tubular member being located slightly inwardly from said end of said outer tubular member so that said fluid mixes with said fuel before discharging from said second discharge orifice.

2. The atomizer of claim 1 wherein said plug member has a conical shape and wherein said corresponding ends are tapered so as to extend substantially parallel to said member plug.

3. The atomizer of claim 2 wherein said plug member defines with each of said ends an annular passage, said fluid mixing with said fuel in the annular passage defined by said plug member and the end of said outer tubular member before discharging from said second discharge orifice.

4. The atomizer of claim 1 further comprises a distributor plug disposed in said inner tubular member and having a plurality of through passages for said fluid and a bore for receiving said plug member.

5. The atomizer of claim 1 wherein said bore is in threaded engagement with a corresponding portion of said plug member to movement of said plug member relative to said corresponding ends to permit the sizes of said discharge orifices

to be selectively varied.

6. An atomizer comprising an inner tubular member for receiving a compressible fluid, an outer tubular member extending in a concentrically spaced relation to said inner tubular member to define an annular passage between said members for receiving a liquid fuel, distributor plug means connected to said tubular members and having passage means for receiving said fluid from said inner tubular member and said fuel from said annular passage, means cooperating with said plug means for defining a mixing chamber communicating with said passage means for receiving said fluid and said fuel, said latter means having a discharge opening communicating with mixing chamber, and a discharge plug member extending within said discharge opening and defining therewith a continuous annular discharge passage for the mixture exiting from said mixing chamber.

7. The atomizer of claim 6 wherein said discharge plug member has a conical shape and wherein said discharge opening is tapered so as to extend substantially parallel to said plug member.

8. The atomizer of claim 6 wherein said distributor plug member includes a threaded bore for receiving a corresponding threaded portion of said plug member to permit movement of said plug member relative to said discharge opening to permit the size of said discharge passage to be selectively varied.

9. The atomizer of claim 6 wherein said passage means of said distributor plug member includes a plurality of circumferentially spaced passages communicating with said annular passage.

10. The atomizer of claim 9 wherein said means cooperating with said plug means also define, with said plug means,

a radial passage connecting said circumferentially spaced passages with said mixing chamber.

11. The atomizer of claim 9 or 10 wherein said passage means of said distributor plug means include a plurality of circumferentially spaced passages connecting said inner tube member with said mixing chamber.

12. An atomizer comprising a first member for receiving a compressible fluid, a second member for receiving a liquid fuel, means defining a mixing chamber communicating with said members for receiving said fluid and said fuel, and means defining a continuous annular discharge passage communicating with said mixing chamber for discharging said mixture.

13. The atomizer of claim 12 wherein said first member and said second member each have an inlet for receiving said fluid and said fuel, respectively, and an outlet for respectively discharging said fluid and said fuel into said mixing chamber.

14. The atomizer of claim 13 wherein said first member and said second member are in the form of tubular members with said second member extending over said first member in a coaxially spaced relation thereto.

15. The atomizer of claim 14 wherein said means defining a mixing chamber comprises a distributor plug connected to said tubular members and having passages for receiving said fluid and said fuel, and for discharging said fluid and said fuel to said mixing chamber.

16. The atomizer of claim 15 wherein said discharge passage defining means includes said distributor plug.

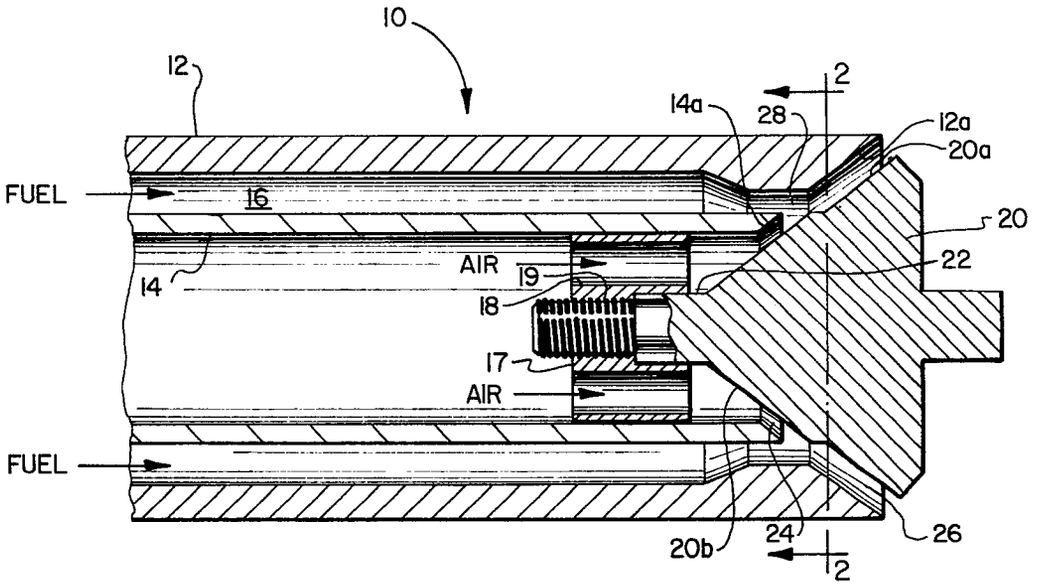
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FIG. 1

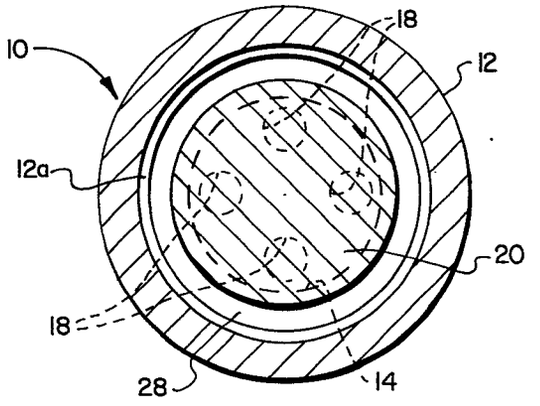
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FIG. 2

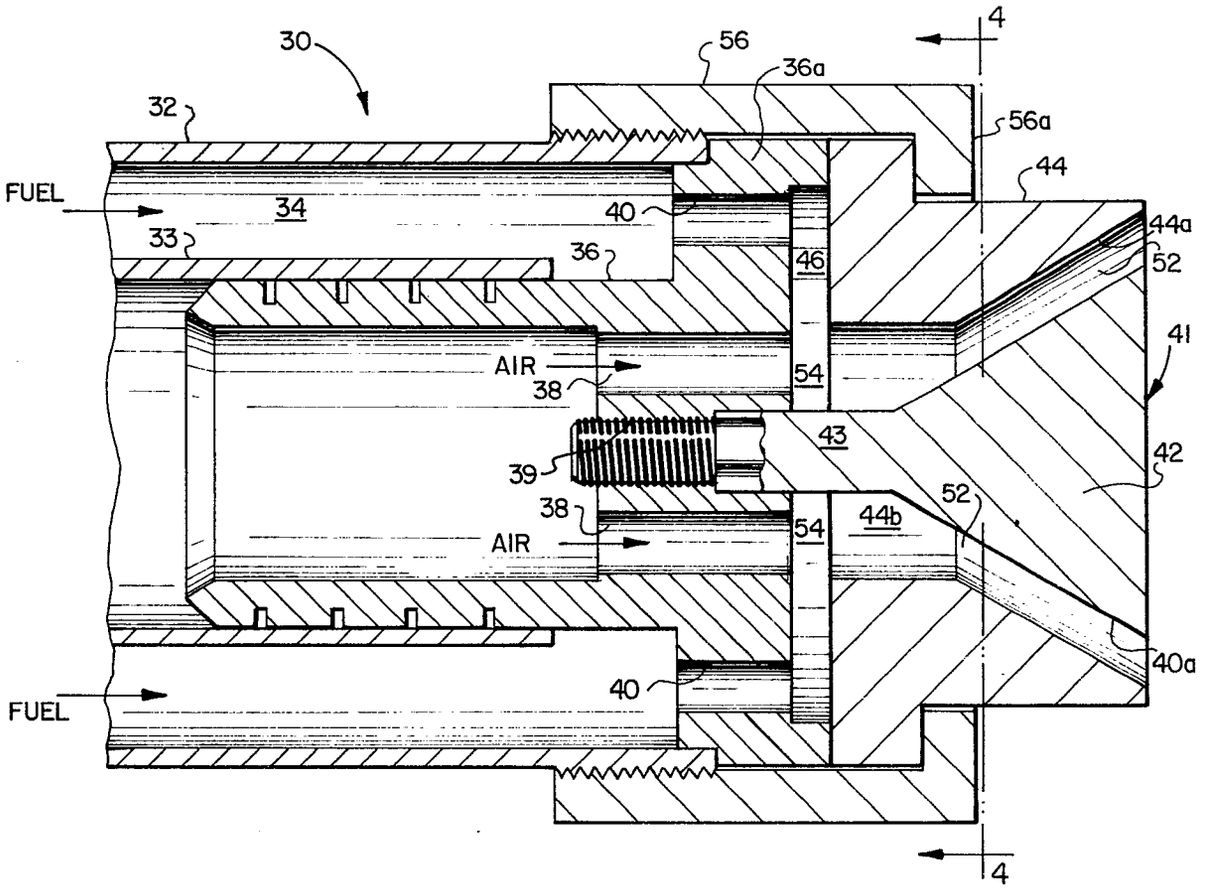
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FIG. 3

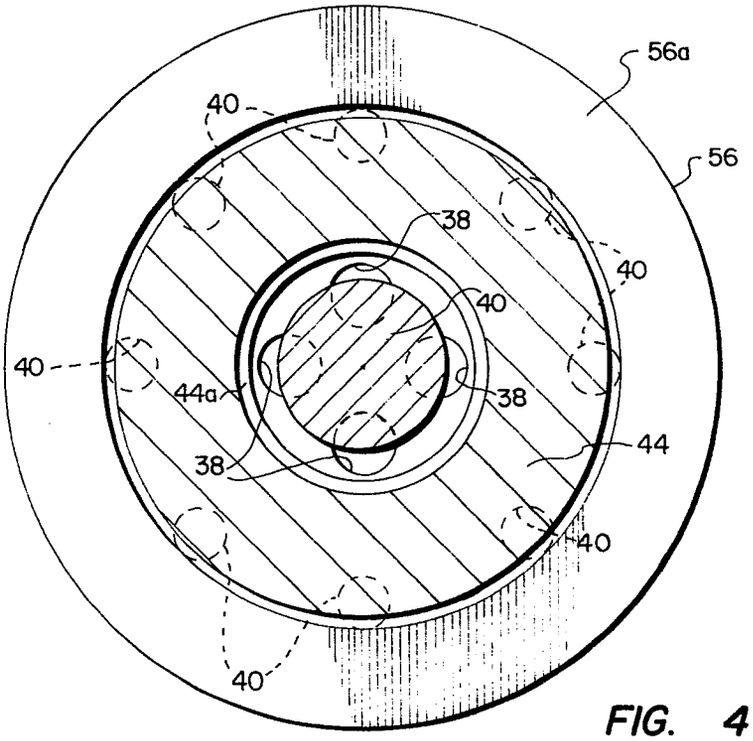
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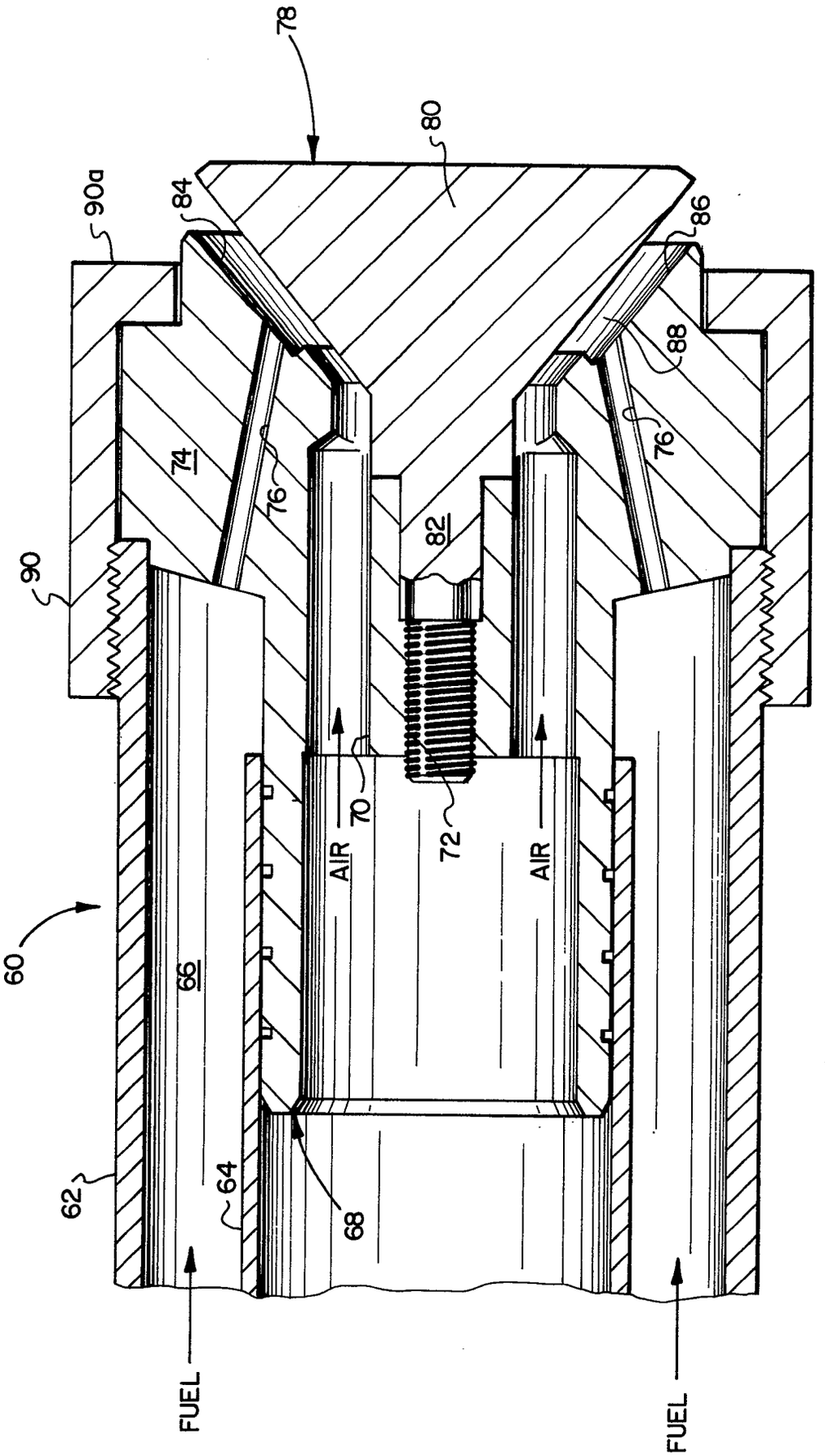
FIG. 4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FUEL
FUEL

FIG. 5