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

(11) Publication number: **0 159 421**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **84301953.0**

(22) Date of filing: **22.03.84**

(51) Int. Cl.⁴: **F 23 Q 9/00**

(30) Priority: **24.01.84 US 573499**

(43) Date of publication of application: **30.10.85 Bulletin 85/44**

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

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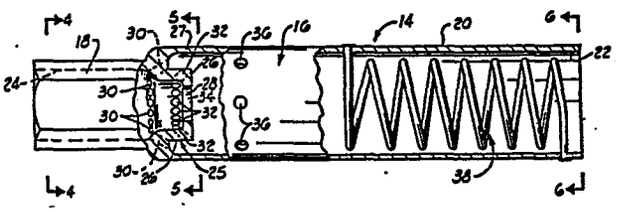
(54) Pilot burner.

(57) Pilot burner apparatus is provided which has improved flame stability and other characteristics. The pilot burner (14) is comprised of a hollow body member (16) having at one end a combustible gas inlet nozzle portion (25) connected to a sleeve portion (20) which forms an outlet (22) at the other end. A heat-retaining member (38) is disposed within the sleeve portion adjacent the outlet end thereof. Upon short duration combustion disturbances, flame stability is maintained by the burner.



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PILOT BURNER

The present invention relates generally to a pilot burner, for example a pilot burner of the type used to ignite combustible materials periodically emitted from one or more main burners in flares, or heaters.

A great variety of pilot burner designs and apparatus has been developed and used over the years. Examples of applications of pilot burners in association with main burners are domestic and industrial heaters, boilers, and dryers. In addition, a variety of emergency and/or waste disposal flare apparatus, utilized in industry, include pilot burners.

In the above mentioned and other applications for pilot burners, it is desirable that the pilot burners have maximum flame stability in a variety of environmental conditions, i.e., that the burners be capable of maintaining a pilot flame in various forms and quantities of draft, and/or at varying inlet pressures of combustible gas, when exposed to draft or winds variable as to direction and/or speed. In addition, it is desirable that a pilot burner have the ability to maintain flame stability upon short duration combustion disturbances. The term "combustion disturbance" is used herein to mean any of a number of circumstances causing flame instability and a possible flame failure such as an interruption of combustible gas flow, the flame being blown away from the pilot by wind, being snuffed by wind or a momentary increase in external pressure, or being pulled away from the burner by momentary decreases in external pressure, etc.

The present invention aims to provide pilot burner apparatus having improved operational stability and other characteristics, including the ability to maintain flame stability during and after short-term combustion disturbances.

Accordingly the present invention provides a pilot burner comprising: a hollow body member having at one end a combustible gas inlet nozzle portion connected to a sleeve portion which forms an outlet at the other end; and a heat-retaining member disposed within said sleeve portion adjacent the outlet end thereof whereby, during the combustion of a combustible gas at said burner, said heat-retaining member is heated and, upon short duration combustion disturbances, flame stability is maintained by said burner.

A further object of the present invention is the provision of pilot burner apparatus having improved flame stability and other characteristics.

Another object of the present invention is the provision of pilot burner apparatus having the ability to re-ignite combustible gas flowing therethrough after short duration combustion disturbances.

In order that the present invention may more readily be understood the following description is given, merely by way of example, of preferred embodiments, with reference to the accompanying drawings.

FIGURE 1 is a schematic illustration of a typical pilot burner assembly associated with a main burner;

FIGURE 2 is a side view of the pilot burner of the present invention;

FIGURE 3 is a partially sectional side view of the pilot burner of FIGURE 2;

FIGURE 4 is a cross-sectional view taken along line 4-4 of FIGURE 3;

FIGURE 5 is a cross-sectional view taken along line 5-5 of FIGURE 3;

FIGURE 6 is a cross-sectional view taken along line 6-6 of FIGURE 3;

FIGURE 7 is a side view of an alternative form of the pilot burner of the present invention;

FIGURE 8 is a partially sectional side view of the pilot burner of FIGURE 7;

FIGURE 9 is a cross-sectional view taken along line 9-9 of FIGURE 8;

FIGURE 10 is a cross-sectional view taken along line 10-10 of FIGURE 8;

FIGURE 11 is an end view taken along line 11-11 of FIGURE 8;

FIGURE 12 is a partially sectional side view of yet another form of the pilot burner of the present invention; and

FIGURE 13 is a cross-sectional view taken along line 13-13 of FIGURE 12.

FIGURE 1 shows schematically a typical pilot burner assembly, generally designated 10, positioned with respect to a main burner 12 such that a pilot flame is continuously maintained in a position whereby, when combustible materials such as fuel or combustible waste are emitted from the main burner 12, they are ignited by the pilot burner flame.

The pilot burner assembly 10 comprises a pilot burner 14 connected by a conduit 15 to a conventional fuel-air mixer apparatus 17. While various fuel-air mixer apparatus have been developed, the most commonly used are of the Venturi type which suck air into the fuel as a result of fuel flow through the mixer. A conduit 19 connects the fuel-air mixer 17 to a source of pressurized fuel.

When desired, the assembly 10 also includes a shut-off valve 21, disposed in the conduit 19, which is maintained open only so long as a flame exists at the pilot burner 14 as determined by a conventional flame sensing device 23 operably connected to the valve 21.

In operation, a constant flow from a source of pressurized fuel passes through the shut-off valve 21 and the conduit 19 into and through the fuel-air mixer 17 where air is sucked into the fuel stream and mixed therewith to form a fuel-air mixture flowing by way of the conduit 15 through the pilot burner 14 where it is combusted to give a pilot flame adjacent the main burner 12.

The flame sensing device 23 maintains the shut-off valve 21 in the open position only so long as a pilot flame exists at the burner 14. If combustion is terminated, and the flame is extinguished, the flame sensing device 23 closes the shut-off valve 21 to shut off the flow of fuel and air to the pilot burner. In addition, the control signal from the flame sensing device 23 can be used to shut off flow of combustible material to the main burner 12.

The pilot burner 14, flame sensing device 23 and main burner or burners 12 may be disposed within a heater or other similar structure wherein the draft (intake of atmospheric air) is induced naturally or wherein at least one blower is used for inducing the draft (forced draft). In a flare application, the pilot burner assembly 10 and one or more main burners 12 can be disposed within an enclosure such as in a stack or they can be disposed in the open, either at ground level or at an elevated level.

FIGURES 2 to 6 illustrate a presently preferred form of the pilot burner 14 having a hollow body member 16 having at one end an inlet nozzle portion 18 for combustible gas, connected to a sleeve portion 20 which forms an outlet 22 at the other end. The inlet nozzle portion 18 can take various forms but, in a preferred form, includes a centrally disposed threaded bore 24 and a hexagonal-shaped exterior whereby it can be conveniently threaded to a conduit. The nozzle portion 18 also includes an inwardly extending wall 26 which forms

a central discharge orifice 28 positioned concentrically to the sleeve portion 20 of the body member 16. In this embodiment, the wall 26 extends radially inwardly a short distance, then laterally towards the discharge end 22 of the body member 16 a short distance, and then radially inwardly again to form a cylindrical nozzle 25 extending within the sleeve portion 20 a short distance to form an annular space 27 therewith.

A first plurality of spaced apart discharge apertures 30 (FIGURE 3) is disposed in the first radially inwardly extending portion of the nozzle 25 from the interior of the nozzle 25 to the annulus 27. A second plurality of spaced apart discharge apertures 32 is disposed in the lateral portion of the wall 26 from the interior thereof to the annulus 27. As best shown in FIGURES 3 and 4, the apertures 30 and 32 are positioned around the interior of the nozzle 25 in spaced relationship to each other and the axes of the apertures 30 and 32 are oblique to the axis of the body 16 and converge. Finally, a plurality of spaced apart slots 34 is formed in the second radially inwardly extending portion of the wall 26. Each slot 34 extends from the centrally disposed discharge orifice 28 radially outwardly to the discharge apertures 32.

The sleeve portion 20 of the body member 16 includes a plurality of spaced apart ports 36 positioned around the sleeve portion 20 in a plane perpendicular to the longitudinal axis thereof.

Positioned within the sleeve portion 20 and terminating adjacent the outlet 22 thereof is a heat-retaining member 38. In the form illustrated in FIGURES 3 and 6, the heat retaining member 38 is a helical metal coil whose ends are rigidly attached, such as by welding, to the sides of the sleeve 20. In this form, the heat-retaining member 38 is preferably a heat-resistant metal alloy such as an alloy of nickel and chromium capable of

withstanding prolonged heating. However, other suitable metals or ceramic materials can also be used.

Operation of the Pilot Burner 14

In operation of the pilot burner 14, a fuel-air mixture enters the interior of the nozzle portion 18 from a conduit threadedly connected thereto. The fuel-air mixture is driven by pressure differential through the discharge apertures 30 and 32, the discharge slots 34 and the discharge orifice 28, all in the nozzle 25. The portion of the fuel-air mixture flowing through the discharge orifice 28 forms a jet which flows longitudinally through the sleeve portion 20 and out of the sleeve portion 20 by way of the outlet 22 as the fuel-air mixture burns. The fuel-air mixture flowing through the discharge apertures 30 and 32 forms jets which collide with each other and with the interior wall of the sleeve portion 20 within the annulus 27 as the fuel-air mixture begins to burn. The collisions bring about a reduction in the velocity of the jets and improve the stability of the flame produced by the pilot burner 14. The discharge slots 34 act to transfer the burning to the main jet produced by the discharge orifice 28. Also, portions of the fuel-air mixture adjacent the internal walls of the sleeve portion 20 may flow through the ports 36 therein and be burnt outside the sleeve portion 20. The ports 36 act to help equalize pressure between the interior of the sleeve 20 and the external environment surrounding the sleeve 20.

As indicated above, the fuel-air mixture flowing through the body member 16 of the pilot burner 14 is combusted, partially within the sleeve portion 20 and partially outside the sleeve portion 20, to form an elongated flame extending from within the sleeve portion 20 for a distance beyond the outlet 22. The combustion that takes place within the sleeve portion 20 of the pilot burner 14 continuously heats the heat-retaining

member 38 which, in the event of short duration combustion disturbances, remains hot and re-ignites or otherwise stabilizes the flame produced from the fuel-air mixture.

FIGURES 7 to 11 shows an alternative form of the pilot burner of the present invention generally designated 40. The structure and operation of the pilot burner 40 are similar to the structure and operation of the pilot burner 14 except that the heat-retaining member of the pilot burner 40 is removable. Also, the pilot burner 40 is illustrated with an alternative nozzle discharge orifice and aperture arrangement. More specifically, the pilot burner 40 includes a hollow body member 42 having at one end a combustible gas inlet nozzle portion 44 connected to a sleeve portion 46 which forms an outlet 48 at the other end. The nozzle portion 44 of the body member 42 can, and in most cases preferably does, include a wall forming an internal nozzle with a central discharge orifice and two sets of discharge apertures identical to the nozzle 25 of the pilot burner 14 described above. However, for purposes of this disclosure, the nozzle portion 44 of the pilot burner 40 is illustrated with an optional nozzle arrangement which can be utilized in applications where the operating environment and/or requirements for the pilot burner are different.

The nozzle portion 44 of the pilot burner 40 includes a radially inwardly extending wall 50 which forms a central discharge orifice 52. A single plurality of spaced apart discharge apertures 54 is provided, the apertures being spaced around the interior of the wall 50 and extending therethrough.

The sleeve portion 46 of the body member 42 includes a plurality of ports 56 which function in the same manner as the ports 36 described above, and has a removable heat-retaining member 60 positioned within the sleeve portion 46. The heat-retaining member 60 is similar to the heat-retaining member 38 in that it includes

a helical coil 62 formed of heat-resistant metal such as a metal alloy. However, instead of being directly attached to the sleeve portion 46 of the body member 42, the coil 62 is attached to three elongate spacing members 64 which are in turn slidably disposed within the interior of the sleeve portion 46. Enlarged portions are provided on the members 64 to prevent the heat-retaining member 60 from being moved too far axially within the sleeve portion 46, and for facilitating their removal.

FIGURES 12 and 13 show yet another form of the pilot burner of the present invention, generally designated 70. The pilot burner 70 is similar in structure and operation to the pilot burners 14 and 40 described above. More specifically, the pilot burner 70 is comprised of a hollow body member 72 having at one end a combustible gas inlet nozzle portion 74 connected to a sleeve portion 76 which forms an outlet 78 at the other end. The inlet nozzle portion 74 is illustrated in the same arrangement as the pilot burner 40, i.e., it includes an internal wall 75 which forms a central discharge orifice 77 and discharge apertures 79. The sleeve portion 76 of the body member 72 includes a heat-retaining member 82 which is removably disposed within the sleeve portion 76. However, instead of being a helical coil, the heat-retaining member 82 is of an alternative design including three elongate longitudinally positioned heat-resistant heat-retaining plates 84 formed of a suitable material. The plates 84 are connected together at their inner sides and have their outer sides in slidable contact with the interior of the sleeve portion 76 so that the member 82 is removable. Each of the plates 84 forming the heat-retaining member 82 can include a plurality of openings 86 formed therein for promoting mixing.

As will be understood by those skilled in the art, the heat-retaining member utilized with the pilot burner of the present invention can take various other forms and

can be formed from a variety of other materials, those having long life and high heat-retention being preferred.

The pilot burner of the present invention has improved flame stability properties over a variety of conditions including (a) over a broad range of fuel gas pressures, (b) under back pressures, (c) over a broad range of draft conditions, both natural and forced, and (d) under various air supply and wind conditions including those at directions transverse to the axis of the pilot burner. For example, while the times vary with a variety of factors, under simulated low natural draft conditions (20 Pa) and a fuel pressure of 103.4 kPa, a pilot burner of the present invention (as illustrated in FIGURES 2 to 6) with a heat-retaining member 38 formed of a heat-resistant alloy of nickel and chromium re-ignites the fuel mixture after fuel mixture flow interruptions of up to six seconds. Under simulated forced draft conditions of 50 Pa positive pressure and 103.4 kPa fuel pressure, re-ignition is achieved after a fuel mixture flow interruption of four seconds. Under a positive pressure of 174 Pa the maximum time the fuel mixture flow can be interrupted while still allowing re-ignition is two seconds provided the heat-retaining member reheats fully between interruptions. Under 174 Pa positive pressure and only a four second reheat time, the maximum pilot burner fuel mixture flow interruption time is one second.

CLAIMS

1. A pilot burner comprising: a hollow body member (16) (42) (72) having at one end a combustible gas inlet nozzle portion (25) (44) (74) connected to a sleeve portion (20) (46) (76) which forms an outlet (22) at the other end; and a heat-retaining member (38) (60) (82) disposed within said sleeve portion adjacent the outlet end thereof whereby, during the combustion of a combustible gas at said burner, said heat-retaining member is heated and, upon short duration combustion disturbances, flame stability is maintained by said burner.

2. A pilot burner according to claim 1, wherein said heat-retaining member (60) (82) is removably disposed within said sleeve portion (46) (76) of said body member.

3. A pilot burner according to claim 1 or 2, wherein said heat-retaining member (38 or 60) at least partially comprises a helical coil.

4. A pilot burner according to any one of claims 1 to 3, wherein said nozzle portion of said body member includes an inwardly extending wall (26) (50) (75) forming a central discharge orifice (28) (52) (77) therein positioned concentrically to said sleeve portion.

5. A pilot burner according to claim 4, wherein said sleeve portion (20) (46) of said body member includes at least one port (36) (56) formed in a side thereof.

6. A pilot burner according to claim 5, wherein said nozzle portion of said body member further includes a plurality of discharge apertures (30) (54) (79) disposed in said wall and positioned around said central discharge orifice (28) (52) (77).

7. A pilot burner according to claim 6, wherein said nozzle portion of said body member further includes a plurality of spaced slots (34) disposed in said wall extending radially outwardly from said central discharge orifice (28).

8. A pilot burner according to any one of claims 1 to 7, wherein said heat-retaining member is formed of metal.

9. A pilot burner according to any one of claims 1 to 7, wherein said heat-retaining member is formed of ceramic material.

10. A pilot burner according to any one of the preceding claims wherein said inlet nozzle portion (25) (42) for combustible gas is connected by way of a combustible mixture conduit (15) to the mixture outlet of means (17) for mixing air with pressurized fuel to form a combustible fuel-air mixture, and wherein said mixing means (17) has a fuel inlet which is connected by a fuel conduit to a source of pressurized fuel.

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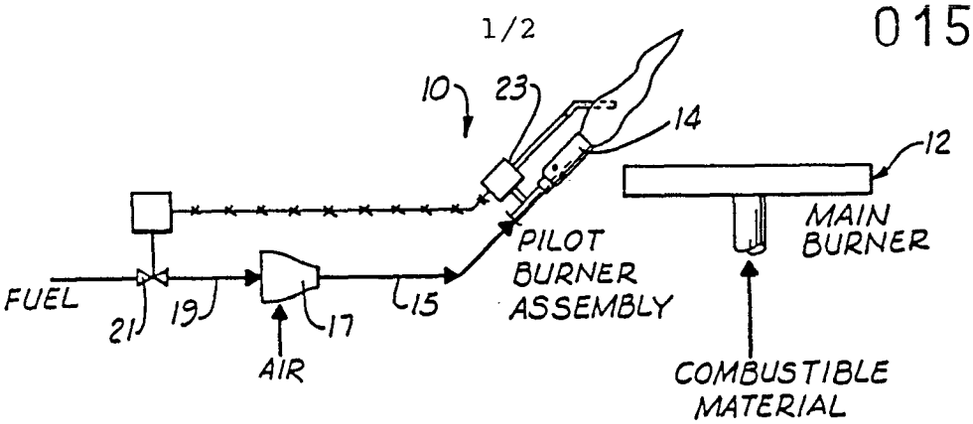

FIG. 1

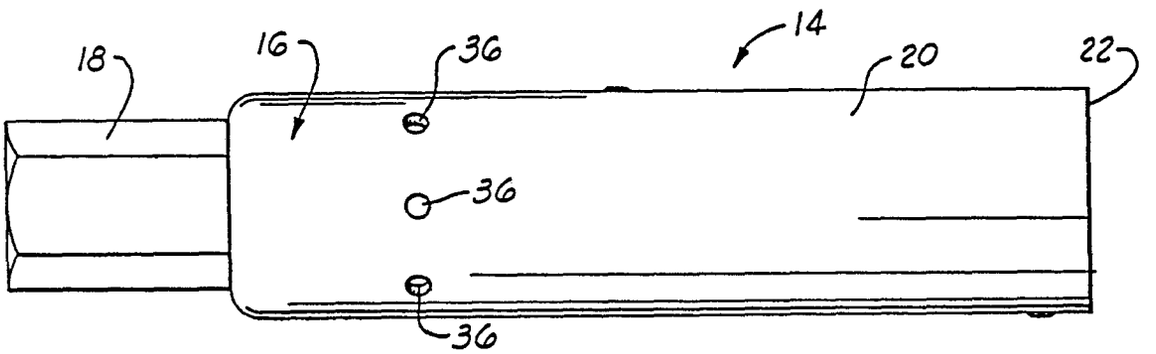

FIG. 2

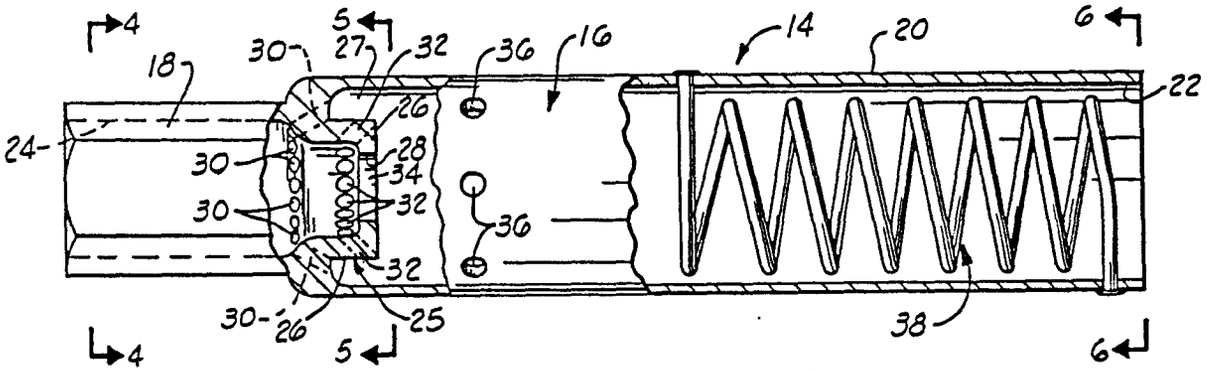

FIG. 3

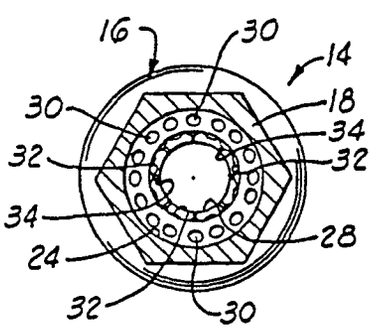

FIG. 4

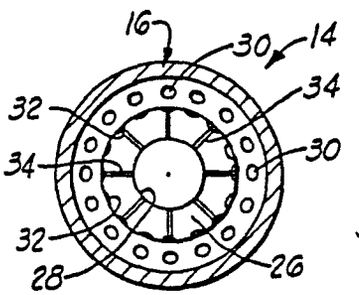

FIG. 5

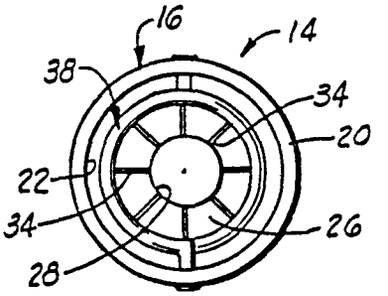

FIG. 6

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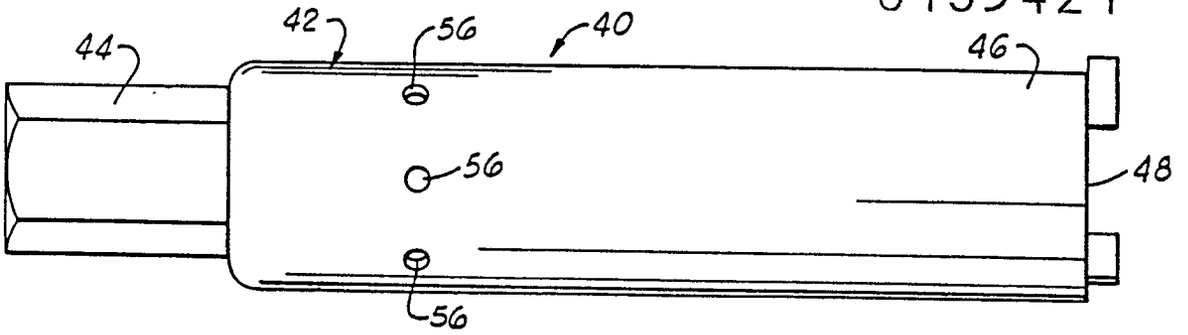

FIG. 7

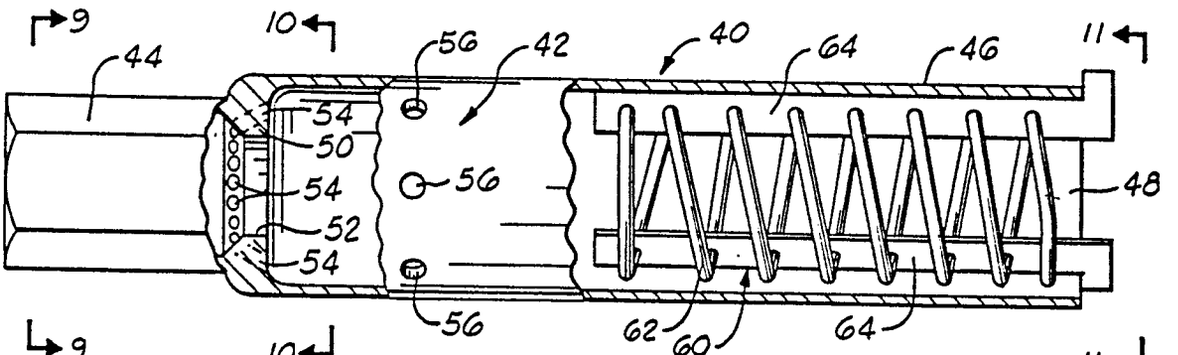

FIG. 8

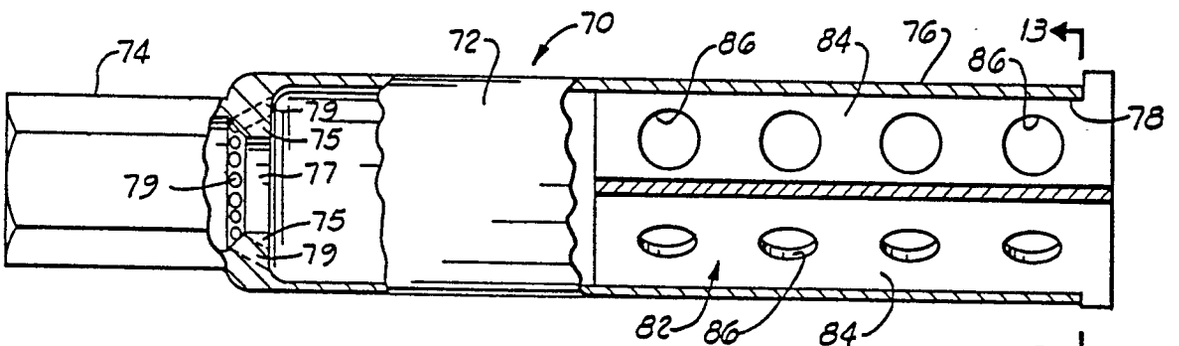

FIG. 12

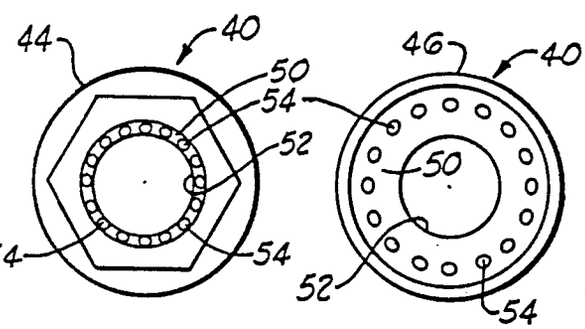

FIG. 9

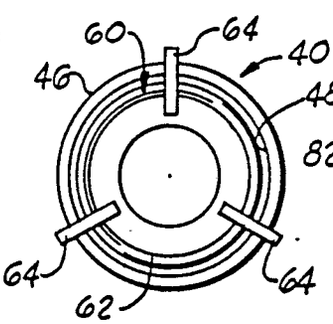

FIG. 11

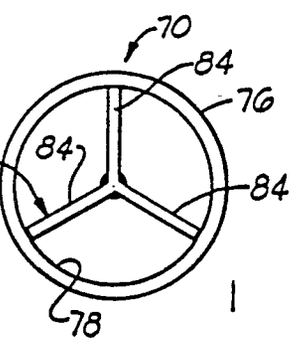

FIG. 10

FIG. 13