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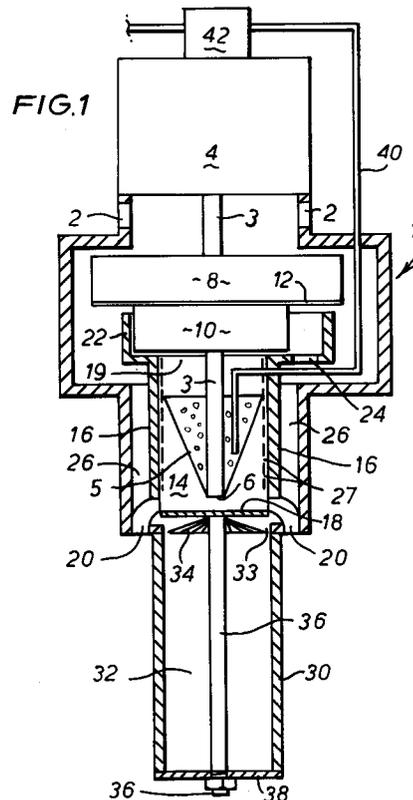
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**Liquid fuel burner.**

A burner comprising a housing (1) in which a vaporization chamber (14) is located and an atomizer (5) arranged in the vaporization chamber. The atomizer is rotatable about a longitudinal axis thereof and has a wall extending in circumferential direction around said longitudinal axis, which wall has an inner radius increasing in longitudinal direction and is provided with a plurality of perforations distributed about said wall. The burner further comprises drive means (4) for rotating the atomizer about said longitudinal axis, means (40) for discharging liquid fuel on the inner surface of said wall, and means (10) for inducing vaporization gas to flow through the vaporization chamber in substantially longitudinal direction of the atomizer.



**EP 0 595 419 A1**

The present invention relates to a liquid fuel burner in which liquid fuel is finely dispersed before entering a combustion zone so as to achieve efficient and clean combustion of the fuel. Burners of this type can for example be used in domestic applications in which clean combustion and low combustion noise are especially important. Furthermore, in most applications coke deposition on the various parts of the burner and the quantity of soot formed should be minimized.

In one type of liquid fuel burners the fuel is dispersed into particles by the action of centrifugal forces. Such a burner is disclosed in US patent No. 3 640 673, which burner is provided with a rotating plate and a rotating fan arranged concentrically around the plate, and whereby a casing is arranged around the plate and the fan. During operation liquid fuel is discharged on the atomizer plate, which fuel is sprayed radially outward by centrifugal forces imparted by the rotating plate. The fan induces heated air to flow together with the fuel in radially outward direction so that heated fuel is sprayed against the casing wall, which leads to undesired carbonaceous deposits being formed at the casing wall.

Another type of liquid fuel burner is disclosed in European patent No. 151 214, which burner includes a rotating evaporator barrel located in a combustion chamber so that during operation of the burner the evaporator barrel is heated by the combustion process. Liquid fuel which is discharged into the evaporator barrel is gasified in the barrel by the heat transmitted from the barrel to the fuel. Since the barrel is in continuous contact with hot fuel, undesired carbonaceous deposits are formed at the inner surface of the barrel. Moreover, this burner has the disadvantage that gasification of the fuel is only naturally so that the combustion capacity of the burner is limited.

An object of the invention is to provide a liquid fuel burner which overcomes the drawbacks of the known liquid fuel burners, and which permits clean and efficient combustion of liquid fuel.

In accordance with the invention there is provided a liquid fuel burner comprising a housing in which a vaporization chamber is located, an atomizer arranged in the vaporization chamber, which atomizer is rotatable about a longitudinal axis thereof and has a wall extending in circumferential direction around said longitudinal axis, the wall having an inner radius increasing in a direction along the longitudinal axis and being provided with a plurality of perforations distributed about said wall, the burner further comprising drive means for rotating the atomizer about said longitudinal axis, means for discharging liquid fuel on an inner surface of the wall defined by said inner radius, and means for inducing vaporization gas to flow through the

vaporization chamber in a direction substantially along the longitudinal axis. Liquid fuel which is fed on the inner surface of the atomizer wall distributes itself over said inner surface and is discharged therefrom through the perforations by the action of centrifugal forces imparted by the rotating atomizer. By the application of the atomizer having a relatively large inner surface it is ensured that the fuel is efficiently atomized into small particles. As the fuel particles flow substantially in radial direction and the vaporization gas flows in substantially in longitudinal direction, the fuel and the gas are intimately mixed and vaporized without contact of the particles with the wall of the vaporization chamber.

The invention will now be described more specifically with the reference to the drawings in which:

Fig. 1 shows schematically a first embodiment of the liquid fuel burner according to the invention; and

Fig. 2 shows schematically a second embodiment of the liquid fuel burner according to the invention.

The burner shown in Fig. 1 includes a housing 1 provided with a plurality of air inlet openings 2. A rotatable shaft 3 extends through the housing, which shaft 3 is at one end connected to an electric motor 4 driving the shaft 3. An atomizer 5 provided with an array of perforations and having a frustoconical shape is fixedly attached to the other end 6 of the shaft 3, whereby the longitudinal axis of the atomizer 5 coincides with the longitudinal axis of the shaft 3 and whereby the smaller diameter part of the atomizer 5 is located nearest the end 6 of the shaft 3. A fan 8 and a fan 10 are fixedly attached to the shaft 3, the fan 8 being located at the side of the electric motor 4 and the fan 10 being located at the side of the atomizer 5. A circular plate 12 is arranged between the two fans 8, 10 to separate the fans 8,10 from each other.

A vaporization chamber 14 is formed within the housing 1 by a side wall 16 which extends concentrically around the atomizer 5, and a bottom wall 18 located adjacent the end 6 of the shaft 3. The vaporization chamber 14 has an open end 19 opposite the bottom wall 16, which open end 19 defines an outlet opening of the vaporization chamber 14. A plurality of inlet conduits 20 are arranged near the bottom wall 16, which inlet conduits 20 extend through the housing 1 to outside the housing 1. An electric heating element 27 for initial heating of vaporization gas is located on the inner surface of the side wall 16.

A shield 22 is connected to the side wall 16 of the vaporization chamber 14 adjacent the outlet opening 19 thereof, which shield 22 is arranged around the fan 10 and is provided with an opening

24 debouching in a space 26 formed within the housing and outside the vaporization chamber 14.

The combustion zone of the burner is located in a cylindrical porous combustion element 30 connected to the housing 1 adjacent the inlet conduits 20, which combustion element 30 surrounds a distributing zone 32 in fluid communication with the space 26 via an opening 33 provided in the housing 1. A swirler 34 is located in the opening 33. The combustion element 30 and the swirler 34 are held in place by a bolt and nut assembly 36 which includes an end plate 38, the bolt being fixedly attached to the bottom wall 18 of the vaporization chamber 14.

A fuel supply conduit 40 extends into the housing and through the vaporization chamber 14 to near the inner surface of the atomizer 5. The conduit 40 is connected to a fuel pump 42 driven by the electric motor 4.

During normal operation of the burner shown in Fig.1 the electric motor 4 is operated to rotate the shaft 3 and thereby to rotate the fan 8, the fan 10 and the atomizer 5. Furthermore, the motor 4 induces the pump 42 to discharge liquid fuel on the inner surface of the atomizer 5. The fuel is distributed over the inner surface of atomizer 5 and small liquid particles are discharged radially outward through the perforations by the action of centrifugal forces imparted by the rotating atomizer 5. The fan 10 sucks vaporization gas in the form of hot combustion gas into the vaporization chamber 14 via the inlet openings 20, and induces the combustion gas to flow axially through the vaporization chamber 14. The hot combustion gas passes along the outer surface of the atomizer and thereby entrains the small liquid particles which are gasified as they flow with the hot combustion gas through the vaporization chamber 14. The combustion gas and the vaporized fuel are blown by the fan 10 through opening 24 of shield 22 into the space 26 surrounding the vaporization chamber 16.

The fan 8 sucks air in via the openings 2 of the housing 1 and blows the air into the space 26 where the air mixes with the combustion gas and the vaporized fuel to form a combustible mixture. The combustible mixture flows through the opening 33 thereby passing the swirler 34 which induces a swirling motion to the mixture as the mixture enters the distributing zone 32. From the distributing zone 32 the mixture flows through the combustion element 30 in which the combustion process takes place. The heating element 27 is only used during start-up of the burner in order to heat the vaporization gas.

The burner shown in Fig. 2 has a housing 51 provided with an air inlet opening 52. A rotatable shaft 53 extends through the housing, which shaft 53 is at one end connected to an electric motor 54

driving the shaft 53. An atomizer 55 provided with an array of perforations and having a frustoconical shape is fixedly attached to the other end 56 of the shaft 53, whereby the longitudinal axis of the atomizer 55 coincides with the longitudinal axis of the shaft 53 and whereby the smaller diameter part of the atomizer 55 is located nearest the end 56 of the shaft 53. A fan 58 is fixedly attached to the shaft 53 at a location between the atomizer 55 and the electric motor 54.

A vaporization chamber 59 is formed within the housing 51 by a wall 60 which extends concentrically around the atomizer 55. The vaporization chamber 59 is open ended, whereby the open end at the side of the electric motor 54 defines an inlet opening 61, and the open end opposite the electric motor 54 defines an outlet 62 in which a diffuser 64 is arranged. An electric heating element 63 for initial heating of vaporization gas is located on the inner surface of the wall 60.

A porous combustion element 65 of cylindrical shape is connected to the wall 60 of the vaporization chamber 59 near the outlet opening 62 thereof by means of a bolt and nut assembly 65A, which porous element 65 extends to outside the housing whereby an annular opening 66 is formed between the housing 51 and the porous element 65. An end plate 67 covers the porous element 65.

An intermediate wall 68 is arranged between the housing 51 and the wall 60 thereby defining a first annular space 69 between the wall 60 and the intermediate wall 68, and a second annular space 70 between the intermediate wall 68 and the housing 51. The first annular space 69 provides fluid communication between the annular opening 66 and the inlet opening 61 of the vaporization chamber 59. The second annular space 70 provides fluid communication between the air inlet opening 52 and the vaporization chamber 59 via a plurality of conduits 72 debouching in the vaporization chamber 59 near the outlet thereof. A fan 74 driven by a second electric motor 76 is arranged in the housing 51 near the air inlet opening 52 so as to blow air from the air inlet opening 52 into the second space 70.

The second electric motor 76 drives furthermore a fuel pump 78 for pumping liquid fuel via a fuel supply conduit 80 to near the inner surface of the atomizer 55.

During normal operation of the burner shown in Fig. 2 the electric motors 54, 74 are operated to rotate the fan 58, the fan 74 and the atomizer 55. Furthermore, the pump 78 is induced to discharge liquid fuel on the inner surface of the atomizer 55. The fuel is atomized by the atomizer 55 similarly to atomization of the fuel in the first embodiment. The fan 58 induces vaporization gas in the form of hot combustion gas to flow from the annular opening

66 and the annular space 69 through the vaporization chamber 59. The hot combustion gas passes along the outer surface of the atomizer and thereby entrains the small liquid particles which are gasified as they flow with the hot combustion gas through the vaporization chamber 59.

The fan 74 blows air into the annular space 70, which air flows via the conduits 72 into the vaporization chamber 59 where the air mixes with the combustion gas and the vaporized fuel to form a combustible mixture. The combustible mixture flows through the outlet 62, passes the diffuser 64 and flows into the space enclosed by the combustion element 65. Therefrom, the mixture flows through the combustion element 65 in which the combustion process takes place. Similarly to the first embodiment the heating element 63 is only used during start-up of the burner.

Instead of the arrangement shown in Figures 1 and 2 where the smaller diameter part of the atomizer is located nearest the end of the shaft, the larger diameter part of the atomizer can suitably be located nearest the end of the shaft.

The porous combustion element preferably forms a sintered wall of non-woven steel fibres. With a combustion element of this type a radiant combustion process is achieved whereby open flame combustion is prevented.

A high resistance against oxidation of the combustion element is achieved if the fibres comprise 15.0 to 22.0 wt.% chromium and 4.0 to 5.2 wt.% aluminium. A particularly suitable material for the steel fibres is Fecralloy (trade mark) which comprises 15.0 to 22.0 wt.% chromium, 4.0 to 5.2 wt.% aluminium, 0.05 to 0.4 wt.% yttrium, 0.2 to 0.4 wt.% silicon and less than 0.03 wt.% carbon.

Other suitable types of combustion elements include a perforated ceramic or metallic plate, a permeable granular material, and a permeable fibrous material with ceramic or metallic fibres. Furthermore, the combustion element can include certain catalytic components such as palladium or platinum. It will be understood that the combustion element can have any suitable shape other than cylindrical as long as the element is adapted to the housing of the burner, for example the shape of a plate or a curved shape.

## Claims

1. A liquid fuel burner comprising a housing in which a vaporization chamber is located, an atomizer arranged in the vaporization chamber, which atomizer is rotatable about a longitudinal axis thereof and has a wall extending in circumferential direction around said longitudinal axis, the wall having an inner radius increasing in a direction along the longitudinal axis and being provided with a plurality of perforations distributed about said wall, the burner further comprising drive means for rotating the atomizer about said longitudinal axis, means for discharging liquid fuel on an inner surface of the wall defined by said inner radius, and means for inducing vaporization gas to flow through the vaporization chamber in a direction substantially along the longitudinal axis.
2. The burner of claim 1, wherein the atomizer has an open end at the side of the larger inner radius of said wall.
3. The burner of claim 2, wherein said means for inducing vaporization gas to flow through the vaporization chamber is arranged to induce vaporization gas to flow in a direction opposite to the direction of increasing inner radius of said wall.
4. The burner of claim 2, wherein said means for inducing vaporization gas to flow through the vaporization chamber is arranged to induce vaporization gas to flow in the direction of increasing inner radius of said wall.
5. The burner of any one of claims 1-4, wherein said wall of the atomizer has a frustoconical shape.
6. The burner of any one of claims 1-5, wherein said means for inducing vaporization gas to flow through the vaporization chamber and said atomizer are connected to a drive shaft driven by an electric motor.
7. The burner of any one of claims 1-6, wherein the vaporization chamber is provided with an inlet opening in fluid communication with a conduit for conducting combustion gas to the vaporization chamber via said inlet opening.
8. The burner of any one of claims 1-7, further comprising means for inducing combustion air to flow to a mixing zone for mixing combustion air with vaporized fuel, said mixing zone being in fluid communication with an outlet opening of the vaporization chamber.
9. The burner of any one of claims 1-8, further comprising an combustion element for combusting vaporized fuel, said element forming a porous body of sintered metallic fibres.
10. The burner of claim 9, wherein said combustion element is of substantially cylindrical shape and is at one end thereof connected to

said housing of the burner.

- 11.** The burner substantially as described hereinbefore with reference to the Figures.

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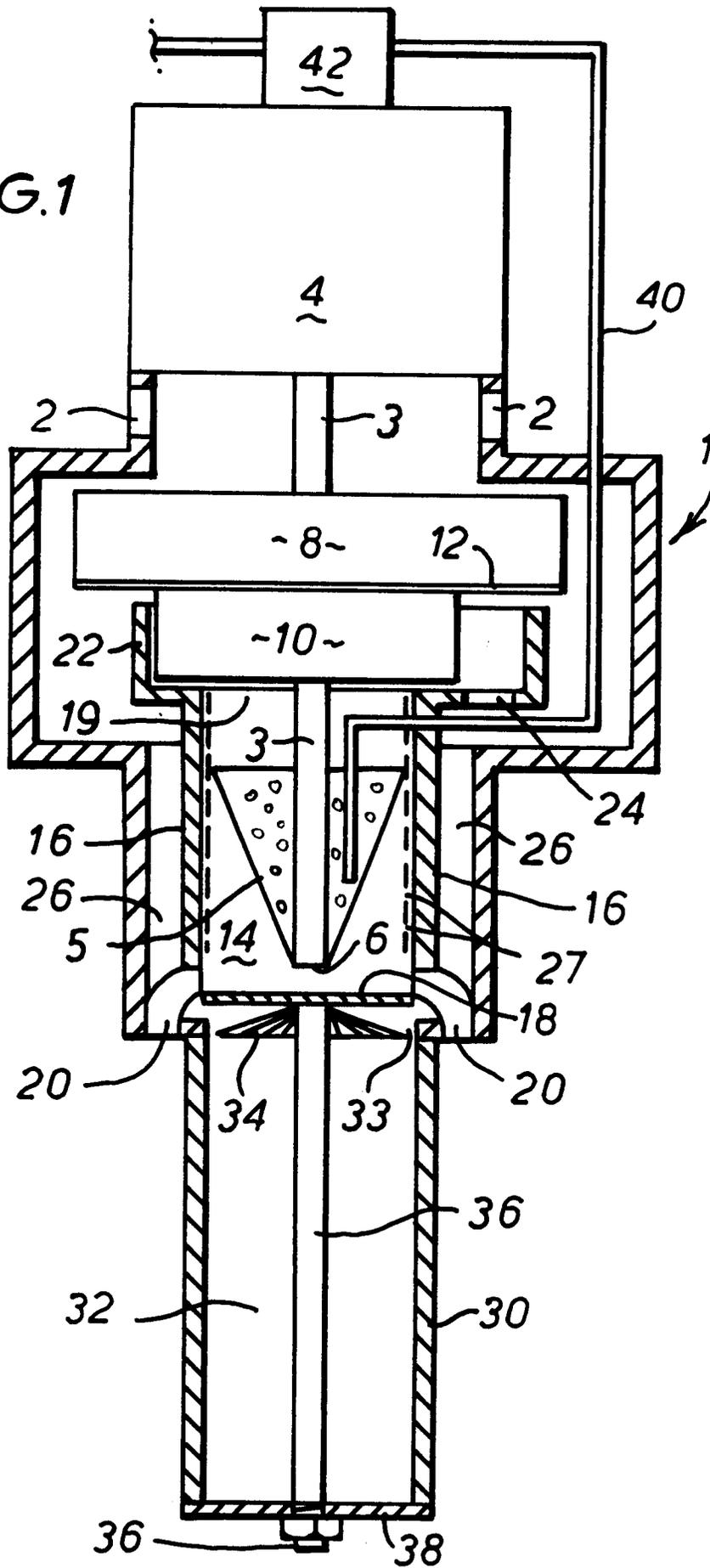
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FIG.1



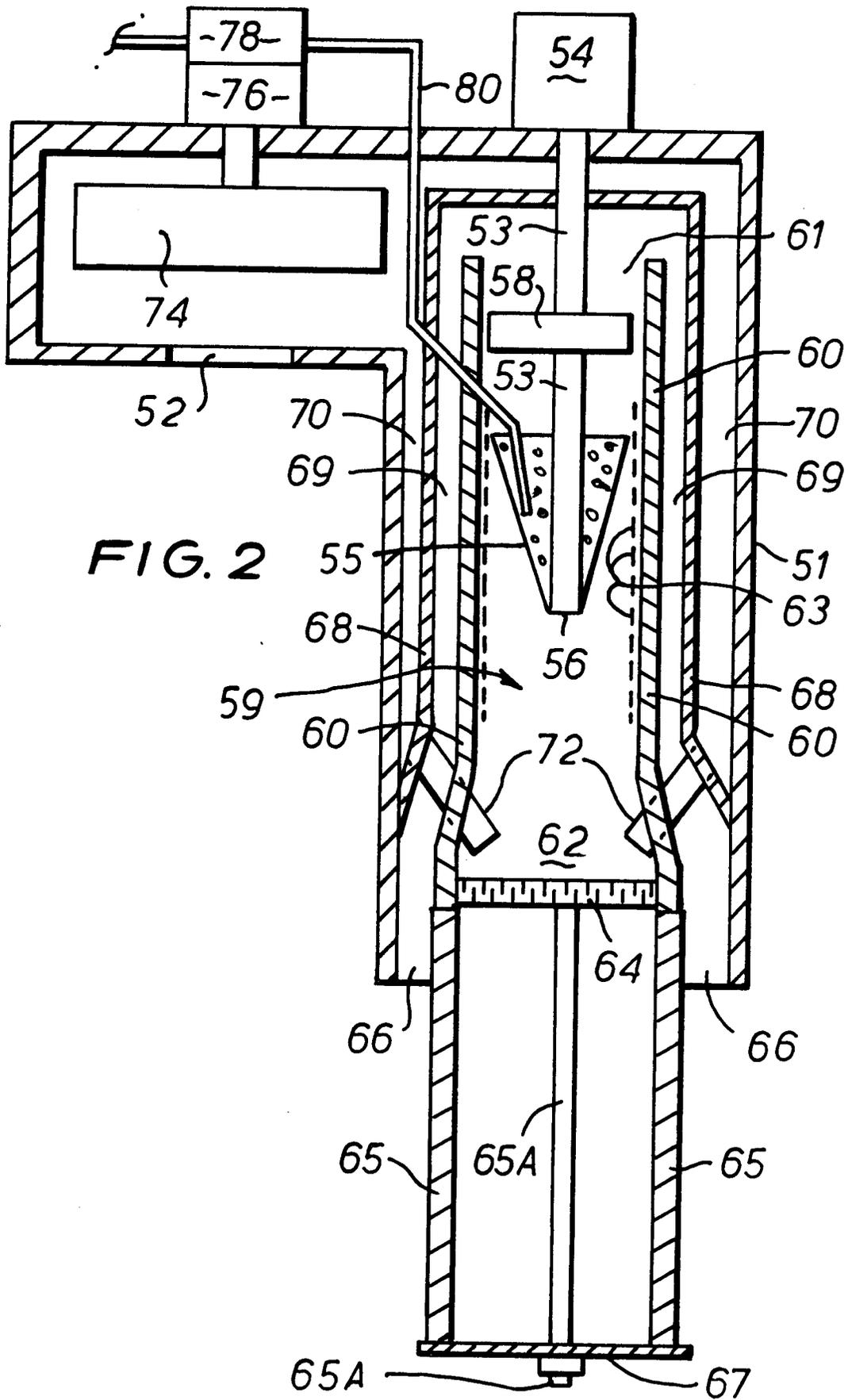


FIG. 2



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A,D	EP-A-0 151 214 (DEUTSCHE BABCOCK WERKE A.G.) * page 2, line 22 - page 4, line 11; figure *	1,5,7	F23D11/00
A	--- PATENT ABSTRACTS OF JAPAN vol. 8, no. 22 (M-272)31 January 1984 & JP-A-58 182 013 (MATSUSHITA DENKI SANGYO KK) * abstract *	1-3,5	
A	--- PATENT ABSTRACTS OF JAPAN vol. 7, no. 257 (M-256)16 November 1983 & JP-A-58 140 505 (MATSUSHITA DENKI SANGYO KK) * abstract *	1,2,5	
A	--- EP-A-0 232 677 (FULLEMANN) * column 9, line 57 - column 10, line 19 * * column 11, line 24 - column 11, line 53; figures 1,2 *	1,6,7	
A	--- US-A-1 700 592 (LOEPSINGER) -----		TECHNICAL FIELDS SEARCHED (Int.Cl.5) F23D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 18 January 1994	Examiner PHOA, Y
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	