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54 **Mix atomizer.**

57 Mix atomizer for the atomization of a liquid with gas comprising a first mixing chamber (2) provided with inlet means for a liquid and primary gas (5, 6), and debouching into a second mixing chamber (3) being wider than the first mixing chamber (2), means (8) for tangentially supplying secondary gas around the mixture of liquid and primary gas from the first mixing chamber (2), the second mixing chamber (3) debouching in its turn into an outlet nozzle (4) being substantially narrower than the second mixing chamber (3).

The invention further relates to an apparatus provided with a plurality of such mix atomizers and having a common liquid supply channel and a common gas supply channel.

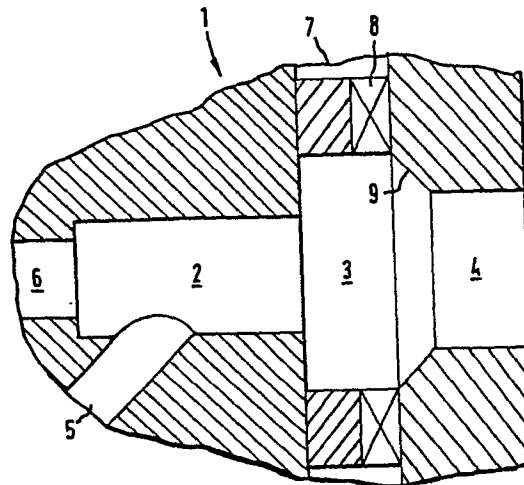


FIG.1

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MIX ATOMIZER

The invention relates to a mix atomizer for the atomization of a liquid with gas. The invention further relates to an apparatus for the atomization of a liquid, which apparatus is provided with a plurality of such mix atomizers.

5 The term liquid is taken throughout the specification and claims also to include dispersions of solid particles in a liquid and emulsions.

Atomizers are applied on a large scale in combustion engineering, especially for atomizing heavy liquid fuel, to
10 promote intensive contact of liquid with combustion air for a proper combustion. In an atomizer liquid fuel is broken up into very small droplets which droplets may be subsequently mixed with oxygen or an oxygen-containing gas, for example air, in a combustion chamber for combustion of the fuel. Atomization is
15 normally effected by causing a liquid to spurt under pressure from one or more orifices with special shape and dimensions. Addition of a gas, for example steam, to the liquid in the atomizer itself promotes the atomization of the liquid. An atomizer wherein gas is added to the liquid to be atomized is in
20 the specification and claims indicated with the expression mix atomizer. When a fuel is to be atomized it is of importance to generate sprays of liquid droplets which are substantially uniformly distributed over the outlet area of the atomizer, in order to promote an optimal combustion of the liquid in the
25 combustion chamber.

Although the elucidation of the present invention to be given hereinafter will deal mainly with steam atomization of liquid, such as oil, it is explicitly stated here that the application of the proposed atomizer is not restricted thereto.

Steam may be replaced by, for example, air or refinery fuel gas. The steam may also be saturated to wet. Apart from application in combustion installations atomizers of the proposed type can also be used in spraying installations, for instance, for the purpose of the vaporization of a volatile component.

The object of the present invention is to provide a mix atomizer for the atomization of a liquid with a gas which apparatus is so designed that the velocity and flux of the liquid leaving the atomizer during operation are substantially uniformly distributed over the outlet area of the atomizer, in order to generate homogeneous liquid sprays, promoting optimal use of the liquid for combustion or other purposes.

The mix atomizer for the atomization of a liquid with gas according to the invention thereto comprises a first mixing chamber provided with inlet means for supplying a liquid and primary gas to form a mixture of liquid and gas, said first mixing chamber debouching into a second mixing chamber having cross-sectional areas being substantially larger than the cross-sectional areas of the first mixing chamber, means for tangentially supplying secondary gas around the mixture of liquid and gas passing through the second mixing chamber during operation, the second mixing chamber debouching into an outlet nozzle, having cross-sectional areas being substantially smaller than the cross-sectional areas of the second mixing chamber, the first mixing chamber, the second mixing chamber, and the outlet nozzle having substantially coinciding longitudinal axes.

In a suitable embodiment of the invention a plurality of the above-mentioned atomizers are combined in a single apparatus for atomization of a liquid, said apparatus having a single liquid supply and a single gas supply serving the plurality of mix atomizers.

The invention therefore further relates to an apparatus for the atomization of a liquid with gas, comprising a member having a longitudinal axis and being internally provided with a plurality

of mix atomizers according to the invention, terminating at the outer surface of a head of the member, the member being internally provided with one liquid supply channel and one gas supply channel, first passages forming fluid communications between the liquid supply channel and the first mixing chambers of the mix atomizers, second passages for supplying primary gas from the gas supply channel into said first mixing chambers, and third passages for tangentially supplying secondary gas from the gas supply channel into the second mixing chambers of the mix atomizers.

The invention will now be described by way of example only in more detail with reference to the accompanying drawings, in which

Figure 1 shows a longitudinal section of a mix atomizer according to the invention.

Figure 2 shows a longitudinal section of an apparatus for the atomization of a liquid provided with a plurality of mix atomizers according to the invention, and

Figure 3 shows a top view of the apparatus shown in Figure 2.

Figure 1 shows a mix atomizer, generally indicated by reference numeral 1, for atomizing a liquid, such as a heavy liquid fuel, with a gas. The mix atomizer 1 has as main components a first mixing chamber 2, a second chamber 3 being in fluid communication with the first mixing chamber 2, and an outlet nozzle 4 connected with the second mixing chamber 3. These three components have substantially coinciding longitudinal axes, while the cross-sectional areas of the second mixing chamber 3 and those of the outlet nozzle 4 are both substantially larger than the cross-sectional areas of the first mixing chamber 2. Further, the cross-sectional areas of the outlet nozzle 4 are chosen smaller than the cross-sectional areas of the second mixing chamber 3. Channels 5 and 6 are arranged in the atomizer for supplying a liquid to be atomized and atomizing

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gas, respectively, into the first mixing chamber 2 at or near the free end thereof. The channels 5 and 6 are positioned at an angle with respect to one another to promote intensive break-up of the liquid flow issuing from channel 5 by the gasflow from channel 6.

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For supplying gas into the second mixing chamber 3 the mix atomizer is provided with a ring-shaped channel 7 with passages 8 forming fluid communications between the channel 7 and said mixing chamber 3. These passages 8, being preferably uniformly distributed over the circumference of the second mixing chamber 3, are so positioned with respect to said second mixing chamber that gas from the ring-shaped channel 7 is tangentially introduced into said mixing chamber 3.

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Downstream of the ring-shaped channel 7 the second mixing chamber 3 has a substantially frusto-conically shaped side wall 9 tapering towards the outlet nozzle 4 thereby providing a smooth guiding for fluid from the channel 7 and the passages 8 towards the outlet nozzle 4.

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During operation of the mix atomizer shown in Figure 1 for the atomization of liquid fuel with steam, the liquid to be atomized and steam are introduced into the first mixing chamber 2. Owing to the impact of the steam flow on the supplied liquid flow, the liquid flow is broken up into small liquid fragments in the first mixing chamber 2. The breaking up of the liquid flow is promoted by causing the steam from the channel 6 to contact the liquid flow from the channel 5 at an angle. The so formed mixture of liquid fragments and steam enters the second mixing chamber 3, where secondary steam is added at sonic velocity to said mixture. Since the secondary steam is tangentially introduced at a high velocity into the second mixing chamber at a wide part thereof, the secondary steam will form an annulus around the core formed by the mixture of liquid fragments and primary steam from the first mixing chamber 2. The major part of the tangentially introduced steam flows substantially along

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the frusto-conically shaped wall 9 of the second mixing chamber 3 and follows its way along the wall of the outlet nozzle 4, thereby preventing direct contact of liquid with said walls. Such a contact might easily reduce the velocity of the liquid
5 flowing close to said walls, resulting in an irregular outflow pattern of the liquid over the outlet nozzle 4.

Since the cross-sectional areas of the outlet nozzle 4 are substantially smaller than the cross-sectional areas of the second mixing chamber 3, the velocity of the mixture of steam and
10 liquid fragments is substantially increased in the outlet nozzle 4, causing a further break-up of the liquid fragments. Owing to the presence of a shield of the tangentially supplied secondary steam the velocity and the density of the liquid fragments over the cross section of the outlet nozzle 4 will be substantially
15 uniform, which feature enables an effective combustion of the liquid in a not shown combustion chamber arranged downstream of the outlet nozzle 4. Upon leaving the mix atomizer the liquid/steam mixture will rapidly expand, resulting in the formation of a mist of very fine liquid droplets in the combustion space,
20 where the liquid droplets are contacted with blast for the combustion of the fuel.

Reference is now made to Figures 2 and 3 showing an apparatus for atomizing liquid, which apparatus is provided with a plurality of mix atomizers of a type discussed in the above
25 with reference to Figure 1.

This atomization apparatus comprises a member 10 provided with a central channel 11 for the supply of atomization fluid to a plurality of mix atomizers 12, and with a concentrically
30 positioned annular channel 13 for the supply of liquid, such as oil, to be atomized. The mix atomizers 12 are arranged in a head 14 of the apparatus 10.

The distance between the outlet nozzles of adjacent mix atomizers 12 should be chosen sufficiently large to prevent interference between adjacent outflowing streams of liquid

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droplets. A suitable arrangement of the mix atomizers 12 is the one shown in Figure 3, wherein the centres of the outlet nozzles of the mix atomizers 12 are positioned in a circular pattern, and wherein adjacent outlet nozzles are spaced apart from one another at 120 degrees. As shown in Figure 2 the head 14 of the apparatus 10 is frusto-conically shaped whereas the mix atomizers 12 are arranged perpendicular to the outer surface of said head 14. This arrangement enables the application of more mix atomizers without the risk of interference between adjacent mix atomizers than possible when using an apparatus having a flat head and the mix atomizers being arranged perpendicular to the flat outer surface of the head.

Each mix atomizer 12 is provided with a first mixing chamber 15, a second mixing chamber 16 and an outlet nozzle 17, wherein the second mixing chamber 16 is substantially wider than the first mixing chamber 15. The first mixing chamber 15, the second mixing chamber 16 and the outlet nozzle 17 of each mix atomizer 12 have coinciding longitudinal axes, positioned perpendicular to the frusto-conically shaped outer surface of head 14.

For supplying primary atomization fluid to the mix atomizers 12, a plurality of passages 18 are provided forming fluid communications between the central channel 11 and the first mixing chambers 15. Secondary atomization fluid is supplied via tangentially arranged passages 19 to the second mixing chambers 16 of the mix atomizers 12. These passages 19 form fluid communications between the mix atomizers 12 and a substantially ring-shaped channel 20 connected to the central channel 11 via a passage 21. For the supply of secondary atomization fluid to the mix atomizers 12 via tangentially arranged passages 19 as shown in Figure 2, the ring-shaped channel 20 surrounds the mix atomizers 12.

Fluid to be atomized is supplied to the first mixing chambers 15 of the mix atomizers 12 via a plurality of passages 22 forming a fluid communication between the annular liquid

channel 13 and the first mixing chambers 15.

The operation of the apparatus shown in Figures 2 and 3 is substantially the same as discussed with reference to the separate mix atomizer shown in Figure 1. When using the apparatus
5 shown in Figures 2 and 3 for the atomization of oil with steam, the mix atomizers 12 are supplied with oil and steam via a common liquid supply, viz. annular channel 13, and a common steam supply, viz. central channel 11, respectively.

It should be noted that the present invention is not
10 restricted to mix atomizers having second mixing chambers with frusto-conically shaped walls downstream of the secondary steam inlets. Instead thereof, other shapes of tapering walls may be applied, provided that there is a smooth passage for the secondary steam from the secondary steam inlets to the outlet
15 nozzle of the mix atomizer, guaranteeing that the secondary steam will form a shield flowing along the walls of the second mixing chamber and the outlet nozzle.

Although in the embodiments shown the mix atomizers are provided with central primary steam inlets in combination with
20 side inlets for liquid, these inlets may also be otherwise arranged, for example a combination of central liquid inlets with side primary steam inlets may be chosen for.

Further, the invention is not restricted to an apparatus with mix atomizers having the particular arrangement of a
25 central steam channel and an annular liquid channel as shown in Figure 2. Any other suitable arrangement may be applied, provided that the mix atomizers can be supplied with steam and liquid from a common steam channel and a common liquid channel, respectively.

30 Finally, it is noted that the invention is not restricted to an apparatus for atomization of a liquid having a frusto-conically shaped head. Instead thereof the apparatus can be provided with a flat-shaped head. With such a head the mix atomizers are preferably arranged at an acute angle with respect

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to the outer surface of the head having their outlet nozzles pointing away from one another to enable the positioning of a relatively large number of mix atomizers in the apparatus without the risk of interference between the fluid flows issuing from the atomizers during operation.

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C L A I M S

1. Mix atomizer for the atomization of a liquid with gas, comprising a first mixing chamber provided with inlet means for supplying a liquid and primary gas to form a mixture of liquid and gas, said first mixing chamber debouching into a second
5 mixing chamber having cross-sectional areas being substantially larger than the cross-sectional areas of the first mixing chamber, means for tangentially supplying secondary gas around the mixture of liquid and gas passing through the second mixing chamber during operation, the second mixing chamber debouching
10 into an outlet nozzle having cross-sectional areas being substantially smaller than the cross-sectional areas of the second mixing chamber, the first mixing chamber, the second mixing chamber and the outlet nozzle having substantially coinciding longitudinal axes.
- 15 2. Mix atomizer as claimed in claim 1, wherein the first mixing chamber is provided with separate inlet means for the liquid and primary gas, the inlet means being inclined towards one another.
- 20 3. Mix atomizer as claimed in claim 1 or 2, wherein the second mixing chamber is provided with a tapering wall portion for smoothly guiding secondary gas to the outlet nozzle.
- 25 4. Mix atomizer as claimed in any one of the claims 1-3, wherein the mix atomizer is provided with a plurality of tangentially disposed passages for tangentially supplying secondary gas into the second mixing chamber, said passages being substantially uniformly distributed over the circumference of the second mixing chamber.
- 30 5. Mix atomizer as claimed in any one of the claims 1-4, wherein the cross-sectional areas of the outlet nozzle are substantially larger than the cross-sectional areas of the first mixing chamber.

6. Apparatus for the atomization of a liquid with gas, comprising a member having a longitudinal axis and being internally provided with a plurality of mix atomizers as claimed in any one of the claims 1-5, terminating at the outer surface of a head of the member, the member being internally provided with one liquid supply channel for liquid and one gas supply channel, first passages forming fluid communications between the liquid supply channel and the first mixing chambers of the mix atomizers, second passages for supplying primary gas from the gas supply channel into said first mixing chambers and third passages for tangentially supplying secondary gas from the gas supply channel into the second mixing chambers of the mix atomizers.
7. Apparatus as claimed in claim 6, wherein the centres of the outlet nozzles are positioned in a circular pattern substantially equally spaced apart from one another.
8. Apparatus as claimed in claim 6 or 7, wherein the head of the member has a substantially frusto-conically shaped outer surface, the mix atomizers being arranged substantially perpendicular to said outer surface.
9. Apparatus as claimed in claim 6 or 7, wherein the head of the member has a substantially flat outer surface, the mix atomizers being arranged at an acute angle with respect to the outer surface of the head and having their outlet nozzles pointing away from one another.
10. Apparatus as claimed in any one of the claims 6-9, wherein one of the supply channels is substantially centrally arranged in the member, and the other supply channel is ring-shaped, the supply channels having substantially coinciding longitudinal axes.

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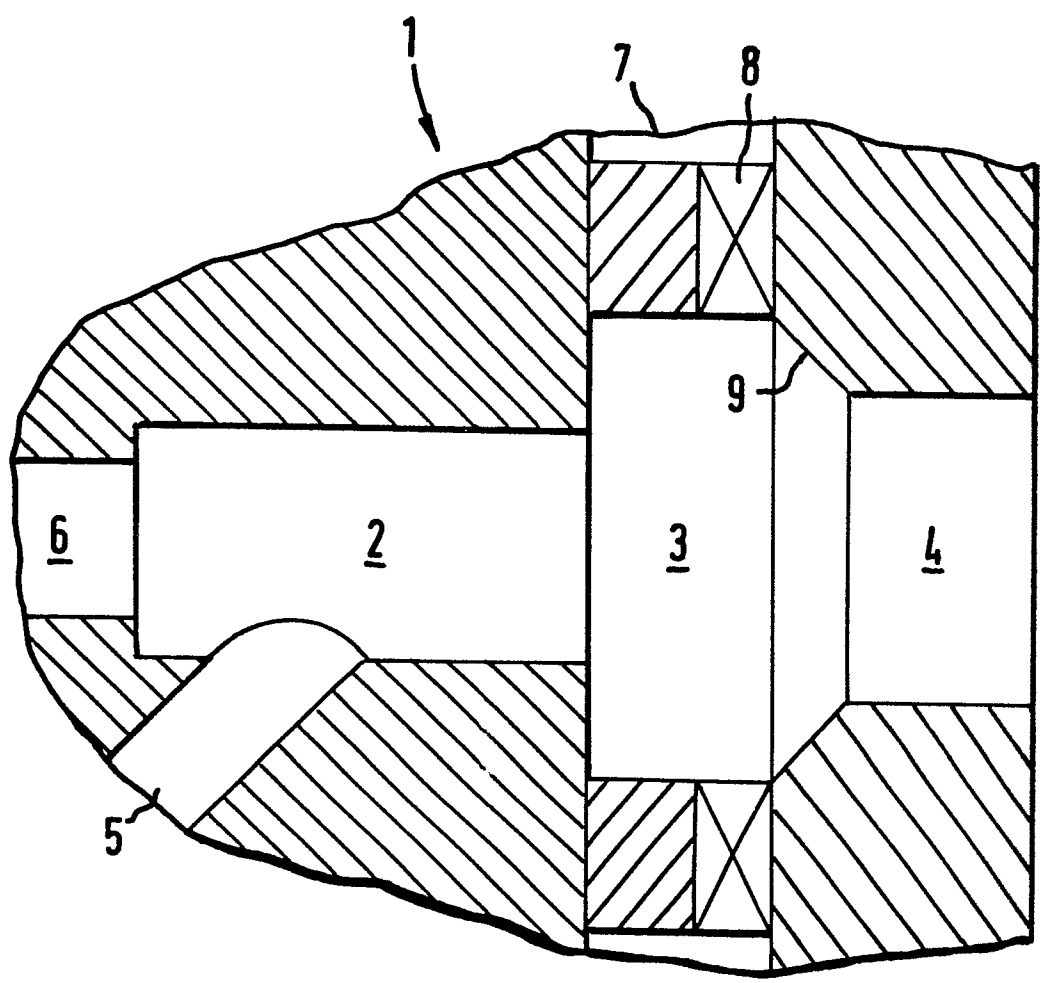


FIG.1

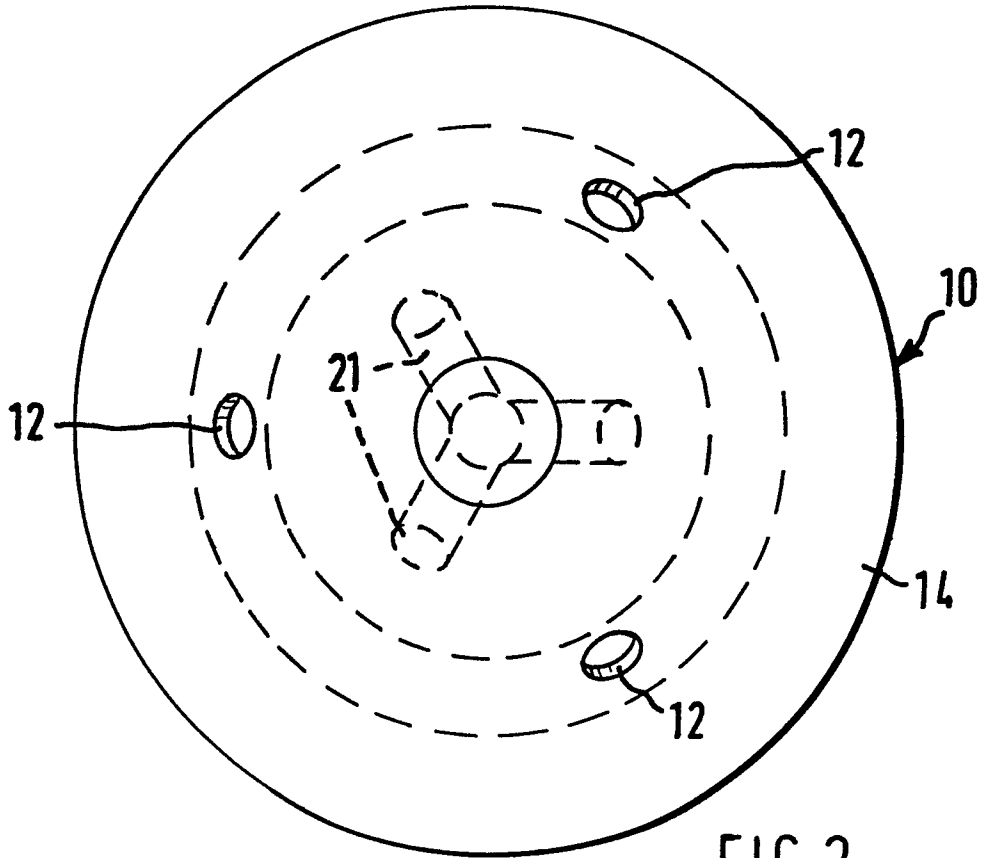


FIG. 3

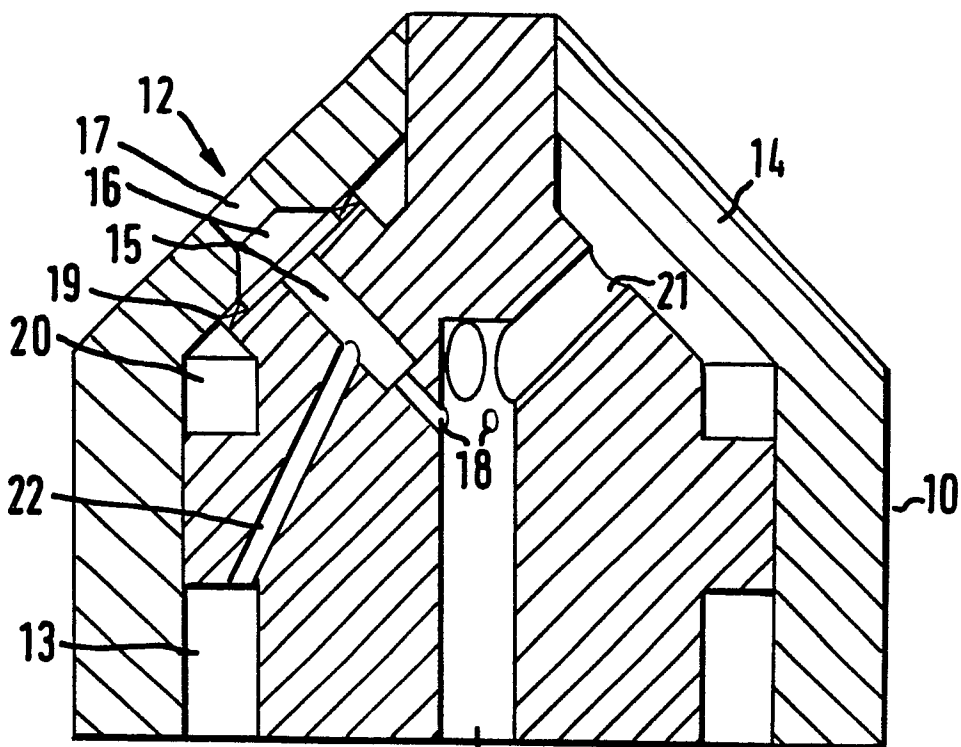


FIG. 2