

(19)



(11)

EP 2 865 942 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.04.2015 Bulletin 2015/18

(51) Int Cl.:
F23D 14/02 ^(2006.01) **F23D 14/72** ^(2006.01)
F23N 5/12 ^(2006.01)

(21) Application number: **13290253.7**

(22) Date of filing: **23.10.2013**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
 GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
 PL PT RO RS SE SI SK SM TR**
 Designated Extension States:
BA ME

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(54) **Gas mixing block for supplying a flame ionisation detector with different fuels**

(57) A mixing block (380) is disclosed for preparing a premix of combustible gas and air to be supplied to a flame detection electrode (382) or to an ignition electrode. The mixing block comprises:

- an outlet channel (384) for guiding a premix of combustible gas and air out of the mixing block,
- at least one inlet (384) for supplying air into the mixing block,
- at least two connections (388, 389) to connect different supplies of combustible gas to the mixing block,
- channels (392, 393) inside the mixing block to guide combustible gas from each of the at least two connections (388, 389). The at least two connections (388, 389) are

connectable via these channels (392, 393) towards the outlet channel (384) in the mixing block,

- a switch (396) for selecting from which of the at least two connections (388, 389) a flow connection is realized to the outlet channel (384).

The gas / air mixture supplying tubes of the detection electrodes (382), downstream the outlet channel (384), are to be placed proximate an infrared radiation burner, from which the flame can propagate to the tube exits, thereby igniting the fuel/air mixture leaving them. These flames are to be recognised then for the ionisation current through the flame detection electrodes (382).

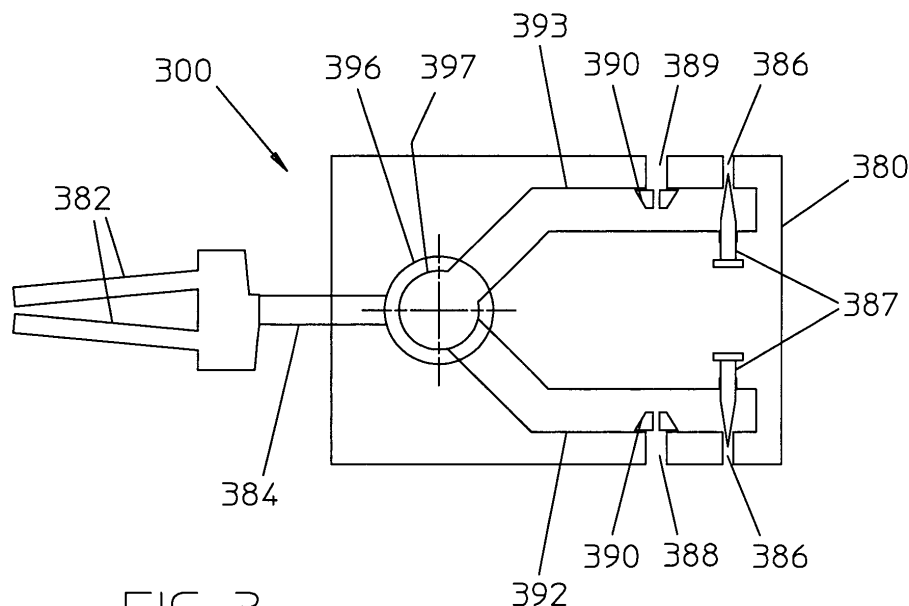


FIG 3

Description

Technical Field

[0001] The invention relates to gas mixing blocks for ignition electrodes and for flame detection electrodes for gas burner systems. The invention relates more specifically to the field of infrared radiation gas burner systems as are e.g. used in infrared drying of sheet like material such paper, board or coatings on metal sheets. In such radiation gas burner systems, ignition electrodes and flame detection electrodes are used. The invention relates to such electrodes that operate on a supply of premix gas, premixed using a gas mixing block.

The invention further relates to ignition electrodes, to flame detection electrodes and to methods of using the electrodes in gas fired infrared drying or curing systems, e.g. in such continuous systems.

Background Art

[0002] In infrared radiation gas burner systems, electrodes are used to detect the presence of combustion of gas by the gas burners. A commonly used type of electrode comprises a gas supply (which is a premix of combustible gas and air) in a tubular supply in the electrode, and two electrical conductors. The premix of combustible gas and air is prepared in a mixing block. The flame detection electrode is positioned close to the infrared gas burner. If combustion of gas occurs at the infrared radiation gas burners, a flame is present at the infrared radiation gas burner. Via contact propagation, a flame will be generated in the gas supplied to the flame detection electrode. The flame will close an electrical circuit between the two electrical conductors of the electrode. An electrical current - the ionization current - is generated. The presence of the ionization current indicates the presence of combustion at the gas burner, absence of the electrical current indicates absence of combustion at the gas burner. The electrodes serve as safety devices: if no flame is present at the gas burners, the electrodes detect it and shut off the gas supply to the gas burners. Flame detection electrodes are continuously supplied with premix gas during the operation of the radiation gas burners in order to have a continuous monitoring of the presence of combustion on the radiation gas burners when combustible gas is supplied to them.

[0003] Ignition electrodes - electrodes to ignite the gas premix supplied to the infrared radiation gas burners - can be similar as the flame detection electrodes. Gas is mixed with air in a mixing block and the premix is sent through a tube. A voltage is applied between two electrical conductors, generating a spark that ignites the gas between the two electrical conductors. The flame of the ignition electrode ignites via contact propagation the infrared radiation gas burner near to which it is located. Flame detection electrodes will detect that the infrared radiation gas burners have been ignited and premix gas

supply to the ignition electrodes will be shut off.

[0004] For obvious reasons, it is common practice to supply the same combustible gas to the infrared radiation gas burners as to the ignition and or flame detection electrodes. For safety reasons, the premix of combustible gas and air is made close to where the premix is to be burnt. It means that the flame detection electrodes and/or the ignition electrodes are supplied by another (and separate) premixing unit or mixing block than the infrared radiation gas burners. In the premixing unit, the combustible gas is entered at a certain pressure through an injector and air is supplied and combustible gas and air are mixed. For operational efficiency and for durability of the electrodes, the premix parameters have to be set right and in tight control.

[0005] Infrared radiation gas burner systems exist that can operate on different types of combustible gas, e.g. on natural gas, on propane, on butane... The gas supply system to such infrared radiation gas burner system is adapted in such a way that a mere change of the gas supply (feed other gas to the supply line) and setting of the appropriate gas pressure and air supply pressure suffices to obtain correct premixing. However, this approach does not work properly for the gas supply to the flame detection electrodes and to the ignition electrodes. The premixing unit of each of the flame detection or ignition electrodes of the infrared radiation gas burner system has to be adapted and tuned manually, e.g. exchange and tuning of injector, exchange and tuning of diaphragm, setting of gas and/or air pressure. As infrared radiation gas burner systems can - dispersed over their surface - comprise a large number of ignition and flame detection electrodes (each with a separate mixing block), such adaptations are time consuming and costly. The tuning has to be done in a precise way. Due to the vulnerability of the electrodes (especially of the flame detection electrodes as these are in continuous operation during operation of the infrared radiation gas burners), incorrect adaptation of the flame detection electrodes when changing gas supply results in reduced lifetime of the flame detection electrodes.

Disclosure of Invention

[0006] It is an objective of the invention to provide a reliable mixing block that can be operated with different kinds of combustible gasses, for use in ignition electrodes and in flame detection electrodes in infrared radiation gas burners.

It is a further objective to provide a mixing block for ignition electrodes and for flame detection electrodes that can be changed over easily for operation with a different type of combustible gas.

[0007] A first aspect of the invention is a mixing block for preparing a premix of combustible gas and air to be supplied to a flame detection electrode or to an ignition electrode. The mixing block comprises

- an outlet channel for guiding the premix of combustible gas and air out of the mixing block,
- at least one inlet for supplying air into the mixing block,
- at least two connections to connect different supplies of combustible gas to the mixing block,
- channels inside the mixing block to guide combustible gas from each of the at least two connections, wherein the at least two connections are connectable via said channels towards the outlet channel in the mixing block.

A switch is provided in the mixing block for selecting from which of the at least two connections a flow connection is realized to the outlet channel in the mixing block.

[0008] It is a benefit of the mixing block of the invention that an easy, fast and reliable change-over can be performed from one type of combustible gas to another type of combustible gas that will be used in the electrode. By activating the switch, the change-over of combustible gas connection is made. The invention allows that all relevant parts or settings (e.g. the installation and setting of appropriate injectors for each gas type) for each of the at least two combustible gases can be made beforehand, e.g. when installing the system. As the change-over can be done in a reliable way, it avoids that settings are not appropriate, which could result in lower lifetime of the electrodes.

[0009] In a preferred embodiment, the switch comprises a flow channel inside it. By actuating the switch in the mixing block the flow channel in the switch is positioned in such a way to create gas flow connection between one of the at least two connections and the outlet channel. The switch can e.g. be mounted rotatable in the mixing block, so that by rotation of the switch, the flow channel in the switch is positioned in such a way to create gas flow connection between one of the at least two connections and the outlet channel.

[0010] In a preferred embodiment, when the mixing block is in use, the premix of combustible gas and air is created in the mixing block after the flow of combustible gas has passed the switch. In this embodiment, it is possible to equip the mixing block with one air inlet only, resulting in a more simple construction of the mixing block.

In another preferred embodiment, when the mixing block is in use, the premix of combustible gas and air is created in the mixing block before the flow of combustible gas has passed the switch. In this embodiment, it is recommended to equip the mixing block with separate air inlets for each of the combustible gas supply connections. This allows to optimally define the air inlets (e.g. appropriate diaphragms of the air inlet) to the combustible gas supply connection, for optimal correspondence of air inlet parameters (pressure, flow rate) with the combustible gas supply parameters (pressure, flow rate) of the combustible gas supply the air inlet is paired with.

[0011] In a preferred embodiment, the switch can be operated manually.

[0012] In a preferred embodiment, the switch can be operated via a control system.

5 **[0013]** In a preferred embodiment, means are provided for setting the pressure of at least one of the combustible gas supplies, preferably for each of the combustible gas supplies; and/or of the air supply.

10 **[0014]** In a preferred embodiment, means are provided for setting the flow rate of the supply of the air that is used to create the premix of combustible gas and air; and/or of at least one of the combustible gas supplies, preferably for each of the combustible gas supplies.

15 **[0015]** In a preferred embodiment, at least two connections at the mixing block are provided each with an injector for a different combustible gas type, e.g. one for natural gas and one for propane.

20 **[0016]** Preferably, the mixing block comprises the same number of air inlets as the number of combustible gas inlet connections. Each of the air inlet can be provided with appropriate parts and/or appropriate settings for the combustible gas type towards which they can supply air, e.g. the air inlets can be provided with appropriate diaphragms so that the correct air flow will be supplied for the gas flow of the combustible gas type with which the air inlet is paired. In an alternative embodiment, the mixing block comprises one air inlet, preferably only one air inlet.

25 **[0017]** A second aspect of the invention is a flame detection electrode for use in infrared radiation gas burner systems, comprising

- a mixing block as in the first aspect of the invention,
- a tube for the premix of combustible gas and air supply, in flow connection from the outlet channel of the mixing block; wherein when the flame detection electrode is in use the premix of combustible gas and air can be ignited at an outlet of the tube by the operation of an infrared radiation gas burner;
- 35 - two electrical conductors that can be electrically connected by means of ionization current through the flame that originates when the flow of the premix through the tube is ignited, for detection of the correct operation of the infrared radiation gas burner by means of the current generated through the electrical conductors.

40 **[0018]** In a preferred flame detection electrode, one of the two electrical conductors is positioned inside the tube and the second electrical conductor is the tube or part of the tube or connected to the tube.

45 **[0019]** Preferably two flame detection electrodes are supplied in parallel with premix from the outlet channel, resulting in a more reliable flame detection system.

[0020] A third aspect of the invention is an ignition electrode for use in infrared radiation gas burner systems, comprising

- a mixing block as in the first aspect of the invention;
- a tube for the premix of combustible gas and air supply, in flow connection from the outlet channel of the mixing block;
- two electrical conductors over which a voltage can be applied, for generating a spark via the voltage, thereby igniting a premix of combustible gas and air flowing through the tube.

[0021] A fourth aspect of the invention are gas fired infrared emitter systems comprising one or more flame detection electrodes comprising a mixing block of the first aspect of the invention and/or comprising one or more ignition electrodes comprising the mixing block of the first aspect of the invention.

[0022] In exemplary systems, the system is equipped with a fan and air channels for the supply of air to the mixing block via the at least one inlet for supplying air into said mixing block.

[0023] In exemplary systems, a first connection of the mixing block is connected to a supply of a first type of combustible gas; and a second connection of the mixing block is connected to a supply of a second type of combustible gas.

[0024] A fifth aspect of the invention is a method for changing over combustible gas supply in a mixing block, wherein a mixing block is used as in the first aspect of the invention and wherein the switch is actuated to select the combustible gas supply between the at least two connections at the mixing block. Preferably the change-over of combustible gas is performed without modifying settings in the mixing block besides the actuation of the switch and without exchanging parts in the mixing block.

[0025] A sixth aspect of the invention is a method of operating a gas fired infrared emitter system as in the fourth aspect of the invention, wherein the gas fired infrared emitters of the gas fired infrared emitter system can be operated on two or more types of combustible gas. When changing over the operation of the gas fired infrared emitters from one type to another type of combustible gas, the switches of the mixing blocks are actuated in order to change over the combustible gas supply to the mixing blocks of the electrodes, for operation of the gas fired infrared emitters and the electrodes on the same type of combustible gas as the gas fired infrared emitters. Preferably the change-over of combustible gas is performed without having to modify settings in the mixing block besides the actuation of the switch and without having to exchange parts in the mixing block. In an exemplary embodiment, the gas fired infrared emitter systems are provided in continuous drying or curing installations, e.g. for the continuous treatment of web like material, such as paper, board or metal strip.

Brief Description of Figures in the Drawings

[0026] Figures 1 and 2 shows an electrode as can be used in the invention as detection electrode or as ignition

electrode.

Figures 3 and 4 show schematic representations of embodiments of electrode systems comprising a mixing block as in the first aspect of the invention.

Mode(s) for Carrying Out the Invention

[0027] Figure 1 shows a flame detection electrode as can be used in the invention. A housing 110 comprises an electrode 120. The electrode 120 comprises a tube 130 through which a premix of combustible gas (e.g. natural gas, e.g. propane gas) with air is supplied. The tube 130 can be made out of electrically conductive material, e.g. Inconel, or the tube 130 can have a ribbon like section made out of electrically conductive material at the inside of the tube 130. An electrical conductor 140 (e.g. in Inconel) is put inside the tube 130, electrically insulated from the tube by a spacer 150. Figure 2 shows the electrode 120 with the tube taken away, in order to show electrical conductor 140 and spacer 150. The electrical conductor 140 and the tube 130 - the latter is not shown on figure 2 - are mounted on a holder 160. Premix gas will be supplied to flow through the tube (which is not shown on figure 2). The spacer 150 has openings that allow the premix gas to flow through the tube. When the premix gas flowing through tube 130 is ignited by flame carry-over from the gas fired infrared emitter on which the flame detection electrode is used, the presence of the flame at the end of the tube 130 creates an electrical contact between tube 130 and electrical conductor 140. The presence of electrical current (ionization current) that flows through this electrical contact is detected as evidence of combustion being present.

[0028] In a similar way, the electrode of figures 1 and 2 can be used as ignition electrode. When a premix of combustible gas is supplied through tube 130 a voltage applied between the two electrical conductors can generate a spark that ignites the flow of premix gas through the tube.

[0029] Figure 3 shows an electrode system 300 comprising a mixing block 380 as in the first aspect of the invention. The mixing block 380 serves to prepare a premix of combustible gas and air to be supplied to one or more electrodes 382. The electrodes can be flame detection electrodes or ignition electrodes, e.g. of the type as described in figures 1 and 2. Figure 3 shows two electrodes in parallel that are supplied by the same mixing block 380. Such a configuration is especially beneficial for flame control electrodes, as it allows that detection is still possible if one of the two flame detection electrodes is defective.

The mixing block 380 comprises

- an outlet channel 384 for guiding the premix of combustible gas and air out of the mixing block.
- two inlets 386 to supply air into the mixing block,
- two connections 388, 389 to connect different supplies of combustible gas to the mixing block. One

connection can e.g. be connected to a natural gas supply, and the second connection can e.g. be connected to a propane supply or a butane supply.

- channels 392, 393 inside the mixing block to guide combustible gas from the two connections 388, 389.

The two connections 388, 389 are connectable towards the outlet channel 384 in the mixing block 380 via the channels 392, 393 for the two connections.

The mixing block 380 further comprises a switch 396. The switch 396 allows to select from which of the at least two connections 388, 389 a flow connection is realized to the outlet channel 384 of the mixing block 380.

[0030] The switch 396 shown in figure 3 comprises a flow channel 397 inside the switch 396. The switch 396 is actuated by rotating it, through which the flow channel 397 in the switch 380 can be positioned in such a way to create gas flow connection between one of the at least two connections 388, 389 and the outlet channel 384. In figure 3, the switch 396 is in the position that a flow connection is made between combustible gas supply connection 389 via channel 393 and the flow channel 397 to the outlet channel 394.

[0031] In the mixing block 380 of figure 3, the premix of combustible gas and air is created in the mixing block 380 before the flow of combustible gas has passed the switch 396.

[0032] Mixing blocks can be provided wherein the switch can be operated manually. It is also possible to provide mixing blocks wherein the switch can be operated via a control system.

[0033] Means 387 can be foreseen for setting the pressure and/or the flow rate of the air supplies. Such means can e.g. be a diaphragm; or via a needle (see 387 in figure 3).

[0034] Means 390 can be foreseen for setting the pressure and/or the flow rate of the combustible gas supplies. Such means can e.g. be an injector 390. The injector for each of the connections 388, 389 for combustible gas supply can best be selected to suit the particular gas supply.

[0035] Figure 4 shows an electrode system 400 comprising a mixing block 480 as in the first aspect of the invention. Reference numbers in figure 4 identical to the reference numbers in figure 3 have the same meaning as in figure 3. Contrary to the electrode system of figure 3, the mixing block 480 in the electrode system 400 in figure 4 has only one inlet 486 to supply air into the mixing block. The premix of combustible gas and air is created in the mixing block 480 after the flow of combustible gas has passed the switch 396. In figure 4, the switch 396 is in the position that a flow connection is made between combustible gas supply connection 388 via channel 392 and the flow channel 397 inside the switch 396 to the outlet channel 394.

[0036] The electrode systems 300, 400 shown in figures 3 and 4 can e.g. be used in gas fired infrared emitter systems.

Claims

1. Mixing block(380, 480) for preparing a premix of combustible gas and air to be supplied to a flame detection electrode or to an ignition electrode, comprising

- an outlet channel (384) for guiding said premix of combustible gas and air out of said mixing block,

- at least one inlet (386, 486) for supplying air into said mixing block, **characterized in that** said mixing block comprises

- at least two connections (388, 389) to connect different supplies of combustible gas to said mixing block, and

- channels (392, 393) inside the mixing block to guide combustible gas from each of said at least two connections (388, 389),

wherein the at least two connections (388, 389) are connectable via said channels (392, 393) towards the outlet channel (384) in the mixing block and; wherein a switch (396) is provided in said mixing block, for selecting from which of the at least two connections (388, 389) a flow connection is realized to said outlet channel (384) in said mixing block.

2. Mixing block as in claim 1, wherein said switch (396) comprises a flow channel (397) inside said switch (396) and whereby by actuating said switch said flow channel (397) can be positioned in such a way to create gas flow connection between one of said at least two connections (388, 389) and said outlet channel (384).

3. Mixing block as in any of the preceding claims, wherein in use the premix of combustible gas and air is created in said mixing block before or after the flow of combustible gas has passed said switch.

4. Mixing block as in any of the preceding claims, wherein said switch can be operated manually.

5. Mixing block as in any of the preceding claims, wherein said switch can be operated via a control system.

6. Mixing block as in any of the preceding claims, wherein means are provided for setting the pressure of at least one of said combustible gas supplies, preferably for each of said combustible gas supplies; and/or of said air supply.

7. Mixing block as in any of the preceding claims, wherein means are provided for setting the flow rate of the supply of the air that is used to create said premix of combustible gas and air; and/or of at least

one of said combustible gas supplies, preferably for each of said combustible gas supplies .

8. Mixing block as in any of the preceding claims, wherein at least two connections at the mixing block are provided each with an injector for a different combustible gas type. 5
9. Mixing block as in any of the preceding claims, wherein the mixing block comprises the same number of air inlets as the number of combustible gas inlet connections. 10
10. Flame detection electrode for use in infrared radiation gas burner systems, comprising 15
 - a mixing block as in any of the preceding claims,
 - a tube for said premix of combustible gas and air supply, in flow connection from said outlet channel of said mixing block; wherein when the flame detection electrode is in use the premix of combustible gas and air can be ignited at an outlet of said tube by the operation of an infrared radiation gas burner; 20
 - two electrical conductors that can be electrically connected by means of ionization current through the flame that originates when the flow of said premix through said tube is ignited, for detection of the correct operation of said infrared infrared radiation gas burner by means of the current generated through said electrical conductors. 25
11. Flame detection electrode as in claim 10, wherein one of said two electrical conductors is positioned inside said tube and the second electrical conductor is said tube or part of said tube or connected to said tube. 30
12. Ignition electrode for use in infrared radiation gas burner systems, comprising 35
 - a mixing block as in claims 1 - 9;
 - a tube for said premix of combustible gas and air supply, in flow connection from said outlet channel of said mixing block; 40
 - two electrical conductors over which a voltage can be applied, for generating a spark via said voltage, thereby igniting a premix of combustible gas and air flowing through said tube. 45
13. Gas fired infrared emitter system comprising one or more flame detection electrodes comprising a mixing block as in claims 1 - 9; and/or comprising one or more ignition electrodes comprising a mixing block as in claims 1 - 9. 50

14. Method for changing over combustible gas supply in a mixing block, wherein a mixing block is used as in claims 1 - 9 and wherein said switch is actuated to select the combustible gas supply between said at least two connections at the mixing block.

15. Method of operating a gas fired infrared emitter system as in claim 13, wherein the gas fired infrared emitters of the gas fired infrared emitter system can be operated on two or more types of combustible gas, and wherein when changing over the operation of the gas fired infrared emitters from one type to another type of combustible gas, the switches of said mixing blocks are actuated in order to change over the combustible gas supply to the mixing blocks of the electrodes; for operation of the gas fired infrared emitters and the electrodes on the same type of combustible gas as the gas fired infrared emitters.

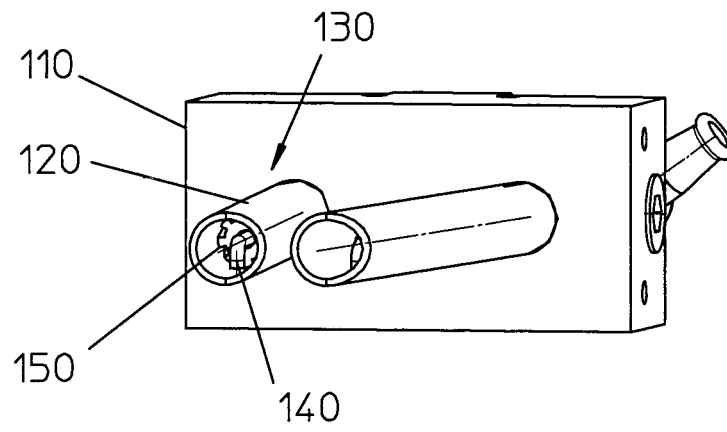


FIG 1

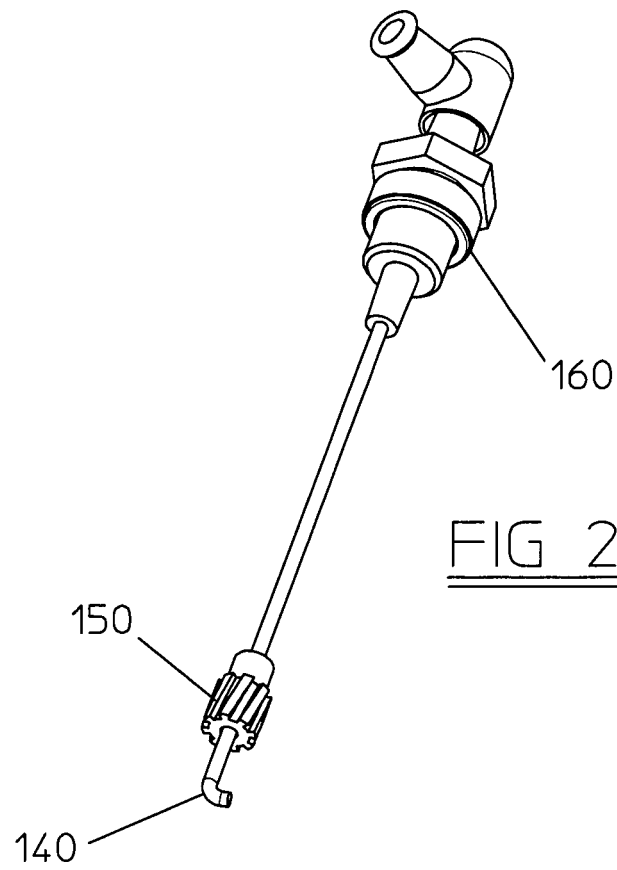
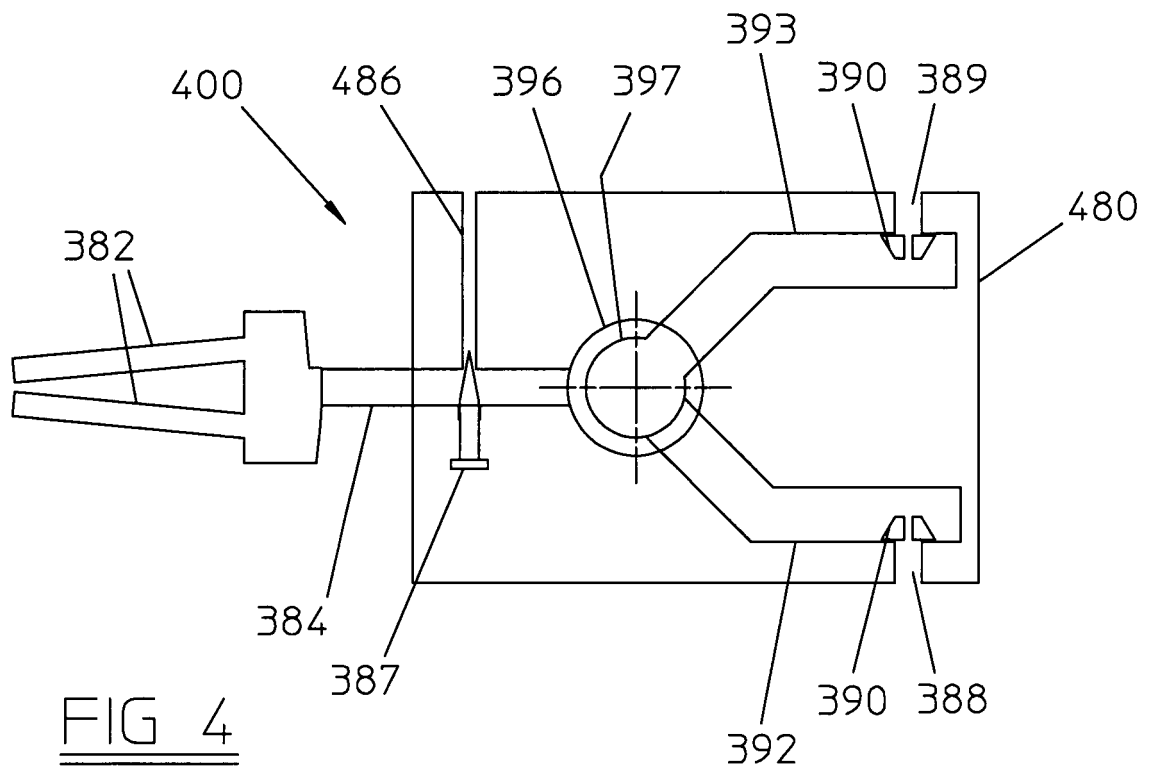
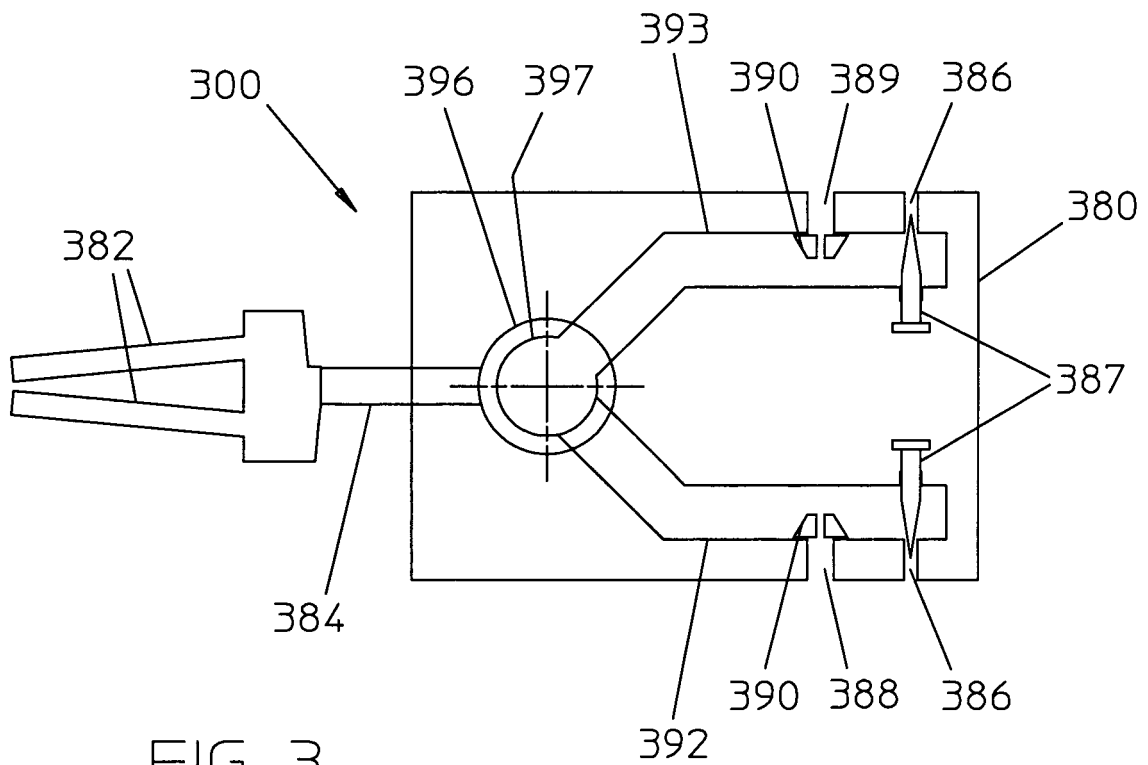


FIG 2





EUROPEAN SEARCH REPORT

Application Number
EP 13 29 0253

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2009/280448 A1 (ANTXIA URIBETXEBARRIA JOSE JOAQUIN [ES] ET AL) 12 November 2009 (2009-11-12) * paragraphs [0002], [0004] - [0008], [0015], [0016], [0019] - [0023]; figures 1, 4 *	1,3,7,8, 10,12-14	INV. F23D14/02 F23D14/72 F23N5/12
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			TECHNICAL FIELDS SEARCHED (IPC)
			F16K F23D F23N
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 December 2013	Examiner Vogl, Paul
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 13 29 0253

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