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(54) Title
DEVICE AND PROCESS FOR BURNING OXIDISABLE COMPONENTS IN A VEHICLE GAS TO BE PURIFIED

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(56) Prior Art Documents
FR 2556446
FR 2248470

(57) Claim

1. Device for the combustion of oxidizable constituents in a carrier gas to be cleaned, involving a gas inlet (36), a burner (19) with attached flame tube (22), which opens into a main combustion chamber (24) with bottom and side walls (21, 20) if necessary divided into sections (23, 25), a combustion chamber outlet (26) preferably on the bottom wall (21) of the opposite side wall of the main combustion chamber, a heat exchanger (32) and a gas outlet (38),
characterized in
that the main combustion chamber (24) is shaped in such a way and/or is provided with at least one deflecting element (40, 42, 44) in such a way that the gas flowing from the bottom wall (21) in direction of the combustion chamber outlet (26) is distributed uniformly or to a large extent uniformly when viewed over the cross section of the main combustion chamber.
13. Method for the combustion of oxidizable constituents in a carrier gas to be cleaned in a device (10) comprising a main combustion chamber (24) starting from a flame tube (22) and limited by bottom and side walls (20), in which cleaned gas is diverted by the bottom wall (21) in direction of a combustion chamber outlet (26) preferably coaxially arranged with respect to the flame tube.

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c h a r a c t e r i z e d i n

that the gas diverted by the bottom wall (21) in direction of the combustion chamber outlet (26) is directed over the cross section of the annular space such that the gas flows and is basically uniformly distributed over the cross section of the main combustion chamber.



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CN, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK,
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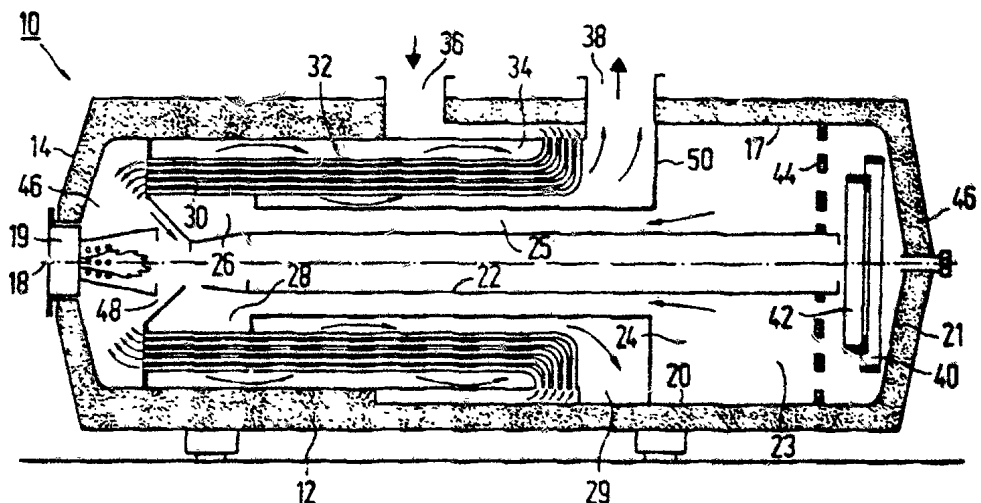
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(54) Title: DEVICE AND PROCESS FOR BURNING OXIDISABLE COMPONENTS IN A VEHICLE GAS TO BE PURIFIED

(54) Bezeichnung: VORRICHTUNG UND VERFAHREN ZUM VERBRENNEN OXIDIERBARER BESTANDTEILE IN EINEM ZU
REINIGENDEN TRÄGERGAS

(57) Abstract

The invention relates to a process and a device for burning oxidisable components in a vehicle gas to be purified, comprising a gas inlet (36), a burner (19) with an attached flame pipe (22) opening into a main combustion chamber (24) comprising a bottom and side walls, an annular chamber leading from the side of the main combustion chamber bottom (21), a heat exchanger (32) around which flows the purified gas and through which flows the gas to be purified, and a gas outlet (38). To obtain good combustion with a compact construction, especially to make the best possible use of the geometric dwell time in the main combustion chamber, it is proposed that the main combustion chamber be constructed in such a way and/or has such guide components (40, 42, 44) that the gas flowing from the bottom towards the annular chamber is distributed completely or largely uniformly over the cross-section of the main combustion chamber.



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PCT/EP94/00539

DescriptionDevice and Process for Burning Oxidisable Components in a Vehicle Gas to be Purified

The invention relates to a device for the combustion of oxidizable constituents in a carrier gas to be cleaned, comprising a gas inlet, a burner with attached flame tube, which opens into a main combustion chamber comprising bottom and side walls, a combustion chamber outlet preferably on the side wall opposite the bottom wall of the main combustion chamber, a heat exchanger and a gas outlet.

In addition, the invention relates to a method for the combustion of oxidizable constituents in a carrier gas which is to be cleaned in a device consisting of a main combustion chamber starting from a flame tube and limited by bottom and side walls, in which cleaned gas is diverted from the bottom wall in the direction of a combustion chamber outlet placed coaxially radially or tangentially with respect to the flame tube.

A device of the type described above can be seen in EP 0 235 277 B1. The flame tube of this device, which is termed a high-speed mixing chamber, opens into the main combustion chamber, cross section of which is larger than the free cross section of flow in the high-speed mixing chamber. The main combustion chamber extends on the outside along the high-speed mixing chamber, which is in the form of a tube. It then changes into a ring-shaped channel



running coaxially to the high-speed mixing chamber, which itself changes into a further channel-type annular space also placed around the high-speed mixing chamber and partly around the ring-shaped channel. A heat exchanger is located in the annular space whose tubes are bent outwards at their colder ends.

In other known systems, the main combustion chamber, flow section of which is also larger than that of the high-speed mixing chamber, extends completely along the high-speed mixing chamber and then preferably ends radially in a heat exchanger, which is preferably arranged in a ring-shaped channel.

Installations in which the heat exchanger is accommodated in a separate housing are also known.

In all these known combustion systems, the gas leaves the high-speed mixing chamber in the form of a free jet. This jet impinges on the bottom wall of the main combustion chamber and is distributed there in a rotationally symmetrical manner corresponding to the flow geometry of the baffle plate flow. High centrifugal forces cause the gas to flow both along the bottom wall and, after a further diversion, like a ring jet axially along the inside surface of the side wall of the combustion chamber. The cross section surface of this ring jet along the side wall of the main combustion chamber up to the combustion chamber outlet increases only slightly, so that a stationary vortex area forms between the ring jet and the outside wall of the high-speed mixing chamber. This results in less than optimum utilization of the main combustion chamber, because of the very wide residence time distribution of the gas as a result of vortex formation. This means that the minimum residence time of the gas in the main combustion chamber is considerably less than the theoretical residence time, which is calculated as the quotient of the volume of the main combustion chamber and the gas flow in it.

The present invention is based on the problem of how to further develop a device or method of the type described above in such a way that the volume of the main combustion chamber is used in an optimum manner to combust the oxidizable constituents in the carrier gas.



With regard to the device, this task is essentially solved by shaping the main combustion chamber in such a way and/or by providing it with a deflecting element of such a kind that the gas flowing from the bottom in the direction of the combustion chamber outlet is distributed equally when viewed over the cross section of the main combustion chamber.

The deflecting element may be a baffle plate, perforated plate and/or a guiding ring or a similar flow-distributing device such as reflector cones, conical baffle plates, and guide vanes. Preferably at least two deflecting elements are placed in the main combustion chamber.

One embodiment of the invention provides for the deflecting element to be shaped symmetrically as a plane in which the longitudinal axis of the main combustion chamber runs. In particular, the deflecting element can be shaped so that it is rotationally symmetrical to the longitudinal axis.

Also, the deflecting element may be a screen such as a resistance grid.

The deflecting element or elements are preferably placed between the outlet of the flame tube and the bottom wall of the main combustion chamber. The deflecting elements may also be placed coaxially around the flame tube or deflecting elements may be placed both between the outlet of the flame tube and the bottom wall and coaxially with the flame tube.

In accordance with the teaching of the present invention, a distribution of the flow of the gas mixture takes place in the entire main combustion chamber. The device in accordance with the invention has the particular advantage that a clear reduction in the main combustion chamber temperature and a reduction in the main combustion chamber volume can be achieved while the residual concentration of oxidizable constituents in the cleaned carrier gas remains the same or the residual concentration is reduced while the main combustion chamber temperature remains the same and the main combustion chamber volume remains the same.



With regard to the method, the invention is characterized in that particularly the partially cleaned gas diverted from the bottom wall in the direction of the combustion chamber outlet is directed in such a way that the flowing gas is distributed equally across the cross section of at least a section of the main combustion chamber. This particularly means that the diverted gas can be basically directed too the combustion chamber outlet while remaining free of turbulence and return flow. This results in complete utilization of the combustion chamber and prevents more completely cleaned gas from mixing with less completely cleaned gas.

Futher details, advantages and characteristics of the invention result not only from the claims, from the features which can be derived from them - in themselves and/or in combination - but also from the following description of the preferred embodiments which can be seen from the drawing.

The following are shown:

Fig. 1 a first embodiment of a device for the combustion of oxidizable constituents in a carrier gas to be cleaned and

Fig. 2 a second embodiment of a device.

In Figs. 1 and 2, devices are shown for the combustion of oxidizable constituents in a carrier gas to be cleaned which can also be termed afterburning devices. The devices (10) involve a cylindrical outer casing (12), which is limited by the front walls (14) and (16). In Fig. 1, one front wall (16) is at the same time the bottom (21) of a main combustion chamber (24), while in Fig. 2 the front wall limits an inlet annular space (45) whose opposite wall is at the same time the bottom (21) of a main combustion chamber (24).



In the region of the front wall (14) in each case, a burner (19) is placed concentrically to the longitudinal axis of the device. Attached to this are a flame tube (22) preferably designed as a high-speed mixing chamber, and the main combustion chamber (24). It is not absolutely necessary for the flame tube (22) to extend into the main combustion chamber. (24).

In the example given in Fig. 1, the main combustion chamber (24) is subdivided into a first section (23) with a large cross-sectional area and a second section (25) with a small cross-sectional area. The first section (23) is arranged annularly with respect to the axis (18) of the device (10) and limited by the front wall (16), by sections (17) of the outer casing (12) and by an intermediate wall (50). The second section (25) of the main combustion chamber is an annular space around the flame tube (22), starting from the intermediate wall (50) and ending in a further annular space (28), in which heat exchanger tubes (30) of a cross counterflow heat exchanger (32) are placed concentrically to the axis (18) of the device (10), and thus also concentrically to the flame tube (22). The heat exchanger tubes (30) lead into an outer annular space (34) bordering the outer wall (12), in which there is an inlet (36). Between the outer annular space (34) and the front wall (16) limiting the main combustion chamber (24), the annular space (28) with the heat exchanger tubes (30) ends in an outlet (38), which penetrates the outer wall (12) of the device (10).

In the embodiment shown in Fig. 2, the flame tube (22) is completely surrounded by the main combustion chamber (24) and opens directly and in a radial manner into an annular space (28) arranged concentrically to the axis (18) of the device (10), where the heat exchanger tubes (30) are located. The heat exchanger tubes (30) lead on the other side into the inlet annular space (45) inside the outer casing (12). The inlet annular space is limited by a section of the outer casing (12), the bottom on the front (16), the combustion chamber bottom (21), sections of the casing (20) surrounding the main combustion chamber (24) and an intermediate wall in the shape of a tube bottom (53), and it has an inlet shaped in the form of a nozzle (36) for the carrier gas.



In accordance with the invention, deflecting elements (40), (42), (44) are placed in the main combustion chambers (24) which result in a uniform, basically equidirectional flow over the entire cross sections of the main combustion chambers (24) and over the cross sections of the individual sections of the main combustion chambers (24).

The deflecting elements may direct the flow both by means of low form drags and by means of large form drags. For example, the deflecting elements (40) and (42) in the form of a guiding ring or a baffle plate may create low form drag, and on the other hand deflecting elements (44) in the form of perforated plates or resistance grids or in the form of screens may create a large form drag.

In order to obtain the effect in accordance with the invention, the deflecting elements, particularly the deflecting elements (40) and (42), have to be shaped in such a way that a shearing of partial volume flows of the rotationally symmetrical flow to the bottom (21) of the main combustion chamber (24) and a diversion by 90° in the direction of the combustion chamber outlet (26) is caused.

The deflecting element (44) which surrounds the end region of the flame tube (22) in each case in the embodiments in the form of a perforated plate, a resistance grid, screen or something of the like, constitutes high flow resistance, which causes a distribution of the flow formed on one side on the outer casing of the main combustion chamber (24) over the entire cross section of the main combustion chamber as a result of the high velocities in the free cross sectional areas present in the deflecting element.

As an example of the combustion of pollutants in a carrier gas with the device according to the invention (10), the following will describe the process in the device as depicted in Fig. 1.

Pollutant-contaminated crude gas, i.e. carrier gas containing oxidizable constituents, enters the device (10) through the gas inlet shaped in the form of inlet nozzle (36), is directed through the heat exchanger tubes (30) arranged concentrically around the flame tube (22), exits from the heat exchanger (32) in a chamber placed coaxially with respect to the burner (19) and



limited by the front wall (14), and is at least partly directed past the burner (19). While the gas is flowing through the heat exchanger (32), preheating takes place by heat absorption via the heat exchanger tubes (30) from the gas which has left the main combustion chamber (24) and is flowing around the heat exchanger tubes (30).

A part of the preheated pollutant-contaminated crude gas comes into contact with the flame of the burner (19) and functions as combustion gas. The other part flows past the burner (19) and past the flame.

Due to the high flow velocities v with $v > 60$ m/s in full load operation in the flame tube (22), the gases from the hot core of the burner (19) are mixed with the colder so-called annular gap flow of the gas, which is directed over a gap (48), which limits the chamber (46) on the burner side, past the burner to the end of the flame tube (22). This initiates the combustion of the pollutants in the entire crude gas. The crude gas with the pollutants, which are already reacting, enters the first section (23) of the main combustion chamber (24) and is distributed there by the deflecting elements (40) and/or (42) and/or (44) acting to direct the flow. Distribution takes place over the entire flow cross section of the main combustion chamber (24), so that a flow in the same direction occurs and the combustion takes place uniformly over the cross section of the main combustion chamber.

As virtually the entire length of the flame tube (22) is necessary in order to mix the colder annular flow flowing over the gap (48) and directed past the burner (19) in the flame tube with the hotter core flow, which is directed through the burner (19), and for this reason there is a temperature difference between the flame tube wall inside and the flame tube wall outside, there is a heat exchange between the hot carrier gas in the second section (25) of the main combustion chamber (24) and the colder uncleaned carrier gas in the flame tube (22). Consequently, the flame tube (22) functions as an additional heat exchanger area. The heat exchange causes a temperature difference of 20°C and 60°C in stationary operation between the inlet in the second section (25) of the main combustion chamber (24) and the outlet (26) out of the main combustion chamber, i.e. the inlet into the annular space (28), in which the heat exchanger (32) is placed.



The cleaned carrier gas is then directed around the heat exchanger tubes (30) of the tubular heat exchanger (32), conveys heat to the carrier gas which is to be cleaned and is conducted to the gas outlet (38), which is also shaped in the form of a nozzle.



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Patent Claims

1. Device for the combustion of oxidizable constituents in a carrier gas to be cleaned, involving a gas inlet (36), a burner (19) with attached flame tube (22), which opens into a main combustion chamber (24) with bottom and side walls (21, 20) if necessary divided into sections (23, 25), a combustion chamber outlet (26) preferably on the bottom wall (21) of the opposite side wall of the main combustion chamber, a heat exchanger (32) and a gas outlet (38),

c h a r a c t e r i z e d i n

that the main combustion chamber (24) is shaped in such a way and/or is provided with at least one deflecting element (40, 42, 44) in such a way that the gas flowing from the bottom wall (21) in direction of the combustion chamber outlet (26) is distributed uniformly or to a large extent uniformly when viewed over the cross section of the main combustion chamber.

2. Device as defined in Claim 1,

c h a r a c t e r i z e d i n

that the deflecting element (40, 42, 44) is a baffle plate, a perforated plate and/or a guiding ring and/or a reflector cone and/or a static mixer and/or is composed of guide vanes.

3. Device as defined in Claim 1 or 2,

c h a r a c t e r i z e d i n

that at least two deflecting elements (40, 42, 44) are placed in different levels of the main combustion chamber (24).



4. Device as defined in at least one of the preceding claims,
characterized in
that the deflecting element (40, 42, 44) is shaped symmetrically to a plane in which
the longitudinal axis (18) of the main combustion chamber (24) runs.
5. Device as defined in at least one of the preceding claims,
characterized in
that the deflecting element (40, 42, 44) is shaped in a rotationally symmetrical
manner with respect to the longitudinal axis (18).
6. Device as defined in at least one of the preceding claims,
characterized in
the deflecting element (44) is a screen or a resistance grid or a perforated plate or a
static mixer.
7. Device as defined in at least one of the preceding claims,
characterized in
that at least two different deflecting elements causing form drag (40, 42, 44) are
placed in the main combustion chamber (24).
8. Device as defined in at least one of the preceding claims,
characterized in
that the deflecting element (40, 42) is placed between the outlet of the flame tube
(22) and bottom wall (21) of the main combustion chamber (24).
9. Device as defined in at least one of the preceding claims,
characterized in
at least one deflecting element (44) is placed between the flame tube (22) and the
side wall (20) of the main combustion chamber (24).
10. Method for the combustion of oxidizable constituents in a carrier gas to be cleaned
in a device (10) comprising a main combustion chamber (24) starting from a flame



tube (22) and limited by bottom and side walls (20), in which cleaned gas is diverted by the bottom wall (21) in direction of a combustion chamber outlet (26) preferably coaxially arranged with respect to the flame tube,

c h a r a c t e r i z e d i n

that the gas diverted by the bottom wall (21) in direction of the combustion chamber outlet (26) is directed over the cross section of the annular space such that the gas flows and is basically uniformly distributed over the cross section of the main combustion chamber (24).

11. Method as defined in Claim 10,

c h a r a c t e r i z e d i n

that the diverted gas is directed without return flows in the main combustion chamber (24) and essentially free of turbulence to the combustion chamber outlet (26).



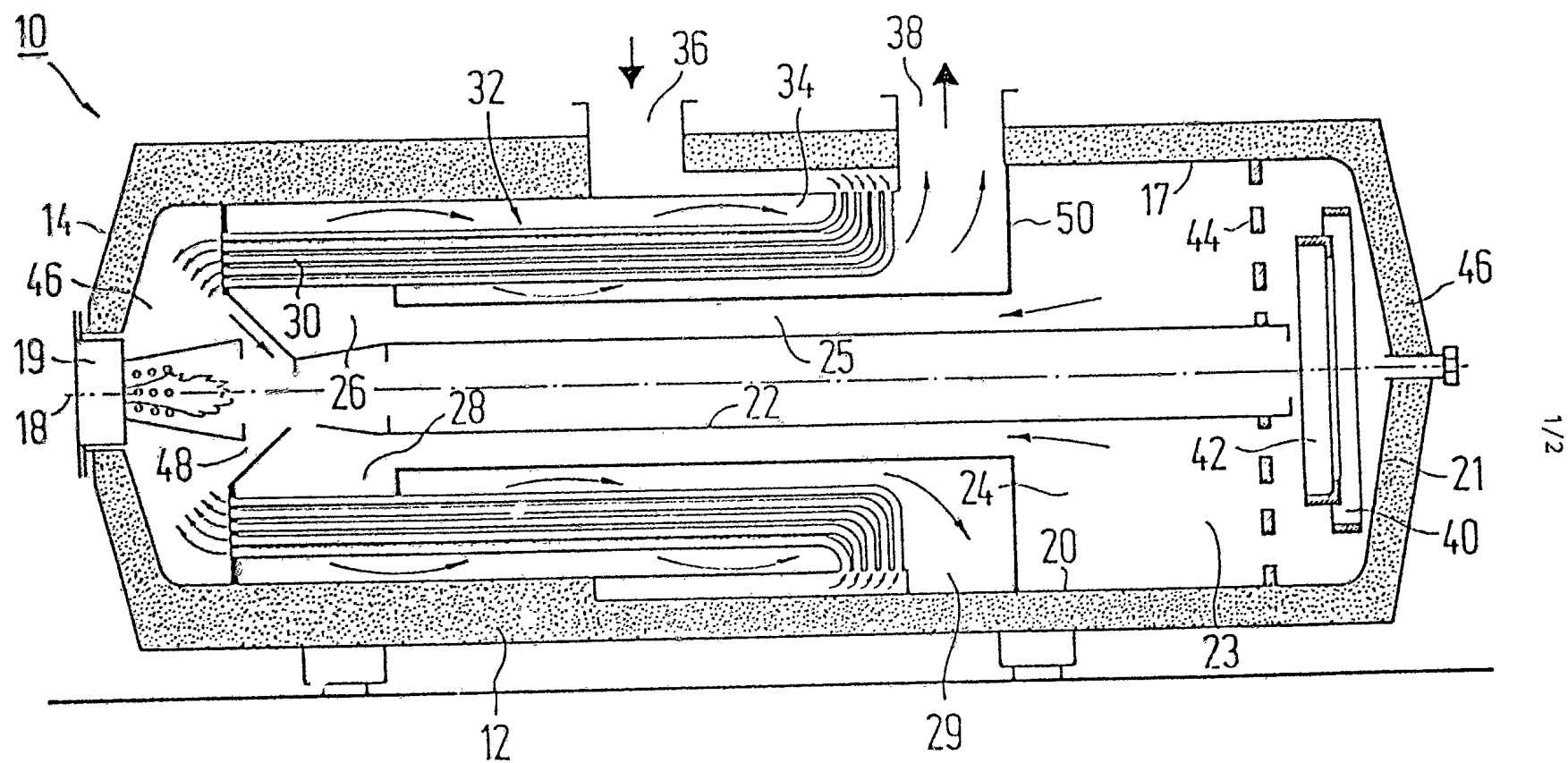
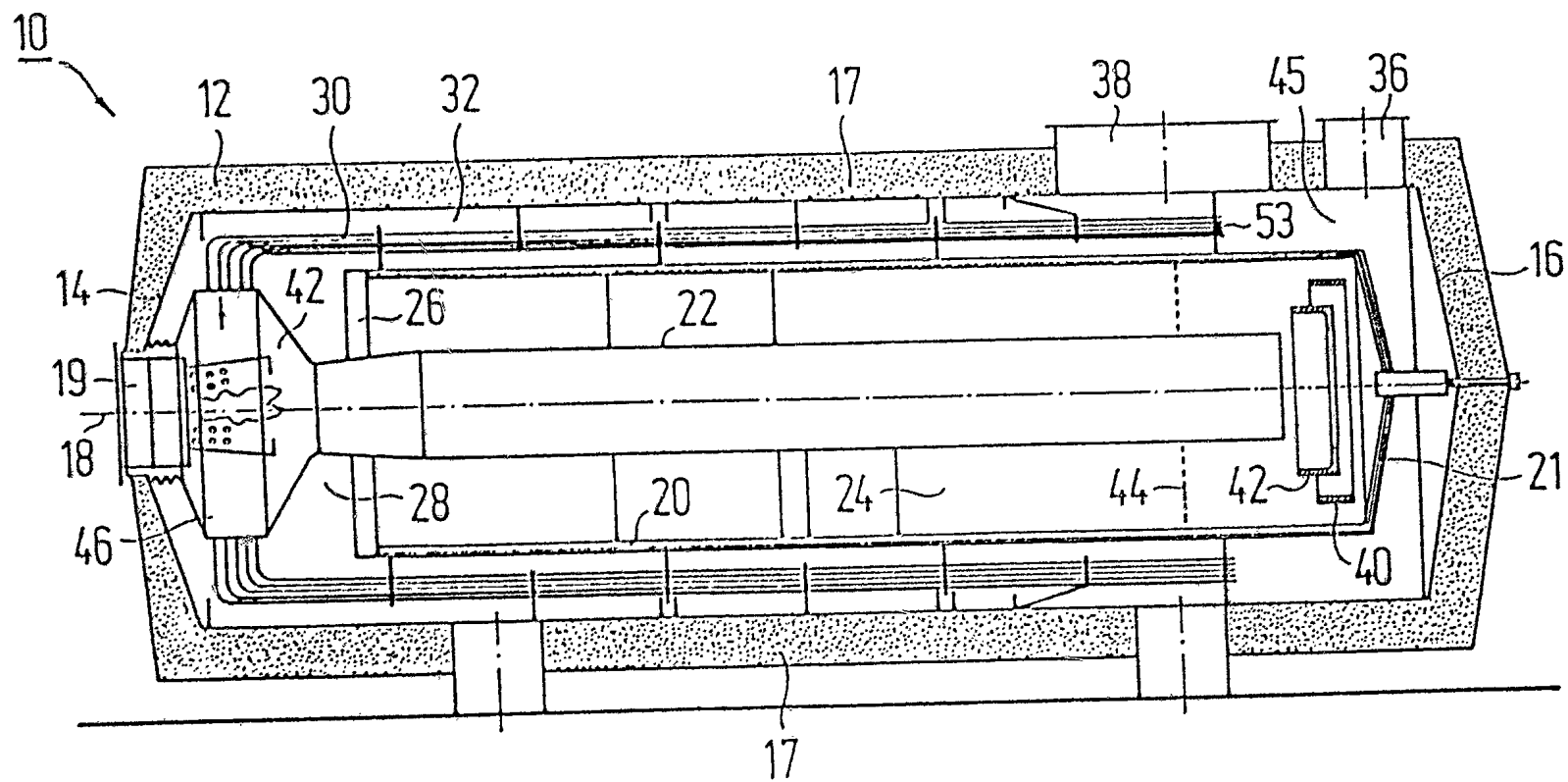


Fig. 1

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Fig. 2

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP 94/00539

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 F23G7/06

According to International Patent Classification (IPC) or to both national classification and IPC:

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 5 F23G F23M F23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR,A,2 248 470 (KATEC KATALYTISCHE LUFTECHNIK BETZ & CO) 16 May 1975 see page 3, line 21 - page 4, line 13 see page 5, line 10 - page 5, line 13 see figures 1-3 ---	1,3-5, 8-10
A	CH,A,361 904 (AG FÜR ÖLFEUERUNGEN) 30 June 1962 ---	
A	FR,A,2 556 446 (HECKMANN) 14 June 1985 -----	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

7 July 1994

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14. 07. 94

Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/EP 94/00539

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR-A-2248470	16-05-75	DE-A- 2352204	30-04-75
		BE-A- 821251	18-04-75
		CH-A- 585368	28-02-77
		GB-A- 1488888	12-10-77
		JP-A- 50111877	02-09-75
		NL-A- 7413270	22-04-75

CH-A-361904		NONE	

FR-A-2556446	14-06-85	NONE	

INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/EP 94/00539

A. KLASSTIFIZIERUNG DES ANMELDUNGSGEGENSTANDES
IPK 5 F23G7/06

Nach der Internationalen Patentklassifikation (IPK) oder nach der nationalen Klassifikation und der IPK

B. RECHERCHIERTE GEBIETE

Recherchierter Mindestprüfstoff (Klassifikationssystem und Klassifikationssymbole)

IPK 5 F23G F23M F23C

Recherchierte aber nicht zum Mindestprüfstoff gehörende Veröffentlichungen, soweit diese unter die recherchierten Gebiete fallen

Während der internationalen Recherche konsultierte elektronische Datenbank (Name der Datenbank und evtl. verwendete Suchbegriffe)

C. ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
A	FR,A,2 248 470 (KATEC KATALYTISCHE LUFTECHNIK BETZ & CO) 16. Mai 1975 siehe Seite 3, Zeile 21 - Seite 4, Zeile 13 siehe Seite 5, Zeile 10 - Seite 5, Zeile 13 siehe Abbildungen 1-3 ---	1,3-5, 8-10
A	CH,A,361 904 (AG FÜR ÖLFEUERUNGEN) 30. Juni 1962 ---	
A	FR,A,2 556 446 (HECKMANN) 14. Juni 1985 -----	

☐ Weitere Veröffentlichungen sind der Fortsetzung von Feld C zu entnehmen

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Datum des Abschlusses der internationalen Recherche

7. Juli 1994

Absenddatum des internationalen Recherchenberichts

14. 07. 94

Name und Postanschrift der Internationalen Recherchenbehörde

Europäisches Patentamt, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
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Bevollmächtigter Bediensteter

Phoa, Y

INTERNATIONALER RECHERCHENBERICHT

Angaben zu Veröffentlichungen, die zur selben Patentfamilie gehören

Internationales Aktenzeichen
PCT/EP 94/00539

Im Recherchenbericht angeführtes Patentedokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie	Datum der Veröffentlichung
FR-A-2248470	16-05-75	DE-A- 2352204	30-04-75
		BE-A- 821251	18-04-75
		CH-A- 585368	28-02-77
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