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(54) Valve and a heating apparatus comprising such valve

(57) A valve (1) to be fitted in a fuel/air-mixture duct (2), combustion air duct or flue duct of a heating apparatus with a burner, wherein the valve comprises a valve plate (3) arranged in the duct, which valve plate is pivotable between a closed position and an open position about a pivot (4) extending parallel to the valve plate and positioned eccentrically relative to the center of the valve plate or the duct in which it is located, so that on a first side of the pivot, the valve plate extends by a larger valve plate subsurface (3a) and on the other side of the pivot, the valve plate extends by a smaller valve plate subsurface (3b), wherein the valve is an antiresonance valve comprising a closing spring (5) adapted to exert a closing moment on the valve plate, so that it is biased in the closed position, wherein the moment of mass inertia of the valve plate is minimized, so that, in use, oscillations of the valve plate are minimized. The invention also relates to a heating apparatus having a valve according to the invention.

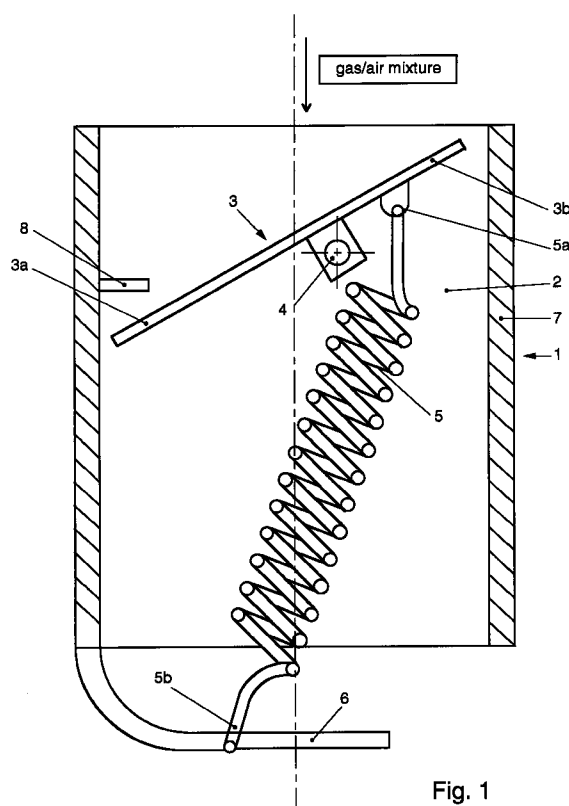


Fig. 1

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Description

The invention relates to a valve according to the preamble of claim 1.

Such a valve is known from European patent application EP-A-0 400 757. This known valve is intended to create a controlled minimum air flow in the combustion chamber, so that a pilot flame does not go out for lack of oxygen and, moreover, no condensation occurs in the combustion chamber, while it is also effected that, owing to the presence of the valve, not unduly much heat is lost that is generated by the pilot flame and/or transmitted by the hot water in the heat exchanger to the air flowing past.

A problem involved in the known heating apparatuses is that of acoustic resonances caused by pressure variations in the combustion air duct, the fuel/air-mixture duct, the combustion chamber and/or the flue duct of the heating apparatus. In particular when the power of the heating apparatus can be modulated, for instance through variation of the speed of the fuel/air-mixture fan, the chance of resonances occurring is great. Such acoustic resonances occur in particular at the lower speed ranges of the fan, i.e. at a modulated burner power. Sources of the resonances are pressure variations created during the combustion process. These pressure variations are amplified through reflection in the heating apparatus with its inlet and outlet channel system, which together form a resonator. Particularly at low-load, the acoustic damping through resistance is small and the chance of resonances occurring is considerable. The resonance can be removed by providing additional acoustic damping by means of flow resistances in the inlet and/or outlet channel system. However, at full load of the installation, i.e. at a maximum fan speed, additional flow resistances are not acceptable, because they require more fan pressure than is generally available.

The resonance problem can be solved by providing a variable flow resistance in the inlet and/or outlet channel system. Examples hereof are motor-controlled valves known in different embodiments. However, such motor-controlled valves are costly because of the necessary drive and control.

The valve discussed in the opening paragraph is controlled by gravity and the fan pressure. Gravity exerts a force on the valve, forcing the valve into a closed position. The valve moves to an open position under the influence of the fan pressure. If the fan pressure is maximal, the valve is in an entirely open position, and if the fan pressure decreases, the valve moves to the closed position until, at a given minimum fan pressure, the valve assumes the closed position under the influence of gravity.

A drawback of the valve controlled by gravity and the fan pressure is that such a valve should have an eccentrically arranged mass so that the gravity exerted thereby on the valve plate overcomes a given minimum fan pressure. As a consequence of the mass necessar-

ily present, the known valve has a relatively great mass moment of inertia. A consequence of such great mass moment of inertia is that the valve may start to oscillate. This causes instabilities occurring in particular during pressure pulses which may for instance occur at the start of the fan or at a sudden gust of wind. The object of the invention is to provide a valve without the drawbacks of the known valves described hereinabove.

To this end, the valve described in the opening paragraph is characterized by the features of claim 1.

Because in a valve according to the invention, the closing moment on the valve plate is exerted by a spring, the valve plate can be of a particularly light construction, allowing the mass moment of inertia thereof to be minimized. A valve plate of such construction exhibits, during the use thereof, a minimum tendency to oscillate, so that the chance of instabilities and, accordingly, the occurrence of resonances, is minimized.

To provide that the valve causes a minimum pressure loss during full-load of the burner, i.e. at the maximum speed of the fan, in accordance with a further elaboration of the invention, the valve is characterized by the features of claim 2. Moreover, these features are particularly favorable because the force exerted on the valve plate by the fuel/air-mixture flow, the combustion air flow or the flue gas flow, decreases at positions that are opened further, because the frontal surface of the valve plate decreases in these further-opened positions.

The invention also relates to a heating apparatus as characterized by the features of claim 9 or 11. Such heating apparatus has as its most important advantage that resonances are prevented therein without requiring a stronger fan than is usual. Moreover, the apparatus has the advantages already mentioned in the description of the valve.

Further elaborations of the invention are described in the subclaims and will be specified hereinafter with reference to the accompanying drawings, wherein:

Fig. 1 is a sectional view of an embodiment of the valve; and

Fig. 2 is a sectional view of a heating apparatus comprising a valve according to the invention.

The valve shown in Fig. 1 is intended to be fitted in a fuel/air-mixture duct, combustion air duct or flue duct of a heating apparatus having a modulating burner. A modulating burner is a burner capable of functioning both at full load and at a continuously variable part load, for instance through variation of the fan speed of the fan associated with the burner. Depending on the speed of the fan, more or less combustion air with an appropriate amount of fuel, such as for instance gas, is fed to the burner. The valve 1 comprises a valve plate 3 which is disposed in the duct 2 and which is pivotable between a closed position and an open position about a pivot 4. The pivot 4 extends parallel to the valve plate 3 and is positioned eccentrically relative to the center of the

valve plate 3 and the duct 2 wherein the valve plate is located. As a result, the valve plate subsurface 3a extending on a first side of the pivot 4 is larger than a valve plate subsurface 3b extending on the other side of the pivot 4. The valve 1 is intended for minimizing resonances in the inlet and outlet channel system of the heating apparatus. For this purpose, in accordance with the invention, the valve 1 comprises a closing spring 5 adapted to exert a closing moment on the valve plate 3, causing it to be biased in a closed position. In order to minimize oscillations of the valve plate 3, the moment of mass inertia of the valve plate 3 has been minimized.

By choosing the force required for holding the valve plate 3 in the open position to be as small as possible, it is effected that the loss of pressure caused by the presence of the valve is as small as possible. On the other hand, in the virtually closed position of the valve plate 3, the closing moment should be sufficiently great to create a sufficient pressure drop over the valve 1 for damping acoustic resonances and to limit oscillations of the valve in this position. To achieve this, in the present case, the spring 5 is arranged so that the closing moment decreases according as the valve plate 3 is pivoted further in the direction of the open position. In the present case, the decrease of the closing moment according as the valve plate 3 is pivoted further in the direction of the open position is realized by the specific arrangement of the spring. However, it is of course also possible that the spring is constructed in a specific manner.

In the present exemplary embodiment, the spring is a draw spring 5 having a first free end 5a attached to the smaller valve plate subsurface 3b and having a second free end 5b attached to a fixed point 6. The attachment is chosen so that the moment arm of the force acting on the valve plate 3, i.e. the distance between the pivot 4 and an imaginary line in the direction of which the force acts - in this case the center line of the spring -, decreases according as the valve plate 3 is opened further.

With a valve of such construction, it is achieved in a constructionally simple manner that the closing moment exerted on the valve plate 3 decreases according as the valve is opened further. Preferably, the closing moment exerted by the spring 5 in the open position of the valve plate 3 is virtually zero. In the present case, this is realized in that in the open position of the valve plate 3, the draw spring, constructed as helical spring 5, extends parallel to the valve plate surface, and in that in the open position of the valve plate 3, the center line of the helical spring 5 virtually intersects the center line of the pivot 4. It is understood that the center line of the helical spring 5 should not pass the center line of the pivot 4 during the opening of the valve, because otherwise the valve would slip into an undesired stable position and not return into the closed position anymore.

To enable the valve to be mounted in a simple manner, the valve 1 preferably comprises a valve sleeve 7 having substantially the same diameter as the duct 2

wherein the valve 1 is to be fitted. The pivot 4 can then be rotatably bearing-mounted in the valve sleeve 7 in a simple manner. Also, a fastening hook 6 can be mounted on the valve sleeve 7, which fastening hook provides the fixed point for attachment of the second end 5b of the draw spring 5.

Such a valve 1 having a valve sleeve 7 can be sold as a single unit and can readily be fitted in a fuel/air-mixture duct, combustion air duct or flue duct of a heating apparatus.

Preferably, the valve sleeve 7 also comprises a stop 8 against which the valve plate 3 abuts, in the closed position thereof. The stop 8 is provided to leave the valve plate 3 always sufficiently open at small gas flows (low load). The remaining opening prevents the occurrence of oscillations on account of unduly great relative changes in the passage, which great relative changes would indeed occur if the valve closed entirely or almost entirely.

Fig. 2 schematically shows, in section, a heating apparatus comprising a premix burner 9, a combustion air fan 10, whose outlet is connected, via a fuel/air-mixture duct 11, to a combustion space 12 with an associated heat exchanger 13. Downstream of the heat exchanger 13, a flue duct 14 is connected to the combustion space 12. In accordance with the invention, the apparatus comprises a valve 1 according to one of claims 1-8. The chance of resonances occurring in such a heating apparatus has been minimized, while it is also provided that owing to the low mass inertia of the valve plate, the chance of instabilities caused by pressure pulses, which may for instance occur during the start of the combustion fan or during a sudden gust of wind, is minimized.

Preferably, the valve 1 is arranged in the fuel/air-mixture duct 11 located upstream of the combustion space 12, because in this area, the temperature of the gas flowing along the valve 1 is low and, also, the gas does not contain any aggressive substances, such as for instance acids that may be released as a result of the combustion process.

When the valve 1 is being mounted, it is preferred that the velocity distribution of the gas flow in the duct 2 be taken into account. The valve should be positioned so that the large valve plate subsurface 3A is located on that side of the duct 2 where the flow rate of the gas is greatest.

Apart from the most important advantage of the valve according to the invention, viz. that resonances are prevented without requiring a stronger fan, the valve according to the invention provides a number of additional advantages:

1. The presence of the valve creates the conditions for controlling the burner in a larger power range without involving acoustic resonances or pulsations;
2. In low-load or a modulated operating range, the higher resistance in the duct, resulting from the

presence of the valve and the higher fan speed, renders the heating apparatus less sensitive to pressure differences between the air inlet and the flue gas outlet, which pressure differences can for instance occur as a result of gusts of wind; in particular, greater counteracting pressures can be overcome;

3. Because the operating range wherein the burner does not resonate is increased, the gas/air mixture can freely be set at an optimum excess air, so that harmful emissions can be limited;

4. The heating apparatus can be started at low load without involving starting resonances (during the start, a conventional heating apparatus is typically extra sensitive to resonance, so that often, starting should take place above the low load);

5. During standstill of the apparatus, the valve, which is in the closed position, limits the standstill losses in that the through-flow of the heat exchanger with air under the influence of draft is drastically reduced.

Claims

1. A valve to be fitted in a fuel/air-mixture duct, combustion air duct or flue duct of a heating apparatus with burner, wherein the valve (1) comprises a valve plate (3) arranged in the duct (2), which valve plate is pivotable between a closed position and an open position about a pivot (4) extending parallel to the valve plate (3) and positioned eccentrically relative to the center of the valve plate (3) or the duct (2) in which it is located, so that on a first side of the pivot (4), the valve plate (3) extends by a larger valve plate subsurface (3a) and on the other side of the pivot (4), the valve plate (3) extends by a smaller valve plate subsurface (3b), **characterized in that** the burner is a modulating burner and the valve (1) is an anti-resonance valve comprising a closing spring (5) adapted to exert a closing moment on the valve plate (3), so that it is biased in a closed position, wherein the moment of mass inertia of the valve plate (3) is minimized, so that, in use, oscillations of the valve plate (3) are minimized.
2. A valve according to claim 1, characterized in that the spring (5) is constructed or arranged so that the closing moment decreases according as the valve plate (3) is pivoted further in the direction of the open position.
3. A valve according to claim 2, characterized in that the spring is a draw spring (5) of which a first free end (5a) engages the smaller valve plate subsurface (3b) and of which a second free end (5b) is attached to a fixed point (6) so that the moment arm of the force acting on the valve plate (3), i.e. the distance between the pivot (4) and an imaginary line in the direction of which the force acts, decreases according as the valve plate (3) is opened further.
4. A valve according to claim 2 or 3, characterized in that in the open position of the valve plate (3), the closing moment exerted by the spring (5) is virtually zero.
5. A valve according to claim 4, characterized in that the draw spring is a helical spring (5) which, in the open position of the valve plate (3), extends parallel to the valve plate surface, and of which helical spring (5) the center line, extending in the longitudinal direction of the spring (5), virtually intersects the center line of the pivot (4) in the open position of the valve plate (3).
6. A valve according to any one of the preceding claims, characterized in that it comprises a valve sleeve (7) having substantially the same diameter as the duct in which the valve (1) is to be fitted, wherein the pivot (4) is rotatably mounted in the valve sleeve (7).
7. A valve according to claims 3 and 6, characterized in that the valve sleeve (7) comprises a fastening hook (6) providing the fixed point for fastening the second end (5b) of the draw spring (5).
8. A valve according to any one of the preceding claims, characterized in that the valve (1) also comprises a stop (8) against which the valve plate (3) abuts in the closed position.
9. A heating apparatus, comprising a premix burner (9) and a combustion air fan (10) whose outlet is connected, via a fuel/air-mixture duct (11), to a combustion space (12) with an associated heat exchanger (13), wherein a flue duct (14) is connected to the combustion space (12) downstream of the heat exchanger (13), wherein the installation comprises a valve (1) according to any one of claims 1-8.
10. A heating apparatus according to claim 9, characterized in that the valve (1) is arranged in the fuel/air-mixture duct (11).
11. A heating apparatus, comprising a premix burner (9) and a combustion air fan (10), whose outlet is connected, via a fuel/air-mixture duct (11), to a combustion space (12) with an associated heat exchanger (13), wherein a flue duct (14) is connected to the combustion space (12) downstream of the heat exchanger (13), wherein the installation comprises a valve (1) arranged in the fuel/air-mixture duct or the flue duct, wherein the valve comprises a valve plate (3) arranged in the relevant duct, said valve plate being pivotable between a closed position and an open position about a pivot

(4) extending parallel to the valve plate and arranged eccentrically relative to the center of the valve plate (3) or the duct (2) in which it is located, so that on a first side of the pivot (4), the valve plate (3) extends by a larger valve plate subsurface (3a) 5 and on the other side of the pivot (4), the valve plate (3) extends by a smaller valve plate subsurface (3b), wherein the burner is a modulating burner and the valve (1) is an antiresonance valve comprising a closing spring adapted to exert a closing moment 10 on the valve plate (3), so that said valve plate is biased in a closed position, wherein the moment of mass inertia of the valve plate (3) is minimized, so that, in use, oscillations of the valve plate (3) are minimized. 15

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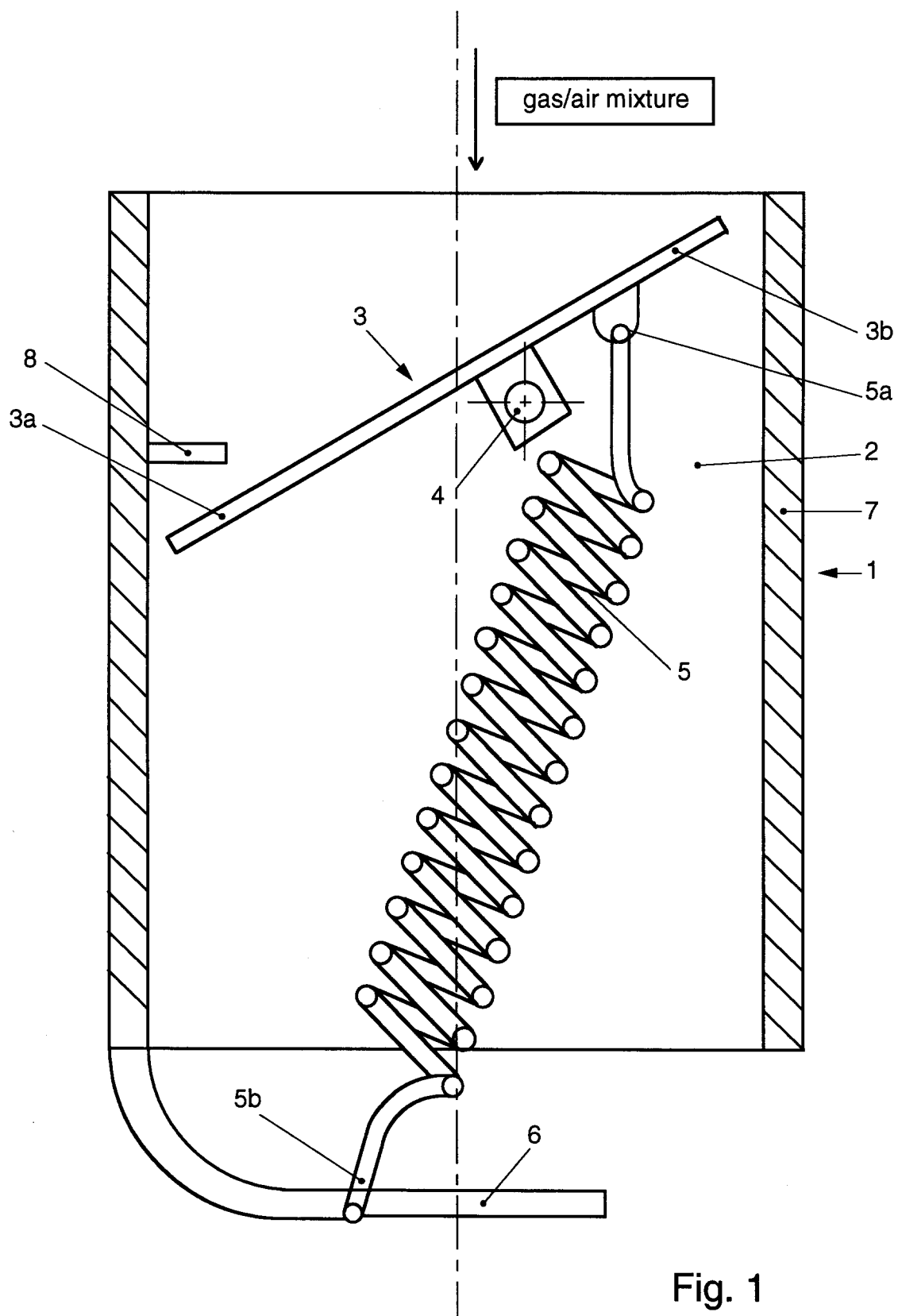
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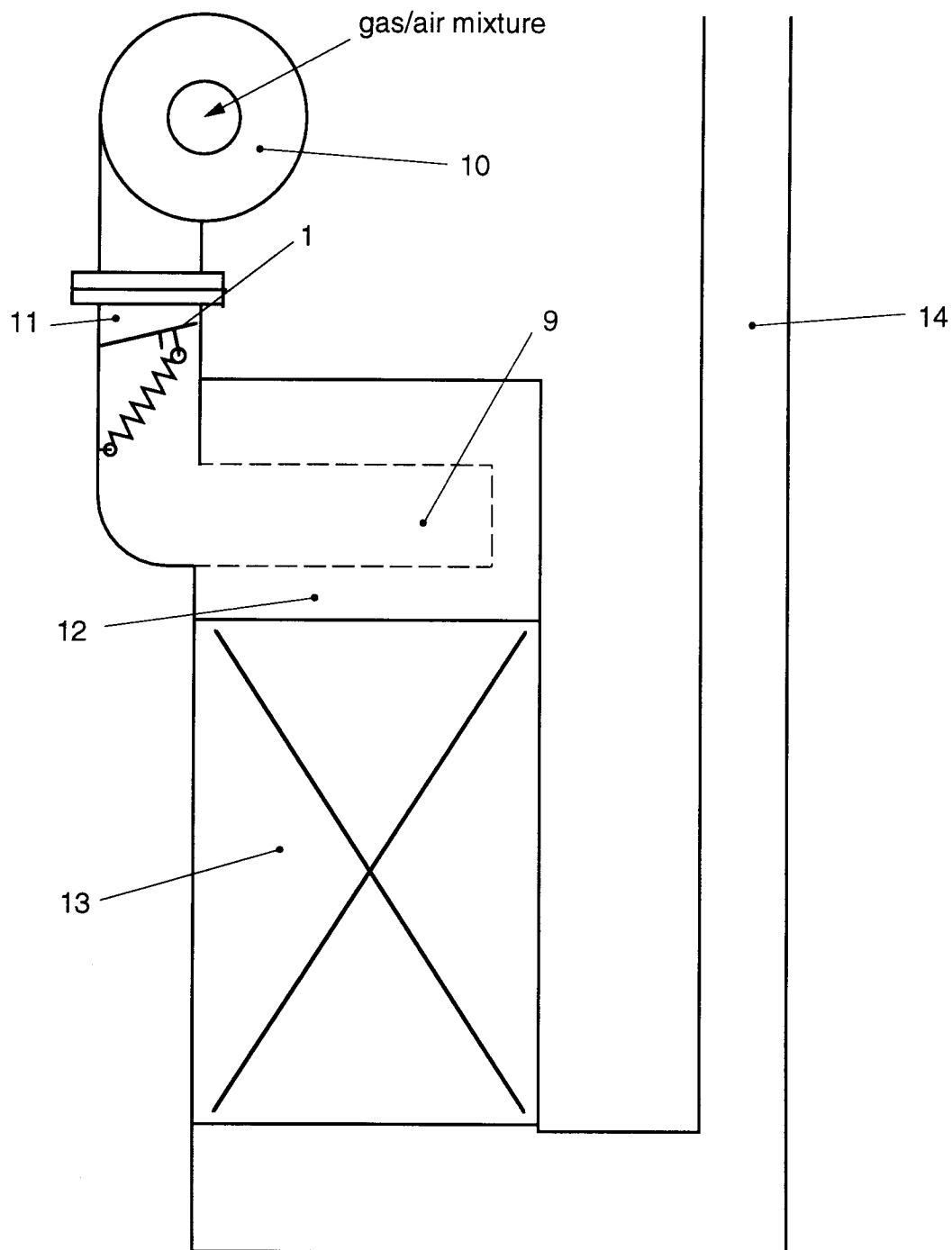


Fig. 2



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 96 20 3726

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.6)
A	US 2 302 678 A (CREW) * the whole document *	1-3	F23L13/02
A,D	EP 0 400 757 A (REMEHA) * column 1, line 28 - column 1, line 49 * * column 2, line 45 - column 4, line 5 * * figures 1-4 *	1,8,11	
A	DE 42 18 754 A (FRÖLING GMBH) * column 4, line 40 - column 4, line 56; figure 2 *	9	
A	DE 27 20 688 A (STEIMER)		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6) F23L F23D
Place of search THE HAGUE		Date of completion of the search 4 April 1997	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			

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