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(54) Improvements in and relating to boilers.

(57) A combustion chamber baffle system for use in the combustion chamber of a boiler, said baffle system comprising at least one baffle plate wherein the or each of said baffle plates are positioned and arranged such that, in use, combustion gases are forced to pass around the or each of the baffles during their passage through the combustion chamber to an output flue, characterised by the presence of a skirt mounted on the or each baffle plate such that combustion gases are directed by said skirt in use to pass around the baffle in close proximity to the heat-exchanging surfaces of the combustion chamber.

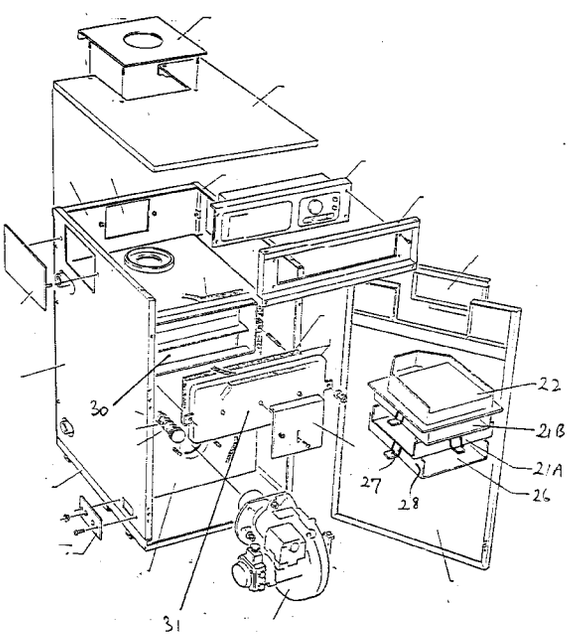

FIGURE 7

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Field of the Invention

The invention relates to an improved baffle system for the combustion chamber of a boiler, and to an improved boiler incorporating such a baffle system.

Background to the Invention

A typical water-heating boiler consists of a burner directing hot combustion gases into a combustion chamber which, in turn, incorporates a water jacket. The path of the combustion gases through the combustion chamber is dictated by baffles, whose purpose is to maximise the time spent by the gases in the combustion chamber in order to extract the maximum amount of heat from them into the surrounding water jacket. The combustion gases then escape through a flue, generally at the opposite end of the combustion chamber to the burner.

The water jacket generally surrounds the combustion chamber and the inner wall of the water jacket itself defines part or all of the combustion chamber.

Various types of baffle plates have been employed to increase the length of travel of the combustion gases through the combustion chamber and increase the amount of heat released. Typical examples of this prior art are described in GB 2 248 918A.

These baffles are generally positioned horizontally across the combustion chamber cavity when the boiler is in its normal in-use vertical position. For clarity, a boiler with a vertical combustion chamber and horizontal baffles will be referred to in this description, however, such baffles can be positioned at any angle as specified by the combustion chamber designer.

Along at least one edge of the baffle is a gap (called a gas passage) through which the combustion gases pass on their way to the output flue. In conventional baffle systems, the gas passages need to be small in order to optimise the heat exchange in this region. The intention is to extract as much heat as possible from the gases and hence they need to be directed into close contact with the combustion chamber walls for as long as possible to facilitate this. However, the small gas passages increase the resistance of the heat exchanger to the flow of gases from the burner, resulting in noisy operation, particularly when starting up the boiler. This is obviously a problem in, for example, domestic boilers, where the market is constantly demanding more and more compact, discreet and quiet boilers.

Furthermore, existing baffles generally consist of flat plates, with or without an upstand along one edge, which rest on brackets attached to the inside walls of the water jacket. This arrangement has a number of disadvantages. Firstly the brackets, or baffle furniture, must be welded or otherwise fixed in position, increasing manufacturing time and costs. There is always a danger that these brackets will become unattached as a result of the continual heating/cooling cycle of the boiler. Secondly, the hot combustion gases are only forced into close contact with the water jacket along the one face of the baffle with the upstand. This feature limits the efficiency of the heat transfer.

It is the object of the present invention to provide an improved combustion chamber baffle system which overcomes these problems.

Summary of the Invention

According to a first aspect of the present invention, in its broadest sense, there is provided a combustion chamber baffle system for use in the combustion chamber of a boiler, said baffle system comprising at least one baffle plate wherein the or each of said baffle plates are positioned and arranged such that, in use, combustion gases are forced to pass around the or each of the baffles during their passage through the combustion chamber to an output flue, characterised by the presence of a skirt mounted on the or each baffle such that combustion gases are directed by said skirt in use to pass around the baffle in close proximity to the heat-exchanging surfaces of the combustion chamber.

Preferably the skirt comprises a plurality of raised lips extending substantially perpendicular to the baffle plate. With this arrangement the skirts are substantially parallel to and narrowly spaced from the inner wall of the combustion chamber.

Preferably the baffle system further comprises a gap maintainer, such as a metal tab, adapted to maintain a defined gap between one edge of the baffle plate and the inner surface of the combustion chamber wall.

In a particularly preferred embodiment the baffle systems are adapted to stack one on top of each other such that the combination of baffle plates and skirts in the stacked array form a labyrinthine gas passage for combustion gases passing between the burner and the flue.

The baffle system may incorporate a turbulator, for example a turbulator substantially as described in UK patent application No GB 90 21208.5.

According to a second aspect of the invention there is provided a boiler incorporating a combustion chamber baffle system as described above.

Preferably the boiler contains a succession of baffles stacked into a cassette and arranged such that the gap maintainers are successively at opposite ends of the baffles so that the combustion gases passing through them are forced to change direction by substantially 180 degrees.

Brief Description of the Drawings

Preferred embodiments of the present invention

will now be more particularly described by way of example, with reference to the accompanying drawings wherein:

Figure 1 shows a perspective view of a combustion chamber baffle system;

Figure 2 shows a side view of the combustion chamber baffle system shown in Figure 1.

Figure 3 shows a perspective view of the type of combustion chamber baffle system located nearest the burner in the combustion chamber;

Figure 4 shows a side view of the combustion chamber baffle system shown in Figure 3;

Figure 5 shows a side view of the combustion chamber baffle systems from Figures 1 and 3 in use inside a combustion chamber, with the path of the combustion gases indicated by arrows;

Figure 6 shows a plan view of the baffle system in use inside a combustion chamber, with the path of the combustion gases indicated by arrows;

Figure 7 shows a perspective exploded view of a boiler incorporating baffles according to the present invention.

Description of the Preferred Embodiment

Referring to Figures 1 and 2, the baffle system 1 consists of a conventional baffle plate 2 to which are attached raised lips 3 and 4. The raised lips 3 and 4 are adapted to form a "skirt" on the baffle plate 2 which serves to direct the flow of combustion gases as described below.

A tab 5 attached to the side of the baffle plate 2 nearest raised lip 3, serves as a gap maintainer; the function of this will also be described below.

It is intended that a number of such baffle systems will be incorporated into the combustion chamber of a boiler, stacked one on top of the other. Conventionally, the baffle system nearest the burner is insulated against the intense heat. Figures 3 and 4 show a bottom baffle system 6 for use in such a position. The inventive concept (i.e. the skirt) is the same as described above, however the baffle plate 2 supports an insulating portion 7. The reader is directed to the disclosure in patent specification GB 2 248 918A for further details.

Figure 5 shows the baffle arrangement inside the combustion chamber 8. In this embodiment, two baffle systems are shown - a bottom baffle system 6 on which is stacked one baffle system 1. The bottom baffle system 6 rests on two brackets (not shown) and further baffle systems 1 are stacked on top.

Gases from the burner 9 move upwards towards the output flue (not shown). Encountering the bottom baffle system 6, they are channelled through a gas passage 10, which is defined by the gap maintainer 5A.

Referring to Figure 6 in conjunction with Figure 5, the first raised lip to be encountered by the combustion gases on their journey from the burner to the flue is lip 3A which acts as a barrier to prevent the gases moving freely to fill the whole cross-section of the combustion chamber 8. Instead, the gases are directed by raised lips 3A and 4, as shown by the arrows, maintaining a path in close proximity to the walls of the combustion chamber 8 around three of its four sides. In this way, the heat exchange between the hot gases and water jacket 11, which surrounds the combustion chamber 8, is increased by maximising contact with the heat-exchanging surfaces.

The gases then enter the next gas passage 10 as defined by the gap maintainer 5 of the next baffle system 1. This baffle system 1 is stacked on top of the bottom baffle system 6 with its gap maintainer 5 at the opposite end so that a continuous but labyrinthine flow passage for the combustion gases is provided. In this way, the gases travel upwards away from the burner 9 and towards the output flue (not shown).

The dimensions of the gas passages 10 must be such that the pressure from the combustion chamber 8 does not exceed the burner pressure or else the performance of the boiler as a whole will be seriously impaired. The greater use of the heat-exchanging surfaces provided by this invention, means that the gas passages 10 may have larger dimensions than in conventional systems. The resistance of the boiler, which the burner must overcome on start-up, is thus reduced which in turn substantially reduces the noise produced by the boiler when starting its operation.

The skirt arrangement described above is particularly versatile and this versatility will now be further explained.

In the previous example, as illustrated in the Figures, the route of the combustion gases past the skirted baffle plate is determined by the position of the tab or spacer 5. In the illustrations the tab 5 is attached to or is an integral part of an edge of the baffle plate which incorporates a skirt lip 3. In an alternative arrangement, not shown, the tab 5 can be located on the opposite edge of the baffle plate ie on a edge with no skirt or lip. In this arrangement combustion gases pass upwards around the edge of the baffle plate and enter a cavity or chamber created by that skirted baffle plate and the bottom of the next baffle plate sitting on top of the skirt.

The combustion gases can circulate within this chamber but can only exit around the sides of the skirt. By this means the hot combustion gases come into intimate contact with all sides of the heat exchanger surface in the region of that particular baffle plate.

This process is repeated as the combustion gases traverse the cassette of baffles. Furthermore, the position of the tab 5 on various baffle plates in the cassette can be varied by the designer to provide the optimum boiler performance.

In previous examples, the combustion gases have been directed from one baffle plate to the next past just one edge of the baffle plate ie there is only one tabbed edge per baffle plate. It is equally possible that two or more edges of the baffle plate can carry tabs and it is envisaged in one embodiment that all the edges of the baffle plates can be tabbed to distance them from the inner surface of the heat exchanger. Once again, the boiler designer can select the number and orientation of tabs to give the optimum or desired boiler performance.

It is common to include turbulators in combustion chambers to avoid laminar flow of the combustion gases. It has been established that where laminar flow predominates there is less effective transfer of heat from the combustion gases to the heat exchanger fluid. These skirted baffles can therefore be used in combination with turbulators which are known in *per se*. Specifically, it is possible to provide a row of tabs 5 along one edge of the baffle plate whereby this multiplicity of tabs acts as a form of turbulator.

Alternatively, the baffle furniture used to support the baffles, can incorporate turbulators as described in GB application number 94 06502.6. The turbulators can also be incorporated into the outer faces of the raised lips 3 and 4 and one way of achieving this is described in GB application number 90 21208.5.

However, an important feature of this invention is that the contact area between hot combustion gases and the water jacket surface has been increased many times compared to conventional baffle systems. As a direct result the width of the gas passage 10 can be wider that in conventional baffle systems and thus the resistance is significantly lower, with all the advantages that that brings.

The inventive concept described above also extends to a baffle plate with a skirt or an equivalent structure hanging or depending from it when fitted into the combustion chamber of a boiler. In its simplest form therefore the baffle plate shown in Figures 1-4 can simply be inverted through 180° and supported in the combustion chamber upside down.

Figure 7 illustrates an exploded view of a boiler incorporating a stack of baffles 21A, 21B, 22 and 26 according to one embodiment of the invention. Each baffle system is small enough to pass through the front servicing aperture and a stack of baffles 30 is also shown *in situ*. To remove the baffles to service the boiler the service cover 31 is removed and the baffles simply lifted out one by one. Assembly is the reverse of this process.

Figures 1 to 6 illustrate skirted baffle systems in which there is a three-sided skirt and the ends of the skirt portions 4 stop short of the baffle plate edge. This feature is not essential and Figure 7 illustrates a baffle system in which the skirted portions 4 extend right up to the edge of the baffle plate.

The orientation of each baffle system in the array or cassette can be determined by the designer. Specifically, the route of the combustion gases around the skirt and within the volume defined by the skirt can be varied at will. Furthermore, there is no requirement for each component of the baffle cassette to be the same.

The skirted baffle plates 1 and 2 can be constructed by using conventional techniques known to those skilled in the art. In fact this arrangement lends itself to very straightforward constructional techniques. Referring to baffle system 26 in Figure 7 this can be constructed by cutting and folding a single sheet of metal. The tab 27 is formed by two substantially parallel cuts followed by folding up the lip 28. Although a small gap remains in the lip 28 where the tab is formed, this is not detrimental to the overall performance of the baffle. The other two lips are simply formed by folding the metal at right angles; no welding being required.

Although it is desirable to fix the elements of the skirt 3 and 4 onto the baffle plate 2 this is not essential. Since the skirts can in fact stand unsupported they could be constructed in just this fashion although it would be normal to include some locating means to locate them in the desired configuration on the baffle plate. The locating means could take the form of pins, pegs, ridges, indentations or the like.

This arrangement simplifies both construction, assembly and servicing of the boiler, since having placed the lowermost-in-use baffle plate 2 in position, alternative skirts and baffle plate 1 can be added in any desired number and configuration.

The reader is directed to the disclosure in patent specification GB 2 248 918A for any further details he or she may need to put the invention into practice.

Claims

1. A combustion chamber baffle system for use in the combustion chamber of a boiler, said baffle system comprising at least one baffle plate wherein the or each of said baffle plates are positioned and arranged such that, in use, combustion gases are forced to pass around the or each of the baffles during their passage through the combustion chamber to an output flue, characterised by the presence of a skirt mounted on the or each baffle plate such that combustion gases are directed by said skirt in use to pass around the baffle in close proximity to the heat-exchanging surfaces of the combustion chamber.

2. A combustion chamber baffle system as claimed in Claim 1 wherein the said skirt comprises a plurality of raised lips extending substantially perpendicular to the baffle plate.

3. A combustion chamber baffle system as claimed in Claim 1 or Claim 2 which further comprises a gap maintainer, such as a metal tab, adapted to maintain a defined gap between one edge of the baffle plate and the inner surface of the combustion chamber wall.

4. A combustion chamber baffle system as claimed in any preceding Claim wherein the baffle systems are adapted to stack one on top of each other.

5. A combustion chamber baffle system according to Claim 4 wherein the combination of baffle plates and skirts in the stacked array form a labyrinthine gas passage for combustion gases passing between the burner and the flue.

6. A combustion chamber baffle system as described in any of the preceding claims wherein any of said baffles incorporate a turbulator substantially as described in UK patent application No GB 90 21208.5.

7. A combustion chamber baffle system substantially as described herein, with reference to and as illustrated in the accompanying drawings.

8. A boiler incorporating a combustion chamber baffle system as claimed in any of the preceding claims.

9. A boiler as claimed in Claim 8 wherein said boiler contains a succession of baffles stacked into a cassette and arranged such that the gap maintainers are successively at opposite ends of the baffles so that the combustion gases passing through them are forced to change direction substantially 180 degrees.

10. A boiler substantially as described herein, with reference to and as illustrated in the accompanying drawings.

FIGURE 2

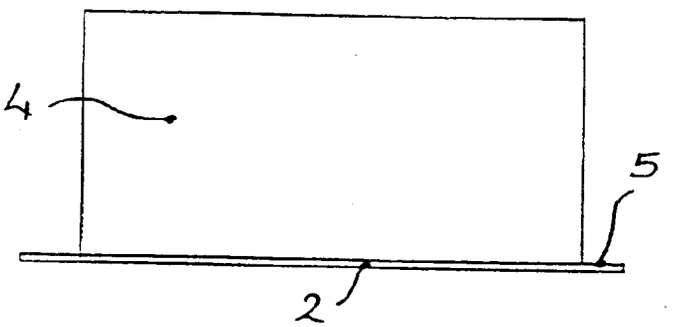


FIGURE 1

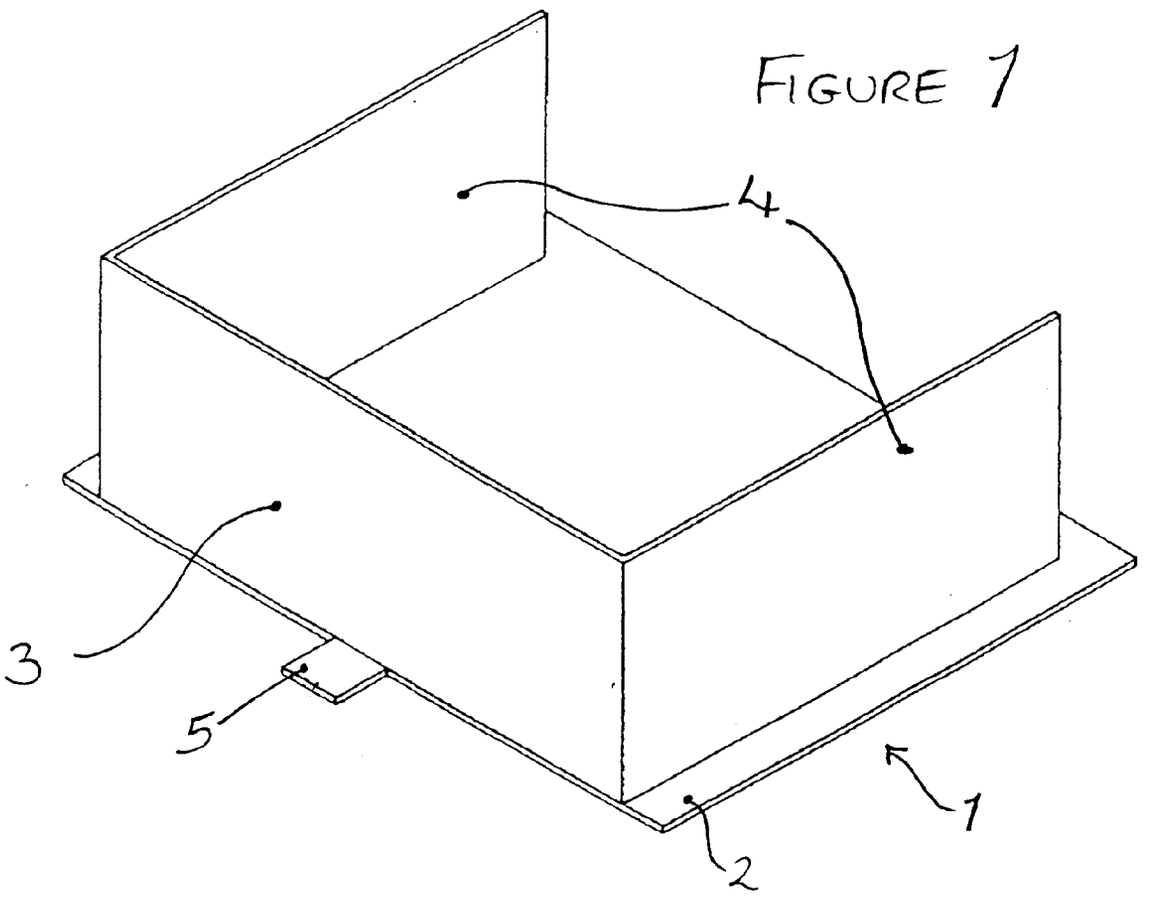


FIGURE 4

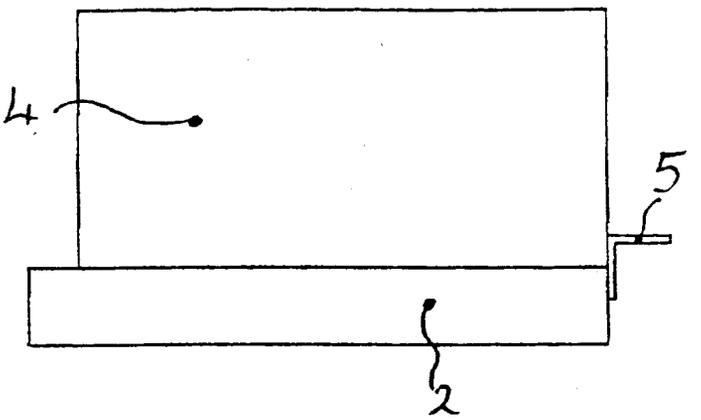
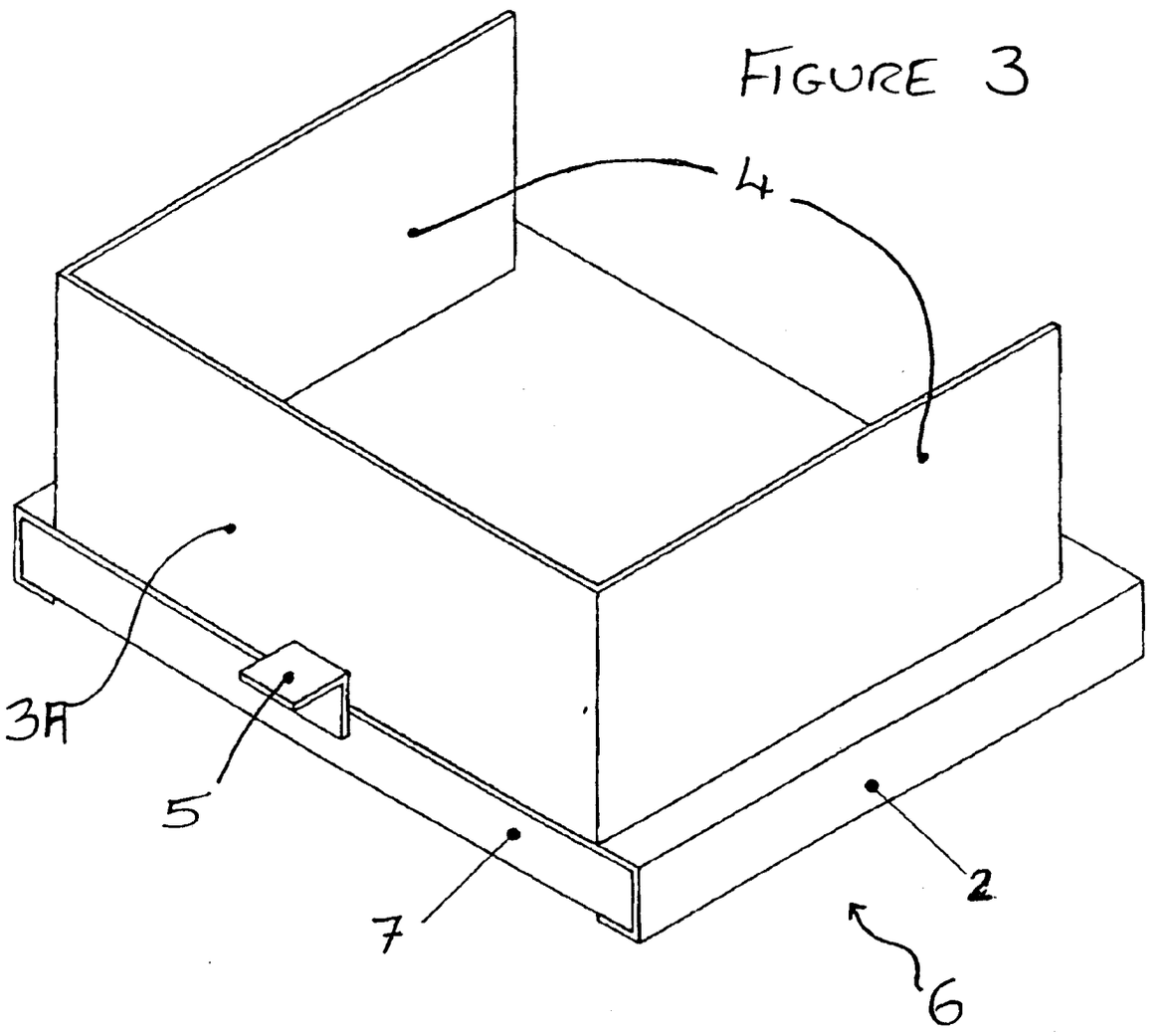


FIGURE 3



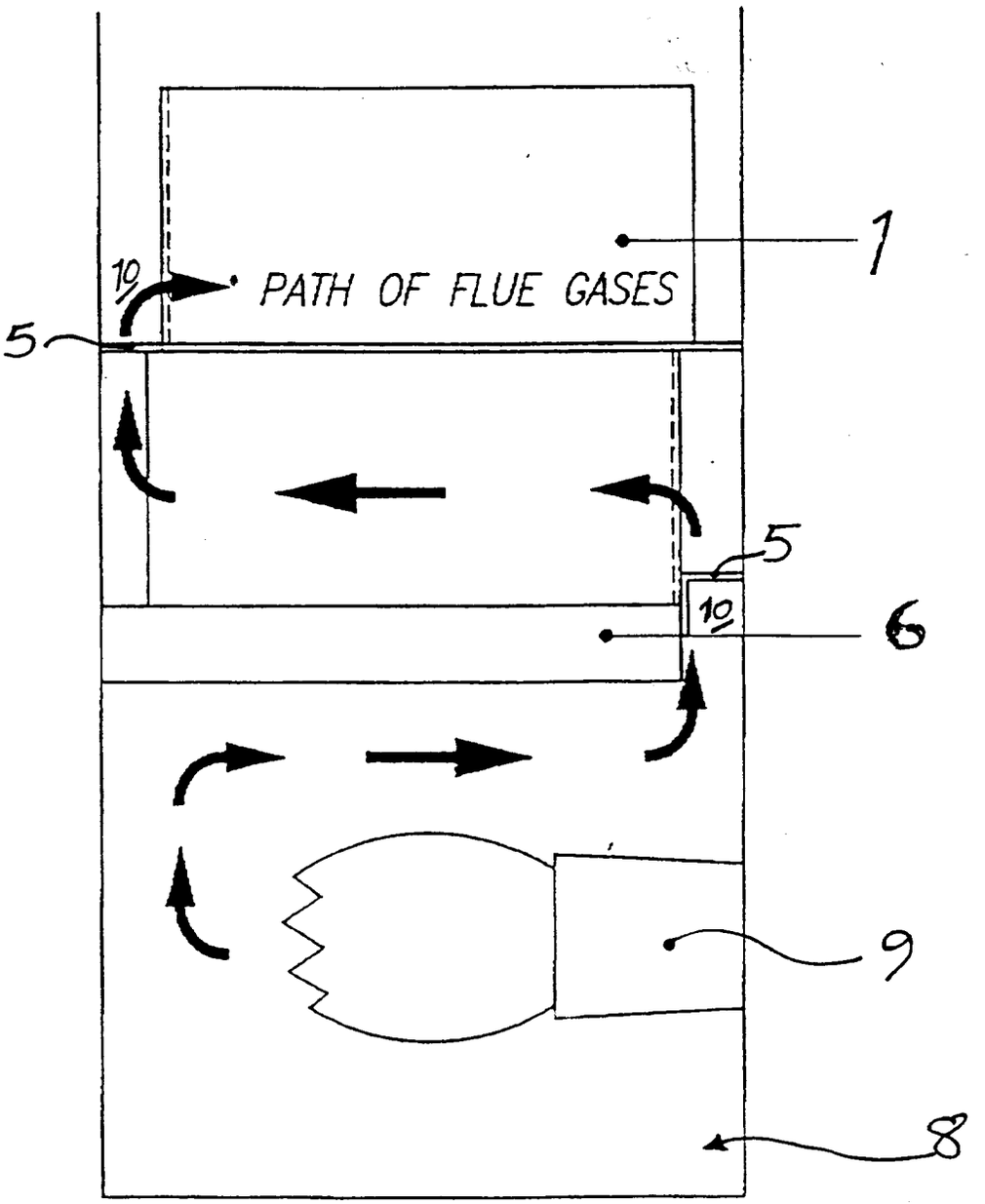


FIGURE 5

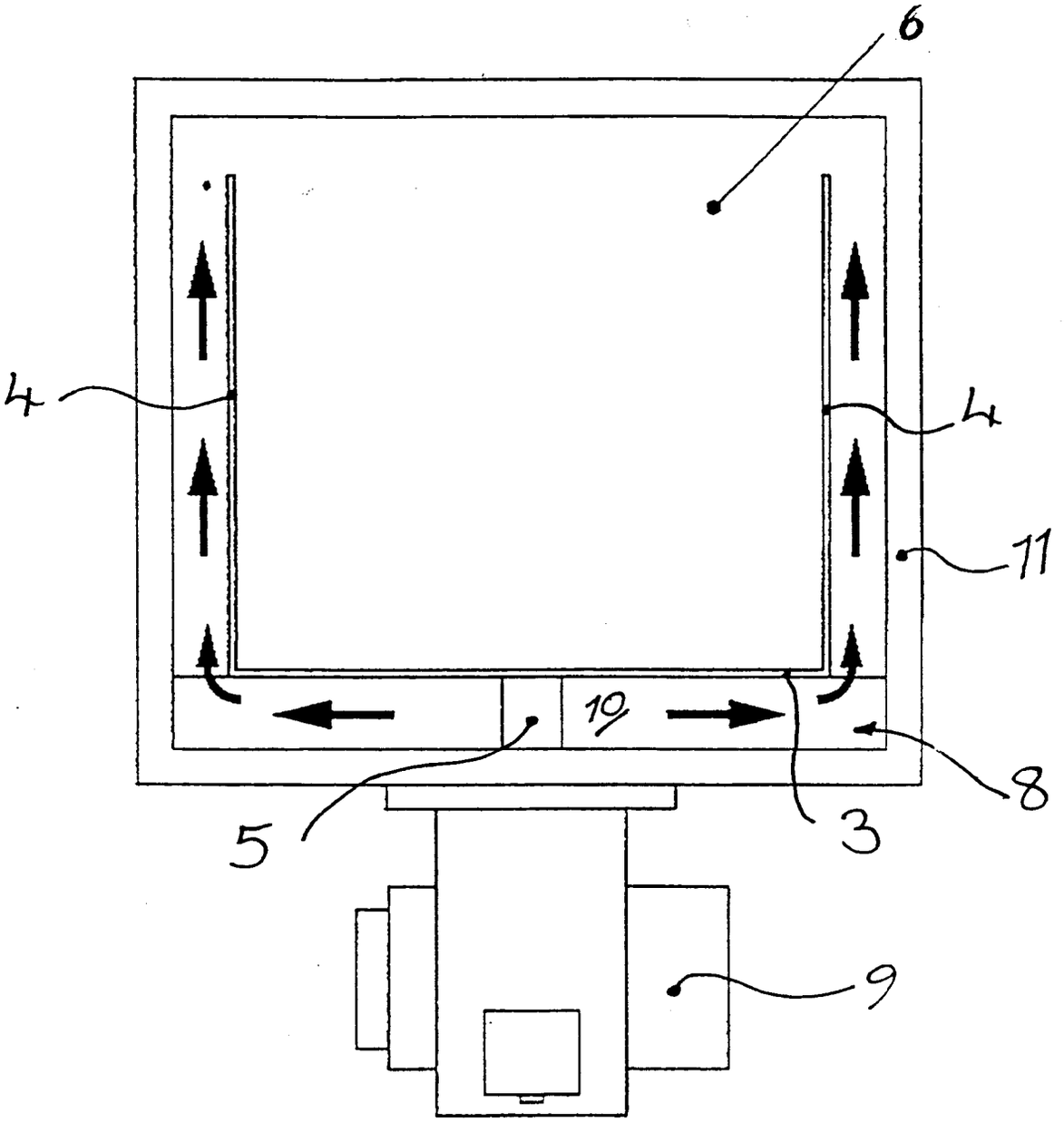


FIGURE 6

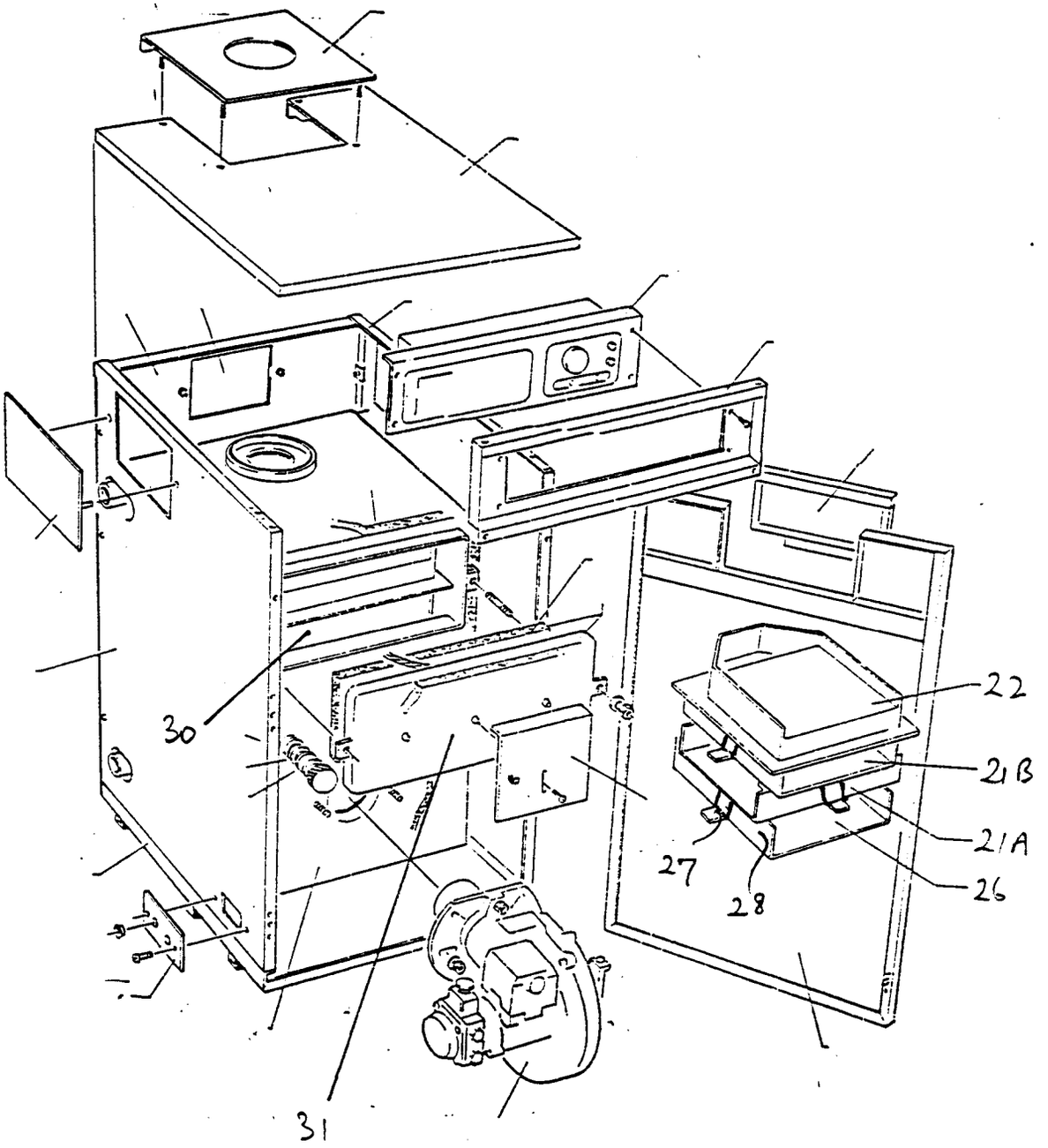


FIGURE 7