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(54) A gas burning apparatus having an atmospheric burner, and related feeding method.

(57) The apparatus comprises an atmospheric burner (10), a combustion chamber (11), and means (13) for creating a vacuum within the combustion chamber. The burner comprises gas outflow nozzles (17), intake and mixing conduits (18) coaxial with the nozzles (17), and diffusers (19,20) in communication with the conduits (18) to deliver the gas/primary air mixture into the combustion chamber (11).

To provide optimum smooth combustion, a box-type structure (23), which is substantially closed and communicated to the combustion chamber (11), is arranged to enclose the intake and mixing conduits (18) and includes a wall (24) disposed crosswise between the nozzles and the conduits which has, for each nozzle, an opening (25) for drawing primary air (AP) into the conduits, and openings (26) for introducing secondary air (AS) adjacent to the primary air opening. The streams of primary air (AP) and secondary air (AS) through their respective openings flow in substantially parallel directions.

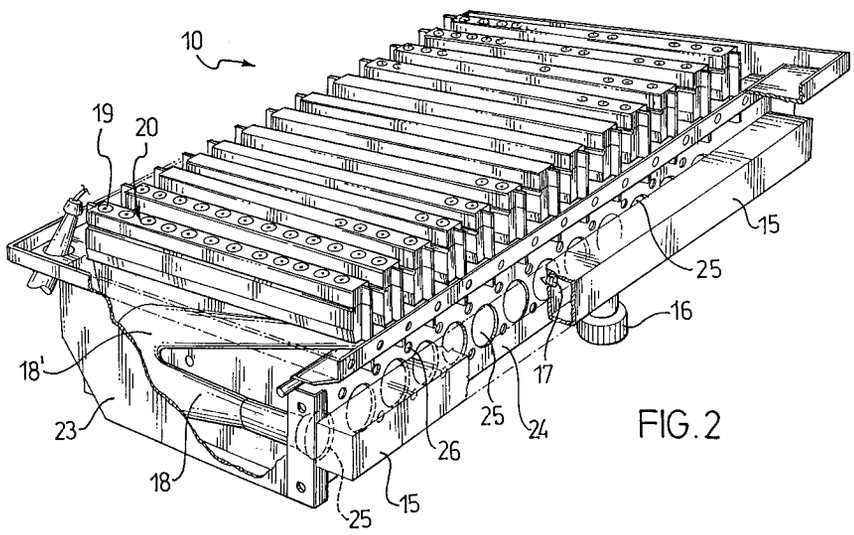

FIG. 2

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This invention relates to gaseous fuel burning apparatus, and in particular, it concerns a method for feeding an apparatus of that kind which is operated using a burner of the atmospheric type, and an apparatus for implementing the method.

A typical application of gaseous fuel burning apparatus employing an atmospheric burner is that of small- and medium-size boilers intended for use in dwelling space heating systems and systems for heating sanitary water. A boiler of that kind consists basically of an atmospheric burner, that is one operating on a Bunsen's burner principle, a combustion chamber, a heat exchanger, and a fan or any other structures effective to create a vacuum within the combustion chamber. The combustion air is admitted through openings provided in the apparatus, usually in the area where the burner is located. A suitable burner for such applications is described, for example, in Italian Patent Application No. 40099-A/90 filed by Worgas Bruciatori s.r.l. on July 6, 1990. Some of the combustion air, the so-called primary air, is drawn into the burner and admixed to the gas being ejected at a high speed through specially provided delivery nozzles. The resultant gas/primary air mixture, wherein the air percentage may vary between 60% and more than 100% of the stoichiometric amount required for combustion, according to the gas type and the design features of the burner, is conveyed from the intake and mixing conduits, through appropriate fittings, to respective diffusers which extend along the remote side of the combustion chamber from the heat exchanger and are provided with openings wherethrough the mixture to be burned flows out. The remainder of the air required for complete combustion, the so-called secondary air, is drawn toward the combustion chamber separately from the primary air.

In some cases, and especially with burners where the amount of primary air is substantially the same as or greater than the stoichiometric amount needed for combustion, and therefore. the amount of secondary air drawn into the combustion chamber is comparatively small, it has been found that the combustion is not enough homogeneous. It has also been found that this deficient homogeneity is the more apparent the more is the feed to the burner reduced to limit its thermal output. Notice that the need to have the output modulated greatly harasses certain applications, such as those where the boiler is used to generate heated water for sanitary use. In such cases, a part of the flame issuing from the diffuser holes may be either too aerated or too little aerated, so that conditions of incomplete combustion, or absence of combustion altogether, are created locally which result in increased harmful emissions and lower thermal efficiency of the burner.

It is an object of this invention to propose a method for feeding a gas burning apparatus which is operated using an atmospheric burner, which can avoid, or at least attenuate, the faulty combustion homogeneity affecting ordinary feeding methods.

Another object is to provide an apparatus for implementing the aforesaid method which has a simple construction.

These objects are achieved by the method and the apparatus as generally defined and characterized in the first and the third of the appended claims to this specification, respectively.

The invention can be better understood by having reference to the following description of two embodiments thereof, to be taken by way of example and not of limitation in conjunction with the accompanying drawings, in which:

Figure 1 shows schematically and in section an apparatus according to a first embodiment of the invention;

Figure 2 is an enlarged perspective view of a portion of the apparatus shown in Figure 1 incorporating an atmospheric burner; and

Figure 3 shows schematically and in section an apparatus according to another embodiment of the invention.

The apparatus depicted in Figure 1 comprises an atmospheric burner 10, a combustion chamber 11, a heat exchanger 12, and a fan 13, all accommodated inside a compartment 14 having a vertical spread, in this case.

The burner comprises, as shown best in Figure 2, a conduit 15 having a square cross-sectional shape and being shown with a portion thereof removed, which conduit is connected to a gas distribution system through a fitting 16 and carries multiple nozzles 17 which extend parallel to one another from the conduit. Associated with each nozzle 17 is a metal conduit 18, in the form of a venturi, which is disposed with its inlet port at a predetermined distance away from the nozzle, and in this case coaxial with the nozzle, for drawing in primary air and admixing it to the gas flowing out of the nozzle. Each venturi 18 conveys, through a connection channel 18', the gas/primary air mixture into a box-type diffuser member 19 which has multiple holes across one of its narrow sides.

The dimensions of the venturis and the openings 25, and more generally, all the physical and construction parameters of the apparatus so embodied are selected such that the primary air is admixed to the gas in varying proportions, depending on individual requirements and/or the power delivered, from substantially equal values to the amount stoichiometrically necessary for gas combustion up to values which exceed this amount by 50-60%.

The venturis 18, their respective connection channels 18', and the diffusers 19 are, as can be seen, arranged in structurally similar sets placed side-by-side a given distance apart and with the holed sides of the diffusers 19 in the same plane to form a horizontal bed whence the flame will issue.

In an apparatus as described thus far and conventionally embodied, e.g. the one described in the aforementioned patent application, a wall of sheet metal is provided between the nozzles and the venturis crosswise to the axes of the latter and has a circular opening at the location of each of the nozzles. In operation of the apparatus, the gas flows at a high speed out of the nozzles and causes air, the primary air, to be drawn into the venturis to become mixed with it; the mixture is then delivered, through the diffuser holes, into the combustion chamber where it is burned. The air required to complete the combustion, i.e. the secondary air, is drawn in from the lower portion of the apparatus which is in open communication with the outside, by the vacuum created by the fan and is introduced into the combustion chamber through the gaps between adjacent sets, including the venturis, connection channels, and diffusers.

On the other hand, according to the invention, while the primary air intake process is kept substantially unaltered, the secondary air supply is controlled such that it will be drawn in toward the combustion chamber 11 in a stream which, in the neighborhood of the inlet ports of the intake conduits 18, will be substantially parallel to the stream of primary air through such ports.

A practical way of obtaining this is shown in Figures 1 and 2. According to the invention, the lower portion of the burner 10 is contained within a box-type structure 23, shown with a portion thereof removed in Figure 2, which has its edges aligned to the walls of the combustion chamber 11 and includes a wall 24 which, additionally to having primary air openings, shown at 25, similarly to the above-described prior art apparatus, has more openings 26 adjacent to them. Such additional openings 26 locate outside the areas facing the inlet ports of the venturis 18 but in all cases near the areas where the entraining effect on the gas streams issuing from the nozzles 17 and attendant intake of air to the venturis are manifest. Thus, the secondary air can only be drawn into the combustion chamber through such additional openings. The primary air AP and secondary air AS streams, as indicated by arrows in the drawing, enter the box-type structure 23 along parallel flow directions.

In the embodiment shown in Figure 3, where similar parts to those in Figure 1 are denoted by the same reference numerals, each of the side-by-side sets which jointly form the burner comprises two venturis, being laid at about 90° to each other, as indicated at 18a and 18b, and communicated to a common diffuser 19'. A gas intake conduit 15', having here a substantially triangular cross-sectional shape, has two sets of nozzles 17a, 17b confronting the intake ports of venturis. In this example, the nozzles are mounted with their axes slightly offset downwards parallel to the axes of their respective venturis, but may be mounted with their axes at a slope angle on the venturi axes. The construction details and advantages of this type of mount are described in Italian Patent Application No. 19294-A/87 filed by Worgas Bruciatori s.r.l..

A box-type structure 23' encloses all the side-by-side sets of the burner and is mounted with its edges aligned to the side walls of the combustion chamber 11. This structure is configured to have a wall, bent to an angle, interposed to the intake ports of the venturis 18a, 18b and its respective nozzles 17a, 17b. The two portions, denoted by 24a and 24b, of that wall have primary air openings 25a, 25b facing the inlet ports of the venturis 18a and 18b and secondary air openings 26a and 26b proximate to the openings for the primary air, similar to what has been described in connection with the apparatus of Figures 1 and 2.

In this embodiment, the streams of primary air APa, APb and secondary air ASa, ASb being flowed through the openings in the portions 24a and 24b, respectively, of the angled wall are parallel to each other, of course.

The expedient of this invention, besides being extremely simple construction-wise, has proved highly advantageous in that it affords a homogeneous combustion even where the burner is operated at the lowest power.

For the apparatus to operate properly, the additional openings 26 would obviously have to be sized such that the flow rate of secondary air is adequate to ensure full combustion of the gas under all conditions. This sizing should take account of the vacuum present within the combustion chamber. In the instance of apparatus wherein the vacuum is provided by a fan, the secondary air flow rate can be readily controlled by suitably adjusting the dimensions of the openings 26. With predetermined relatively low vacuum levels, such as can be obtained using a flue, the additional openings provided in the wall formed with the primary air openings may not be sufficient for the secondary air to attain the required flow rate. In this case, further openings may obviously be provided in the other walls of the box-type structure until the required flow rate is obtained.

While just two embodiments of the invention have been described and illustrated, it is understood that many variations and modifications are possible within the scope of the same inventive concept. For example, to fill particular construc-

tional or functional demands, both the primary air openings and those for the secondary air could be other than circular in shape, and more generally, the overall design of the apparatus could be made quite different from that shown provided that its general features, as defined in the appended claims, are retained.

Claims

1. A method for feeding a gas burning apparatus incorporating a burner (10) of the atmospheric type, in which

   a stream of fuel gas is mixed with a stream of primary air (AP) within an intake conduit (18), and

   the resultant mixture is introduced, through a diffuser (19,20), into a combustion chamber (11) in the presence of secondary air (AS),

   characterized in that the secondary air (AS) is, at least in part, drawn toward the combustion chamber (11) in a stream which, in the neighborhood of the inlet port of the intake conduit (18), is flowed substantially parallel to the stream of primary air (AP) through said port.

2. A method according to Claim 1, characterized in that the primary air (AP) is admixed to the gas in an amount which is at least equal to the amount required for stoichiometric combustion of the gas.

3. A gas burning apparatus comprising a burner (10) of the atmospheric type, a combustion chamber (11), and means (13) for creating a vacuum within the combustion chamber, the burner (10) comprising,

   a plurality of gas outflow nozzles (17),

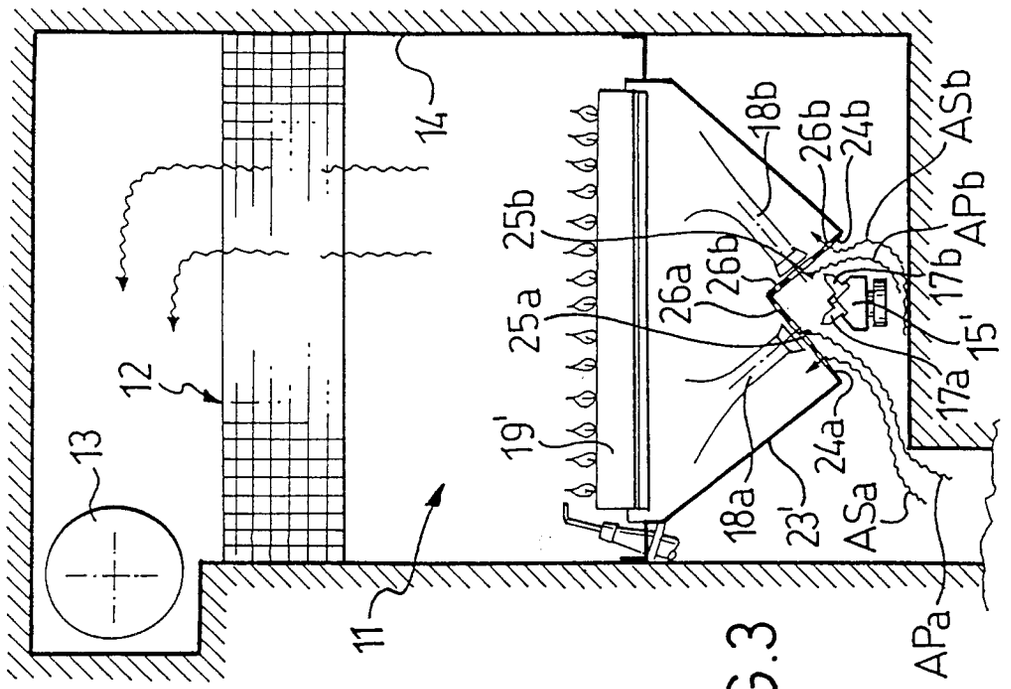
   a corresponding plurality of intake and mixing conduits (18) with inlet ports facing their respective nozzles, and

   a plurality of diffusers (19,20) in communication with the conduits (18), wherethrough the gas/primary air mixture is caused to flow into the combustion chamber (11),

   said apparatus being characterized in that it further comprises a box-type structure (23) whose edges are aligned to the walls of the combustion chamber (11) and which encloses the intake and mixing conduits (18) and has a wall (24) disposed between the nozzles (17) and the conduits (18) crosswise to the axes of the conduits, said wall also having, at the location of each nozzle (17), an inlet opening (25) for drawing primary air (AP) into its respective conduit, and in the neighborhood of the opening (25) for the primary air (AP), openings (26) located substantially outside the area facing the conduit (18) inlet port.

4. An apparatus according to Claim 3, characterized in that the physical and size parameters of the apparatus are selected such that the primary air (AP) is admixed to the gas in an amount at least equal to the amount required for stoichiometric combustion of the gas.

5. An apparatus according to either Claim 3 or 4, characterized in that the nozzles (17a,17b) are arranged in two sets of aligned nozzles, with the axes of the nozzles in one set lying at an angle to the axes of the nozzles in the other set, that the intake and mixing conduits (18a,18b) are associated in pairs with a diffuser (19'), and that the wall located between the nozzles has two bent portions (24a,24b) which are bent to the same angle included between the axes of the nozzles in the two sets, each including said openings for the primary air (APa,APb) and the secondary air (ASa,ASb).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12
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11
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25b
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26b
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APa
APb
17a
17b
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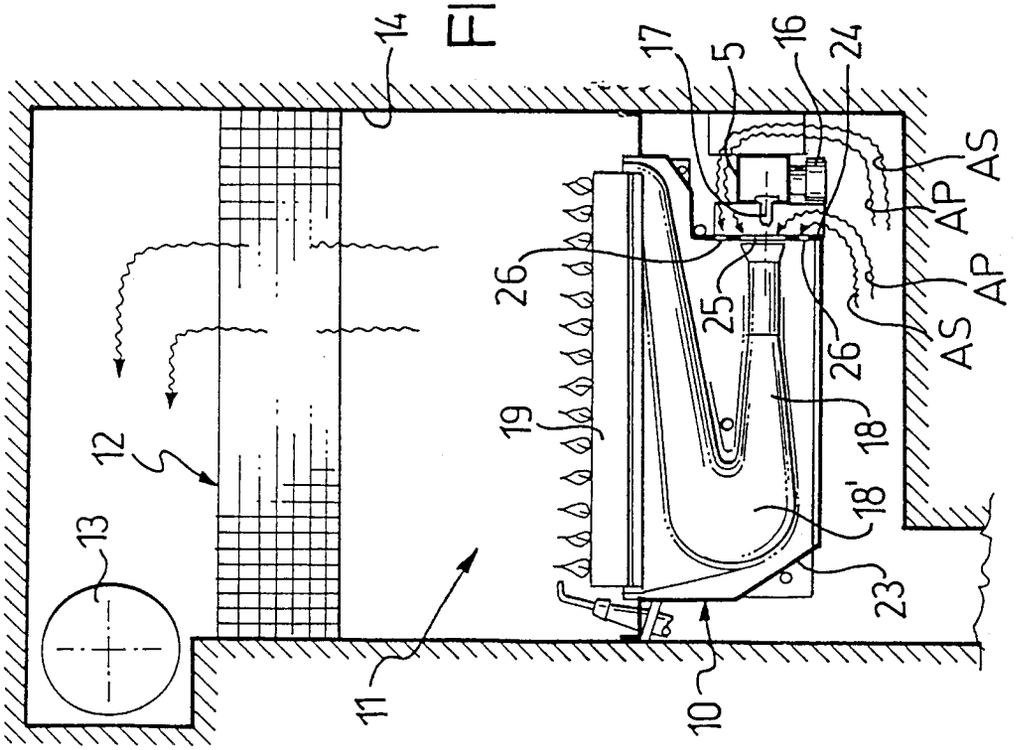
FIG.3

FIG.1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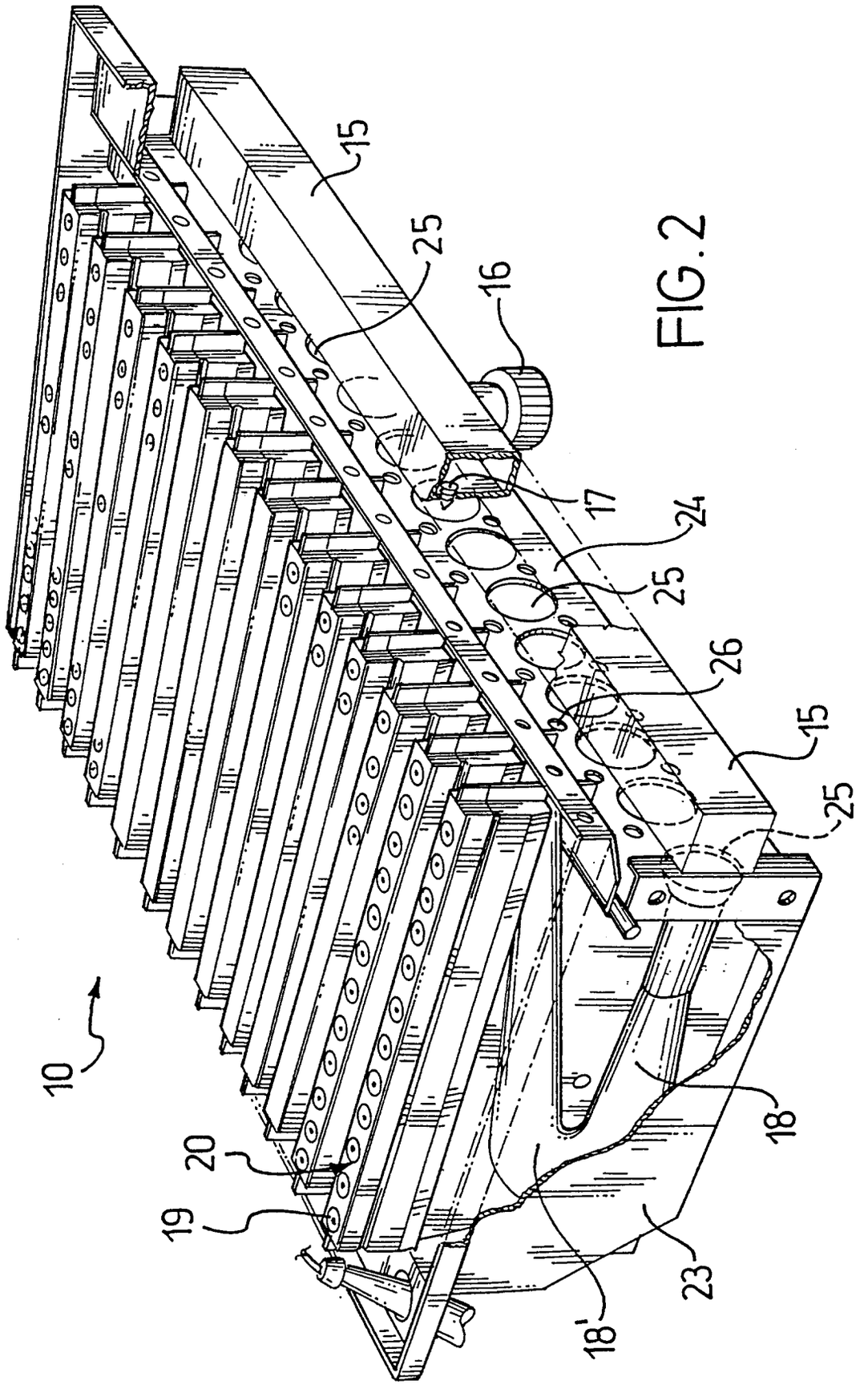

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 93 20 2975

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.5)
A	DE-B-12 94 302 (SAUNIER, DUVAL) * column 2, line 3 - line 25 * * figures 1,2 *	1,3	F23D14/04
A	EP-A-0 434 599 (VAILLANT)		
A	GB-A-1 517 957 (AEROMATIC COMPANY)		
A	GB-A-1 297 005 (POTTERTON INTERNATIONAL)		

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

F23D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 January 1994	Vrugt, S

CATEGORY OF CITED DOCUMENTS

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