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(54) Heat exchanger having a burner and a heat exchanger unit.

(57) Heat exchanger having a burner and a heat exchanger unit. The burner is provided with a base part having a bottom and a shell-shaped part. The bottom is provided with a central bore and a central elevation. The shell-shaped part is internally provided with a shoulder. A tube placed in the central opening is present for transporting a gaseous fuel. A bush-shaped part having an end is placed on the base part and surrounds and abuts the central elevation. An annular closing element supports on the shoulder and on the bush-shaped part and is provided with a central opening. The exit opening of the tube is situated in the central opening. The internal diameter of the central opening is larger than the external diameter of the tube. The base part is provided with a supply opening for supplying oxidation agent, and the bush-shaped part is provided with continuous openings for passing oxidation agent to the inside of the bush-shaped part. The heat exchanger unit is provided with a tubular wall of which one end is arranged in the base part and with a helical tube for containing a cooling medium.

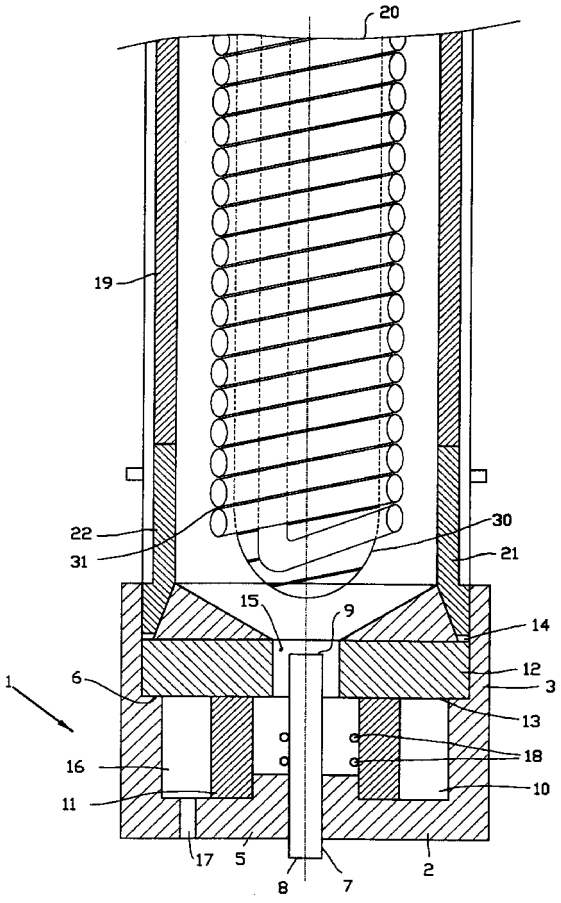

FIG. 1

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Description

[0001] The present invention relates to a heat exchanger having a burner and a heat exchanger unit.

[0002] Usually such a heat exchanger has a space which can be connected to the exit of a burner, for instance an ancillary burner, and hollow walls for containing cooling medium surrounding the space. The burner introduces a mixture of a fuel and an oxidation agent, usually a mixture of a gas or a compound of gasses and air or oxygen, into the space so that the cooling medium, for instance water, present in the walls, is heated and the heated mixture is cooled down at the same time.

[0003] It is an objective of the present invention to provide a high-efficiency heat exchanger, the burner having a low emission, for instance a low NOx emission, the construction of the heat exchanger also being simple and cheap.

[0004] To that end according to the present invention a heat exchanger is provided having a burner and a heat exchanger unit, the burner being provided with a base part having a round bottom and a shell-shaped part extending from the circumference of the bottom in a direction, the shell-shaped part having a height, the bottom being provided with a bottom surface, a central bore and a central elevation extending in the direction and the shell-shaped part being internally provided with a step-like narrowing for forming a shoulder, which shoulder is situated at a first distance from the bottom surface, a tube placed in the central opening for transporting a gaseous fuel, which tube has an entrance opening and an exit opening, which exit opening is situated at a second distance from the bottom surface, which second distance is larger than the first distance, a bush-shaped part having an end placed on the bottom surface and the other end being situated at the first distance from the bottom surface, the bush-shaped part surrounding and abutting the central elevation, an annular closing element having a thickness and having a first surface and a second surface, the closing element with its first surface supporting on the shoulder and on the other end of the bush-shaped part, the closing element being provided with a central opening and the exit opening of the tube being situated in the central opening, the thickness of the closing element plus the first distance being smaller than the height of the shell-shaped part, and the internal diameter of the central opening being larger than the external diameter of the tube, an annular space being defined by the base part, the bush-shaped part and the closing element, the base part being provided with a supply opening for supplying oxidation agent to the space, and the bush-shaped part being provided with one or several continuous openings for passing the oxidation agent from the space to the inside of the bush-shaped part, and the heat exchanger unit being provided with a tubular wall of which one end is arranged in the base part, and a helical tube for containing a cooling medium, which tube is accommodated within the tubular wall. As a result a heat exchanger having an integrated burner is provided, which has a very simple and compact construction.

[0005] In a preferred embodiment of the heat exchanger according to the invention the continuous openings for passing the oxidation agent are arranged such in the bush-shaped part that supplied oxidation agent enters the inside of the bush-shaped part almost tangential to the inner wall of the bush-shaped part. As a result a swirling of oxidation agent is created in the inside of the bush-shaped part and in the bore of the closing element, as a result of which a good mixing of the gaseous fuel is obtained.

[0006] In a further embodiment of a heat exchanger according to the invention a disk of high-grade insulation material is arranged on the second surface of the closing element, the disk having a central hole having the same or a larger diameter than the central opening of the closing element and the thickness of the disk of the central hole increasing to the outside. The disk of high-grade insulation material absorbs heat from the ignited mixture of gaseous fuel and oxidation agent, so that said mixture is cooled on that location, resulting in a low emission of flue gasses, in particular NOx. As the disk is made of insulation material, the heat absorbed is radiated to the helical tube, so that the cooling medium can be further heated.

[0007] A further low emission of particularly NOx is contributed to because the end of the tubular wall, which is arranged in the base part, is made of high-grade insulation material.

[0008] In an extremely efficient manner heat of the ignited mixture is transferred to the cooling medium when the helical tube for containing cooling medium has an elliptic cross-section, the long axis thereof being parallel to the direction of the extension of the shell-shaped part. As a result the efficiency of the heat exchanger is improved.

[0009] A heat exchanger according to the invention with an extremely high heat transfer per winding is obtained by the helical windings of the tube having a diameter in the range of approximately 60 mm to approximately 500 mm, preferably 80 mm to approximately 100 mm, and in which preferably the short axis of the elliptic cross-section has a size in the range of approximately 10 mm to approximately 20 mm, more preferably of approximately 11 to approximately 14 mm, and preferably the helical windings of the tube being spaced apart in the range of approximately 3 mm to approximately 20 mm, more preferably approximately 4 mm to approximately 6 mm.

[0010] Below the invention will be elucidated by way of example on the basis of some exemplary embodiments referring to the attached drawing, in which:

Figure 1 schematically shows a cross-section of a heat exchanger according to the invention,

Figure 2 schematically shows a cross-section of a base part to be used in a heat exchanger according to the present invention, and

Figure 3A and figure 3B schematically show a side view and top view, respectively, of a bush-shaped part to be used in a heat exchanger according to the present invention.

[0011] In figure 1 a heat exchanger having a burner and heat exchanger unit according to the present invention is schematically shown in cross-section. The burner of the heat exchanger according to the present invention is provided with a base part 1 having a round bottom 2 and a shell-shaped part 3 extending from the circumference of the bottom 2 in a direction. The shell-shaped part 3 has a height, which can be chosen amongst others depending on the wanted power.

[0012] The bottom 2 has a bottom surface 10, a central bore 4 and a central elevation 5. The elevation 5 extends in the same direction as the shell-shaped part 3. The shell-shaped part 3 is internally provided with a step-like narrowing so that a shoulder 6 is formed. Said shoulder 6 is situated at a first distance from the bottom surface 10.

[0013] A tube 7 is placed in the central opening 4 (see figure 2) for transporting a gaseous fuel. The tube 7 has an entrance opening 8 and an exit opening 9, which exit opening is situated at a second distance from the bottom surface 10, which second distance is larger than the first distance. In an alternative embodiment the tube 7 can be provided with continuous openings in the wall, for having the gaseous fuel flow out radially.

[0014] A bush-shaped part 11 has an end placed on the bottom surface 10. The other end of the bush-shaped part 11 is situated at the first distance from the bottom surface 10. The bush-shaped part 11 surrounds and abuts the central elevation 5.

[0015] An annular closing element 12 with its first surface 13 supports on the shoulder 6 and on the other end of the bush-shaped part 11. The closing element 12 has a central opening 15, in which the exit opening 9 of the tube 7 is situated. The thickness of the closing element 12 plus the first distance is smaller than the height of the shell-shaped part 3. The internal diameter of the central opening 15 is larger here than the external diameter of the tube 7 so that there is sufficient room around the tube 7 for letting the oxidation agent, for instance air, pass through.

[0016] An annular space 16 is defined by the base part 1, the bush-shaped part 11 and the closing element 12. Oxidation agent is supplied to the space 16 by means of a supply opening 17 arranged in the base part 1. The supply opening can, as shown by figure 1, go through the bottom 2 of the base part 1 or, as shown by figure 2, through the shell-shaped part 3. For passing the oxidation agent from the space 16 to the inside of the bush-shaped part 11, the bush-shaped part 11 is provided with continuous openings 18, which can be seen better in figures 3A and 3B.

[0017] When the gaseous fuel goes through the tube 7, and oxidation agent flows through the supply opening 17 and the passage openings 18, a mixture of the fuel and the oxidation agent is created near the exit opening 9 of the tube 7. At this location ignition means, known per se but not shown, are arranged for igniting the mixture.

[0018] An extremely uniform and sufficient mixing of the fuel and the oxidation agent is obtained by generating a swirling of the oxidation agent in the inside of the bush-shaped part 11. According to the invention this takes place because the continuous openings 18 for passing oxidation agent are arranged such in the bush-shaped part 11 that supplied oxidation agent enters the inside of the bush-shaped part 11 almost tangential to the inner wall of the bush-shaped part 11. An example of this is clearly shown in figure 3B.

[0019] When a disk 21 of high-grade insulation material is arranged on the second surface 14 of the closing element 12, the disk 21 having a central hole having the same or a larger diameter than the central opening 15 of the closing element 12 and the thickness of the disk 21 of the central hole increasing to the outside, said disk 21 is heated by the ignited mixture of gaseous fuel and oxidation agent, so that the mixture is cooled down on that location, resulting in a low emission of flue gasses, particularly NOx. Furthermore the heated disk radiates heat to a helical tube and heats the cooling medium flowing in there.

[0020] The heat exchanger unit of the heat exchanger according to the present invention has a tubular wall 19 of which one end 22 is arranged in the base part 1. Furthermore a helical tube 20 for containing a cooling medium is accommodated within the tubular wall 19.

[0021] The heat developed by the ignited mixture of fuel and oxidation agent is transferred to the cooling medium which is thus heated.

[0022] In order to improve heat transfer to the cooling medium, the end 22 of the tubular wall 19 which is arranged in the base part 1 is made of high-grade insulation material.

[0023] After extensive experiments it appeared that a high heat transfer and thus a high-efficiency for the heat exchanger is obtained, when the helical tube 20 has an elliptic cross-section, the long axis thereof being parallel to the direction of the extension of the shell-shaped part 3.

[0024] It appeared that the heat transfer can further be improved by choosing the internal diameter of the helical windings of the tube 20 in the range of approximately 60 mm to approximately 500 mm, preferably 80 mm to approximately 100 mm. Preferably the short axis of the elliptic cross-section has a size in the range of 10 mm to approximately 20 mm, more preferably of approximately 11 to approximately 14 mm, and preferably the

helical windings of the tube 20 being spaced apart in the range of approximately 3 mm to approximately 20 mm, more preferably approximately 4 mm to approximately 6 mm.

[0025] In a known manner a displacement body 30 can be accommodated within the space formed by the helical tube. According to the invention said displacement body is made of insulating ceramic fibre material, so that its outside can glow at an increased temperature of for instance 800°C. As a result the heat is used more efficiently. Furthermore it appeared that a better heat transfer takes place when the outer surface of the displacement body is provided with a helical groove 31, preferably having a different pitch than the pitch of the windings of the tube.

[0026] Although on the basis of figure 1 the impression could be given that the base part 1, the tube 7, the bush-shaped part 11, the annular closing element 12, the disk 21, the tubular wall 19, and the end 22 of the tubular wall 19, are only separate elements, it is also possible that one or more of said elements form one integrated unit.

Claims

1. Heat exchanger having a burner and a heat exchanger unit, the burner being provided with:

a base part (1) having a round bottom (2) and a shell-shaped part (3) extending from the circumference of the bottom (2) in a direction, the shell-shaped part (3) having a height, the bottom (2) being provided with a bottom surface (10), a central bore (4) and a central elevation (5) extending in the direction and the shell-shaped part (3) being internally provided with a step-like narrowing for forming a shoulder (6), which shoulder is situated at a first distance from the bottom surface (10);

a tube (7) placed in the central opening (4) for transporting a gaseous fuel, which tube (7) has an entrance opening (8) and an exit opening (9), which exit opening (9) is situated at a second distance from the bottom surface (10), which second distance is larger than the first distance;

a bush-shaped part (11) having an end placed on the bottom surface (10) and the other end being situated at the first distance from the bottom surface (10), the bush-shaped part (11) surrounding and abutting the central elevation (5);

an annular closing element (12) having a thickness and having a first surface (13) and a second surface (14), the closing element (12) with its first surface (13) supporting on the shoulder (6) and on the other end of the bush-shaped part (11), the closing element (12) being provided with a central opening (15) and the exit opening (9) of the tube (7) being situated in the central opening (15), the thickness of the closing element (12) plus the first distance being smaller than the height of the shell-shaped part (3), and the internal diameter of the central opening (15) being larger than the external diameter of the tube (7);

an annular space (16) being defined by the base part (1), the bush-shaped part (11) and the closing element (12), the base part (1) being provided with a supply opening (17) for supplying oxidation agent to the space (16), and the bush-shaped part (11) being provided with one or several continuous openings (18) for passing the oxidation agent from the space (16) to the inside of the bush-shaped part (11); and the heat exchanger unit being provided with:

a tubular wall (19) of which one end is arranged in the base part (1); and

a helical tube (20) for containing a cooling medium, which tube (20) is accommodated within the tubular wall (19).

2. Heat exchanger according to claim 1, the continuous openings (18) for passing the oxidation agent being arranged such in the bush-shaped part (11) that supplied oxidation agent enters the inside of the bush-shaped part (11) almost tangential to the inner wall of the bush-shaped part (11).

3. Heat exchanger according to claim 1 or 2, a disk (21) of high-grade insulation material being arranged on the second surface (14) of the closing element (12), the disk (21) having a central hole having the same or a larger diameter than the central opening (15) of the closing element (12) and the thickness of the disk (21) of the central hole increasing to the outside.

4. Heat exchanger according to claim 1, 2 or 3, the end of the tubular wall (19) which is arranged in the base part (1) being made of high-grade insulation material.

5. Heat exchanger according to claim 1, 2, 3 or 4, the helical tube (20) for containing a cooling medium having an elliptic cross-section, the long axis thereof being parallel to the direction of the extension of the shell-shaped part (3).

6. Heat exchanger according to claim 5, the helical windings of the tube (20) having a diameter in the range of approximately 80 mm to approximately 100 mm.

7. Heat exchanger according to claim 5 or 6, the short

axis of the elliptic cross-section having a size in the range of approximately 11 to approximately 14 mm.

8. Heat exchanger according to claim 5, 6 or 7, the helical windings of the tube (20) being spaced apart in the range of approximately 4 to approximately 6 mm.

9. Heat exchanger according to any one of the preceding claims, a displacement body (30) being accommodated within the helical tube (20), which body is made of insulating ceramic fibre material, which glows at an increased temperature of for instance 800°C.

10. Heat exchanger according to claim 9, the outer surface of the displacement body (30) being provided with a helical groove (31).

11. Heat exchanger according to claim 10, the pitch of the helical groove (31) being different from the pitch of the helical tube.

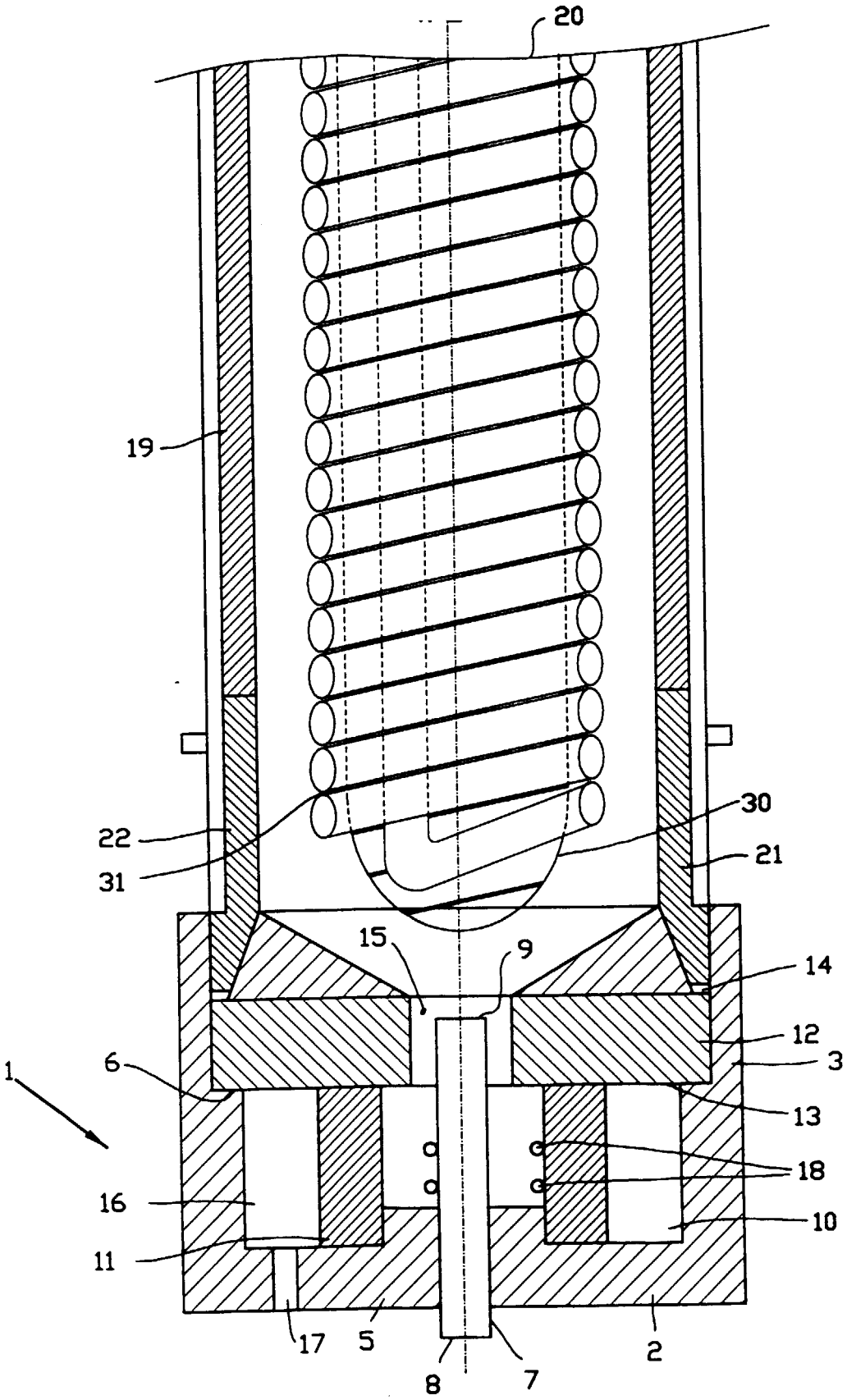

FIG. 1

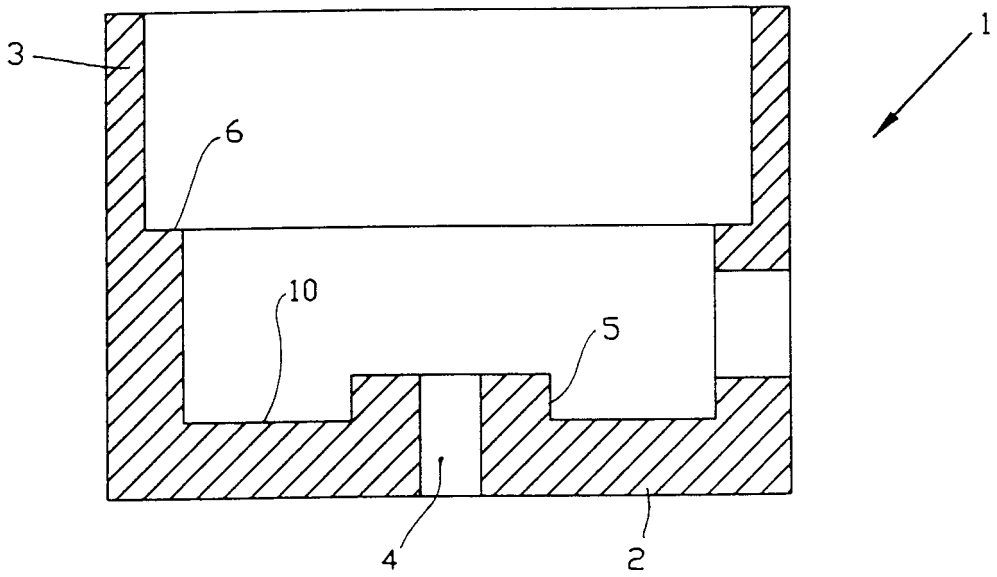

FIG. 2

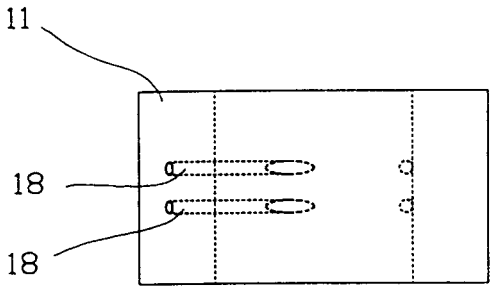

FIG. 3A

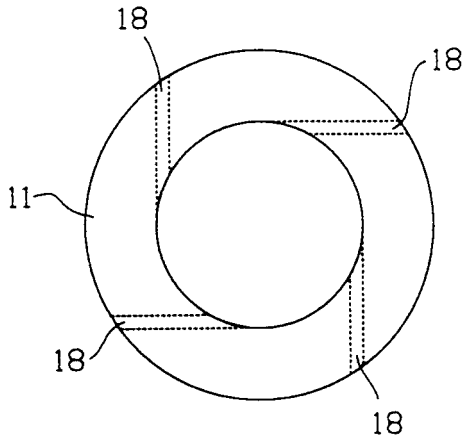

FIG. 3B

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EUROPEAN SEARCH REPORT

Application Number
EP 00 20 1594

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.7)
A	GB 1 403 534 A (PRIEST E H;PRIEST G M) 28 August 1975 (1975-08-28) * the whole document *	1-3	F24H1/43 F23D14/24
A	PATENT ABSTRACTS OF JAPAN vol. 007, no. 221 (M-246), 30 September 1983 (1983-09-30) & JP 58 115210 A (NISSAN JIDOSHA KK), 8 July 1983 (1983-07-08) * abstract *	1,2	
A	US 4 505 667 A (FRUSTA GEORGES ET AL) 19 March 1985 (1985-03-19) * abstract; figures *	1-3	
A	FR 1 392 532 A (CHATELIER) 30 June 1965 (1965-06-30) * the whole document *	1,5,8	
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F24H
F23D
F23C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 August 2000	Van Gestel, H

CATEGORY OF CITED DOCUMENTS

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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