(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 February 2002 (14.02.2002)

PCT

(10) International Publication Number
WO 02/13577 A1

(51) International Patent Classification[7]: H05B 3/00, 3/60, C25B 1/04, H01L 35/00, F24J 1/00

(21) International Application Number: PCT/EP01/08918

(22) International Filing Date: 1 August 2001 (01.08.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
MI2000A001809 3 August 2000 (03.08.2000) IT

(71) Applicant *(for all designated States except US)*: GIACOMINI S.P.A. [IT/IT]; Via per Alzo, 39, I-28017 S. Maurizio d'Opaglio (IT).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: GIACOMINI, Luca [IT/IT]; Via Santuario, 19, I-28010 Madonna del Sasso (IT).

(74) Agent: ZANELLA, Ireneo; Zanella & Associati S.r.l., P.O. Box 98, I-22074 Lomazzo (IT).

(81) Designated States *(national)*: AT, AT (utility model), BG, CA, CH, CN, CZ, DE, DE (utility model), DK, DK (utility model), ES, FI, FI (utility model), GB, GE, HR, HU, IN, LU, MX, NO, PL, PT, RO, RU, SE, SI, SK, SK (utility model), TR, UA, US, YU.

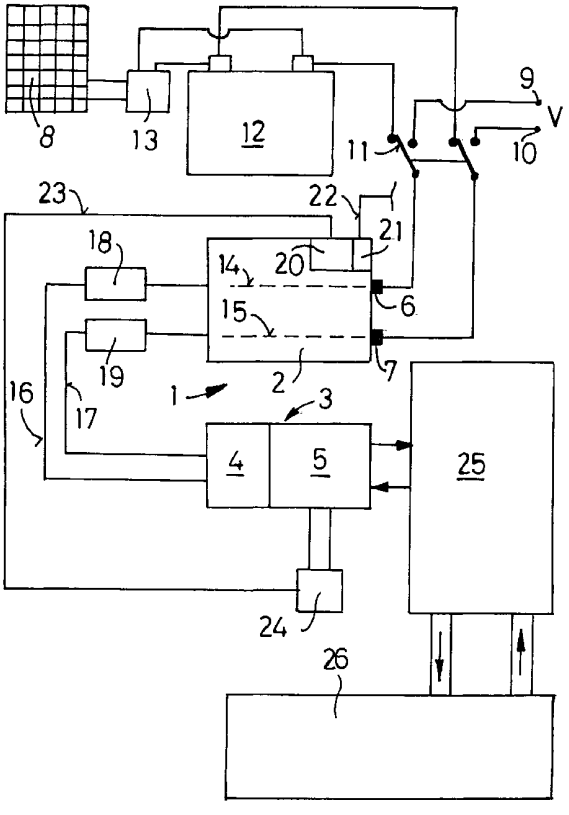
(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AT, BG, CA, CH, CN, CZ, DE, DK, ES, FI, GB, GE, HR, HU, IN, LU, MX, NO, PL, PT, RO, RU, SE, SI, SK, TR, UA, YU, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR)*

[Continued on next page]

(54) Title: CUMULATIVE HEAT GENERATING SYSTEM INCLUDING AN ELECTROLYSIS DEVICE



(57) Abstract: A heat generating system comprises a fuel supply and a burner-combustor assembly, the fuel supply including an electrolysis device (2) for generating, from water having a suitable electric resistivity, hydrogen and oxygen, forming a burning mixture which is fed to a burner burning the mixture without emitting unburnt gases and noxious substances. The electrolysis current is preferably supplied by AC sources or relieved-rate supply networks. A heat accumulator (25) can be coupled to the burner-combustor assembly (4, 5). The system (1) can be advantageously used for hot sanitary water and/or heating systems.

WO 02/13577 A1

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designation US*
— *of inventorship (Rule 4.17(iv)) for US only*

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

CUMULATIVE HEAT GENERATING SYSTEM INCLUDING AN ELECTROLYSIS DEVICE

Background of the invention

The present invention relates to a cumulative heat generating system according to the preamble of claim 1.

As is known, conventional heat generating systems, which, for example, are used in hot sanitary water and/or heating systems, are supplied with liquid fuels, such as gas oil, or gaseous fuels, such as methane. For a liquid fuel use it is necessary to provide large storing vessels or tanks.

For a gaseous fuel application, on the other hand, it is generally necessary to provide a connection with the gas supplying system or, at a region not serviced by a gas supplying system, outside installed gas supplying tanks, as in a liquid gas or GPL application.

However, the burning of conventional fuels is affected by several drawbacks and disadvantages. At first, a conventional fuel burning process involves a generation of unburnt gases holding noxious substances, which unburnt gases require moreover a outlet stack or fume chimney. Moreover, for preventing corrosive phenomena related to a condensation of aggressive substances from occurring, the unburnt gases must have a high temperature, which negatively affects the thermal efficiency of the system and its operating cost.

Electrolytic devices and methods have been furthermore extensively used for making hydrogen, oxygen, chlorine, sodium hydroxide, for affinating and passivating metals and depositing alloys, such as for chromium plating applications and the like.

Also know is the generation of electric power from alternative sources, such as solar panels, eolic generators and the like. In general, these alternative power sources are used for heating small amounts of water to rather low temperatures, and are frequently used as back-up system in conventional hot sanitary water generating systems and/or in domestic or industrial heating systems.

Summary of the invention

In the light of the above discussion, the aim of the present invention is to provide a system for generating cumulative heat, which system:

- performs a burning process without emitting unburnt gases and noxious substances,
- requires, for its operation, a use of electric power and an inexpensive, easily available and easily produced raw material,
- alternately to a use of fixedly rated expensive electric power from fixed-rate power systems, as provided in Italy, the subject system can also operate, at least partially, with a less expensive alternative electric power, and
- allows to improve the thermal efficiency of the system.

According to the present invention, the above mentioned aim is achieved by a system for generating cumulative heat having the features of claim 1.

The cumulative heat generating system according to the present invention provides a lot of important advantages. As electrolyte, it is possible to use simple distilled water, demineralized water or water having an electric resistivity suitable for the electrolytic process, the cost of which is very small and which can be either stored in low amounts, for example of the order of few liters, or produced in situ, starting from the water system

supplied water or from a water store dedicated to the electrolysis device.

Thus, by exploiting the electrolysis principle, the subject system can be power supplied by a rather unexpensive electric power derived from alternative sources such as solar panels, aeolic generators and so on. The condensating water, which represents the sole residue of the burning process, can be advantageously recycled by re-supplying it to the water tank of the electrolysis device. A use of hydrogen and oxygen as a fuel or combustible gas, requires only small modifications to conventional burners or boilers. A further important advantage is that in the burning process no unburnt gases or noxious substances are generated. Accordingly, the inventive system is per-se not polluting and does not generate noxious polluting substances. The absence of unburnt gases, in particular, allows to omit discharging or outlet chimneys therefor. By exploiting the high hydrogen-oxygen mixture burning temperature of the order of about 2,000°C, and in absence of unburnt gases, the thermal efficiency is greatly improved. Moreover, it is possible to derive a greater amount of the burning heat by reducing the temperature of the heated fluid, such as water, for example to about 40°C. Such a temperature would allow to directly supply, for example, coil heating systems, such as floor heating systems and the like.

Owing to a suitable dimensioning and an industrial making of the alternative electric power generator to power supply the electrolysis device, the hydrogen and oxygen making cost can be considered as negligible.

A further advantage is that, in order to accumulate the generated heat, it is possible to connect to the burner-combustor assembly, any suitable conventional heat accumulators, of any suitable configuration or operating principle. Moreover, the heat generating system according to the invention can be advantageously

used in conventional systems, other of recent construction or already existing, for producing hot sanitary water and/or for heating applications, and this in a very simple manner, without requiring any intensive fitting operations.

According to claim 2, as electrolyte is merely used water having a suitable electric resistivity.

To allow hydrogen and oxygen to be used as fuels in any desired mixing ratio, according to claim 3, said gases are at first separately collected in suitable accumulators and then supplied to the burner in an individually adjustable manner.

According to claim 4, the heat generated in the combustor or combustion chamber is accumulated in a heat accumulator coupled to said burner-combustor assembly.

To exploit in a maximum degree the generated heat, according to claim 5, a heat accumulator including a substance suitable to change the physical status thereof depending on the temperature thereof is used.

To reduce as far as possible the cost of the electrolysis electric power, according to claim 6, electric power generated by alternative electric power sources such as solar panels, aeolic generators or the like, or an electric power derived from relieved rate networks, such as the night electric power of France and Germany is used.

Advantageously, according to claim 7, the electric power for power supplying the electrolysis device is supplied at a low voltage, for example of the order of 2-24V, preferably 2-12V and, more preferably, of 2-4V.

As claimed in claim 8, the electrolysis device is advantageously power supplied in an adjustable manner, and by using a battery of electric accumulator assembly.

By including in the electrolysis device a processing device to process the system or stored water to a suitable electric

resistivity electrolyte, as claimed in claim 9, it is possible to omit any distilled water storing tank.

As claimed in claim 10, the burning condensating water is advantageously reused as an electrolyte.

The heating generating systems according to the invention can be advantageously used in or for domestic or industrial systems for making hot sanitary water and/or heating systems, as well as in air heating systems, radiating heating systems and so on, as claimed in claim 11.

Moreover, due to the high burning temperature of the hydrogen-oxygen mixture, the heat generating systems according to the invention can be moreover advantageously used in industrial systems for heating or thermally processing fluids at conventional temperatures, and higher temperatures, with very high thermal efficiencies and without any additional costs for achieving the mentioned high temperature, which allows to carry out novel processing methods, which could not be carried out, at a like low cost, in the prior art.

Brief description of the drawing

Further characteristics, advantages and details of the cumulative heat generating system according to the present invention will become more apparent from the following disclosure of an exemplary embodiment thereof which is illustrated in the sole figure of the accompanying drawing.

Description of the preferred embodiment

With reference to the drawing, the cumulative heat generating system according to the invention, has been generally indicated herein by the reference number 1. Said system substantially comprises a gaseous fuel supply 2, and an assembly 3 including a burner 4 and associated combustion chamber or

combustor 5.

The gaseous fuel supply 2 comprises a "fuel generator" in the form of an electrolysis device, i.e. a device for carrying out an electrolysis of an electrolyte, including, for example, a suitable electric resistivity water. The term "suitable electric resistivity water" must be intended as including distilled water, demineralized water and the like. The electrolysis device 2 can be of any suitable type, for example of a ion exchange membrane type. The electrolysis device 2, in particular, is supplied, at its positive and negative poles 6 and 7, with an electric power preferably supplied by an alternative electric power source, in the embodiment being shown solar panels 8, eolic generators or the like, or, for example in a case of a relieved rated or tariff electric power, such as for the night electric power in France and Germany, directly from the network terminals 9 and 10, through the commutating switch 11. The reference number 12 indicates a battery assembly which can be supplied by the panels 8. The reference number 13 indicates an adjusting member.

According to the invention, the electric power is supplied to the electrolysis device 2 at a low voltage, for example from 2 to 24V, preferably from 2 to 12 V and, more preferably from 2 to 24V. If the device is supplied by the power mains, then known transformer-rectifier assemblies, or the like, per se known and not shown in any further details will be used. Likewise, said solar panel 8 and aeolic generators will not be disclosed in further details since they are well known.

Near the electrodes 14 and 15 are provided ducts 16 and 17 respectively for conveying hydrogen and oxygen, said ducts suitably leading to the burner 4 and a holding tank 18, 19 for discretely accumulating hydrogen and oxygen. The reference number 20 shows a tank holding a suitable electric resistivity water therein, operating as an electrolyte, which is supplied to the

electrolysis device 2. The reference number 21 shows a known device for processing water for example coming from the water system duct 22, to allow said water to be used as said suitable electric resistivity water forming the electrolyte. If necessary, said device 21 can also supply the water processed thereby directly to the electrolysis device 2 or tank 20. In the shown embodiment, said tank 20 communicates with a duct 23 coupled, at the other side thereof, to a condensating water collecting tank 24 for collecting the condensating water formed in burning of the hydrogen-oxygen mixture in the burner/combustion chamber or combustor 4/5 assembly.

According to the invention, moreover, the heat generated by the mixture burnt in the chamber 5 is accumulated in a heat accumulator 25 which can have any suitable configuration for optimally exploiting the high temperature heat generated in the combustion chamber or combustor 5. The heat accumulator 25 can then be used to supply heat, through any suitable heat carrier, such as water, to any desired thermal utilizers, such as the heat radiators of a domestic or industrial heating system, supply hot sanitary water, perform thermal processes on fluids in chemical or the like systems, said utilizers being generally indicated by 26.

The system according to the present invention operates as follows:

The hydrogen and oxygen generated by the electrolysis performed in the electrolysis device 2 are supplied, upon suitably mixing them, to the burner 4 and burnt herein, to provide a temperature of about 2,000°C. In burning the hydrogen-oxygen mixture, no unburnt gas emission is generated, and the condensating water, which represents the sole burning or combustion product, is collected in the tank 24 and re-supplied as an electrolyte to the electrolysis device 2 through the duct 23. The electric power for performing the electrolysis is supplied as above

stated.

The high burning heat is advantageously accumulated in the heat accumulator 25, optionally in a plurality of not shown accumulators.

The absence of any unburnt gases overcomes the prior requirements of evacuating the high temperature burnt gases, so as to prevent any known corrosion phenomena related to a condensation of aggressive substances from occurring. Thus, this aspect greatly improves, per se, the thermal efficiency. Said thermal efficiency is further enhanced since the burning temperature is much greater than the burning temperatures of prior combustors of conventional systems, thereby it is possible to use a heat amount much greater than that which can be used in conventional systems. Moreover, the unburnt gases and noxious substances having been eliminated, it is possible to derive greater heat amounts, since the temperature of the derived hot water can be brought to a low value, such as, for example, 40°C, which could not be previously obtained because of the necessary (high) minimum temperatures of the outlet gases. As stated, such a low temperature can be advantageous, among the other things, for prior low temperature heating systems.

In the meanwhile, owing to the high temperature of the combustor or combustion chamber, it is likewise possible to provide fluids heated to a temperature which is much greater than that which can be achieved in conventional systems.

The cumulative heat generating systems according to the present invention can be optimally used in domestic and industrial systems for providing hot sanitary water and/or for heating applications, which can be made, as conventional, by any desired components and circuits. These systems have not been disclosed in further details since they are well known.

From the above constructional and operational disclosure of the cumulative heat generating system according to

the invention it should be easily apparent that this system efficiently achieves the indicated objects and provides the stated advantages.

In practicing the invention, the above disclosed and illustrated systems can be subjected to several modifications and variations, such as the use of a different electric power supply source, or it would be also possible to use electrolysis devices power supplied at a greater voltage, for example 220V or 380V, or it would be also possible to replace individual components with other technically equivalent components, without departing from the scope of the invention.

CLAIMS

1. A cumulative-heat generating system, said system substantially comprising:

- a gaseous fuel supply and
- a burner with an associated combustor,

characterized in that:

a) the gaseous fuel supply comprises an electrolysis device (2) for making, from an electrolyte, hydrogen and oxygen which, as suitable metered, provide a burning mixture to be supplied to said burner, said burning mixture burning without generating either unburnt gases or noxious substances,

b) the electric power for carrying out the electrolysis is preferably supplied, at least partially, by an alternative power source, or a relieved-rate network, and

c) to the burner-combustor assembly (4, 5) at least a heat accumulator (25) is coupled.

2. A system according to Claim 1, characterized in that suitable electric resistivity water is used as said electrolyte.

3. A system according to Claim 1, characterized in that said hydrogen and oxygen are stored in storing tanks (18, 19) and conveyed to said burner in an individually adjustable manner.

4. A system according to Claim 1, characterized in that the generated heat is accumulated in a heat accumulator (25) coupled to said burner-combustor assembly (4, 5).

5. A system according to Claim 4, characterized in that said heat accumulator holds a substance which can change its physical status depending on the temperature.

6. A system according to Claim 1, characterized in that, as an alternative electric power source solar panels (8) aeolic generators and the like are used.

7. A system according to Claim 1, characterized in that

said electric power for supplying said electrolysis device (2) is supplied at a low voltage, for example of 2-24V, preferably of 2-12V and more preferably 2-4V.

8. A system according to one or more of Claims 1, 6 and 7, characterized in that said electrolysis device (2) is power supplied in an adjustable manner through a battery assembly (12) or, in a case of a mains power supply, through a transformer-rectifier assembly.

9. A system according to Claim 1, characterized in that said electrolysis device (2) comprises a water processing device (21) for processing the water stored therein to provide a suitable electric resistivity water.

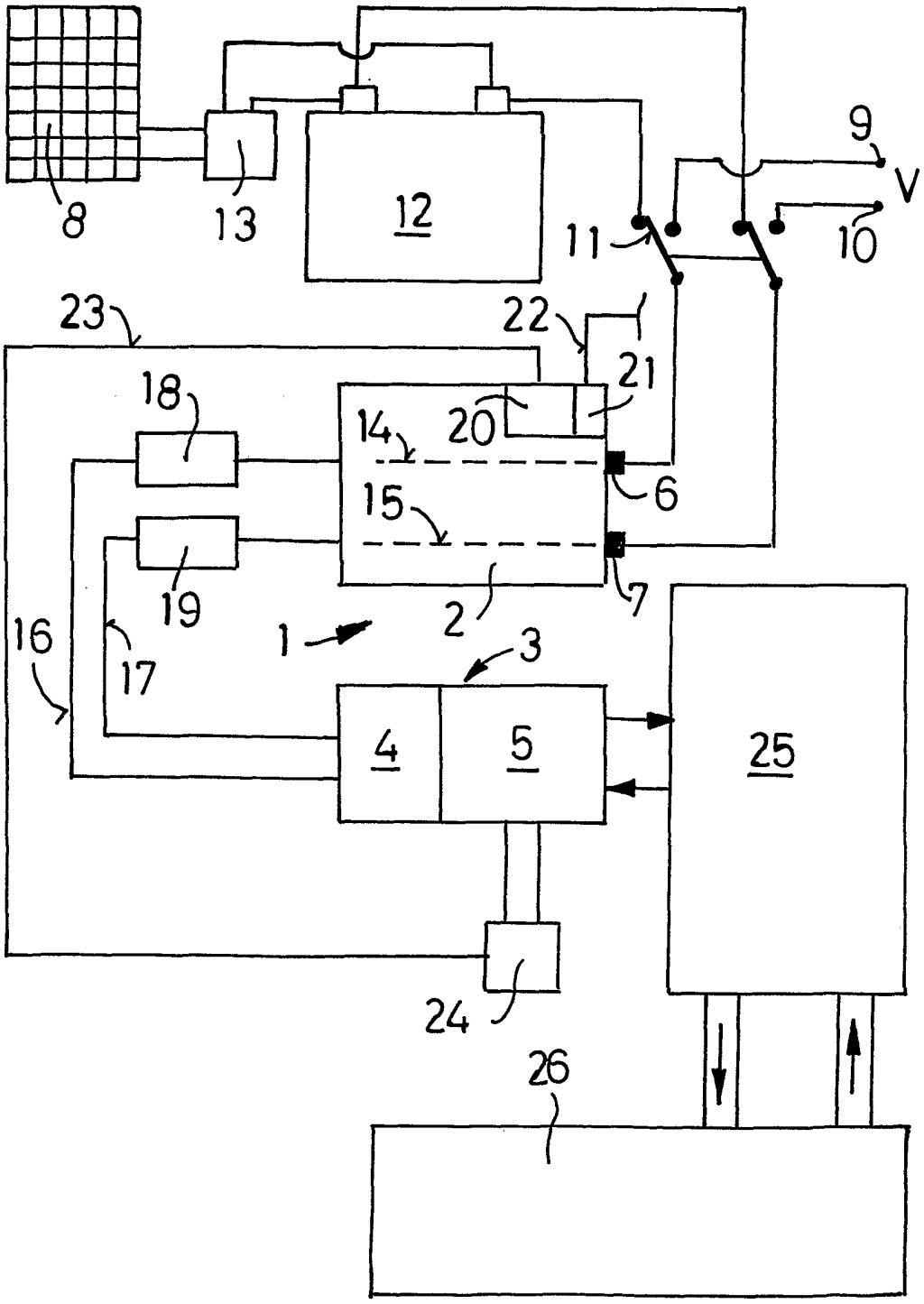
10. A system according to one or more of the preceding claims, characterized in that the condensation water produced by burning said mixture is re-conveyed (24, 23) as an electrolyte to said electrolysis device (2)

11. A use of a cumulative heat generating system, according to one or more of claims 1 to 10 in a domestic or industrial system for providing hot sanitary water and/or for heating applications, in air heating systems, in heat radiating systems and the like.

12. A use of a cumulative heat generating system according to one or more of Claims 1 to 10, in industrial systems for heating or thermally processing fluids.

13. A system for providing hot sanitary water and/or for heating applications, or for thermally processing fluids, characterized in that said system comprises a cumulative-heat generating system according to one or more of Claims 1 to 10.

1/1



INTERNATIONAL SEARCH REPORT

Ir tional Application No
PCT/EP 01/08918

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H05B3/00 H05B3/60 C25B1/04 H01L35/00 F24J1/00

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 7 H05B C25B H01L F24J

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)
EPO-Internal, WPI Data, PAJ, INSPEC, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 246 080 A (SHINN WILLIAM A) 20 January 1981 (1981-01-20) column 2, line 12 -column 3, line 29; figures 1-3	1-13
A	US 4 599 865 A (DALAL RAJENDRA P) 15 July 1986 (1986-07-15) abstract column 2, line 28 -column 3, line 35; figure 1	1-13
A	GB 2 066 293 A (NELSON H P A) 8 July 1981 (1981-07-08) the whole document	1-13

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 December 2001	19/12/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bergado Colina, J

1

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 965 362 A (HARVEY GERALD J) 22 June 1976 (1976-06-22) abstract column 2, line 20 -column 4, line 29; figure 1 ---	1-13
A	DE 42 08 609 A (DAIMLER BENZ AG) 30 September 1993 (1993-09-30) the whole document ---	1-13
A	DE 195 47 048 A (ALCOCEBA ALCOCEBA JOAQUIN) 4 July 1996 (1996-07-04) the whole document -----	1-13

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 01/08918

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4246080 A	20-01-1981	NONE	
US 4599865 A	15-07-1986	NONE	
GB 2066293 A	08-07-1981	NONE	
US 3965362 A	22-06-1976	NONE	
DE 4208609 A	30-09-1993	DE 4208609 A1	30-09-1993
DE 19547048 A	04-07-1996	ES 2114785 A1 DE 19547048 A1	01-06-1998 04-07-1996