



**STATEMENT OF INTENTION TO PROCEED WITH  
PCT NATIONAL PHASE APPLICATION**

We VEAG VEREINIGTE ENERGIEWERKE AKTIENGESELLSCHAFT

of Allee der Kosmonauten 29, 12631 Berlin, GERMANY

confirm the intention that the International Application identified below shall proceed under the Patents Act for the grant of a Standard Patent for an invention entitled:

**PROCESS FOR DRESSING BROWN COAL FOR COMBINED GAS AND STEAM  
PROCESSES**

The International Application number is: PCT/DE92/00108

The International filing date is: 13 February 1992

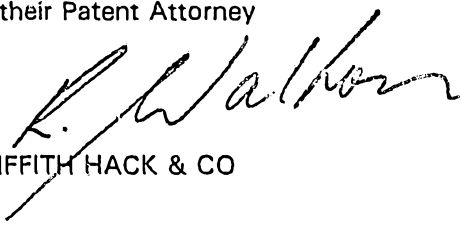
The International Application claims priority from the following:

Application No	Country	Filing Date
P41 05 128.9	Germany	15 February 1991

Our address for service is: GRIFFITH HACK & CO  
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NORTH SYDNEY NSW 2060

DATED this 15th day of September 1993

VEAG VEREINIGTE ENERGIEWERKE AKTIENGESELLSCHAFT  
By their Patent Attorney

  
GRIFFITH HACK & CO

S 040513 150993

AUSTRALIA  
Patents Act 1990

651871

**NOTICE OF ENTITLEMENT**

We **VEAG VEREINIGTE ENERGIEWERKE AKTIENGESELLSCHAFT**

of **Allee der Kosmonauten 29, 12681 Berlin, GERMANY**

being the Applicant and Nominated Person, in respect of Application No. 12347/92 entitled **PROCESS FOR DRESSING BROWN COAL FOR COMBINED GAS AND STEAM PROCESSES** state the following:

Bernd Krödel is the actual inventor of the invention.

The inventor made the invention for and on behalf of the nominated person in the course of his duty as an employee of the nominated person.

Convention priority is claimed from the following basic application(s):

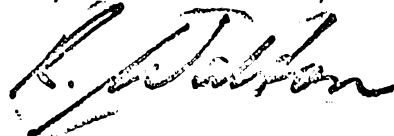
Basic Applicant	Application Number	Application Date	Country	Country Code
VEAG VEREINIGTE ENERGIEWERKE AKTIENGESELLSCHAFT	P41 05 128.9	15 February 1991	Germany	DE

The basic application was the first application made in a Convention country in respect of the invention the subject of this request.

DATED this 13th day of December 1993

VEAG VEREINIGTE ENERGIEWERKE AKTIENGESELLSCHAFT

By their Patent Attorney



GRIFFITH HACK & CO



AU9212347

**(12) PATENT ABRIDGMENT (11) Document No. AU-B-12347/92**  
**(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 651871**

- (54) Title  
**DRESSING BROWN COAL PRIOR TO COMBUSTION**
- International Patent Classification(s)  
(51)<sup>5</sup> **C10F 005/00 F01K 023/06**
- (21) Application No. : **12347/92** (22) Application Date : **13.02.92**
- (87) PCT Publication Number : **WO92/14802**
- (30) Priority Data
- | (31) Number    | (32) Date       | (33) Country      |
|----------------|-----------------|-------------------|
| <b>4105128</b> | <b>15.02.91</b> | <b>DE GERMANY</b> |
- (43) Publication Date : **15.09.92**
- (44) Publication Date of Accepted Application : **04.08.94**
- (71) Applicant(s)  
**VEAG VEREINIGTE ENERGIEWERKE AKTIENGESELLSCHAFT**
- (72) Inventor(s)  
**BERND KRODEL**
- (74) Attorney or Agent  
**GRIFFITH HACK & CO. , GPO Box 4164, SYDNEY NSW 2001**
- (56) Prior Art Documents  
**WO 91/14801**  
**WO 90/10785**  
**AU 619025 38620/89 F01K 17/06 F26B 23/02**
- (57) Claim

1. Process for dressing brown coal in combined gas-steam processes having a waste heat boiler and a coal dryer coupled by means of a heat transfer system, characterised by operating the coal dryer in combination with a pressurised fluidised bed combustor, a gas turbine, a steam turbine, an air-heated intermediate steam superheater and a waste heat boiler, utilising the energy content of the dedusted exhaust vapour of the coal dryer, which is under medium pressure, to evaporate a partial flow of feed water, operating the gas turbine with waste gases from the pressurised fluidised bed combustor, using compressed combustion air for intermediate steam superheating of steam in the intermediate steam superheater with cooling of the combustion air, and utilising the exhaust vapour condensate formed by the energetic interconnection of the process after treatment thereof to provide a water supply for the circulation process.

OPI DATE 15/09/92

APPLN. NO 12347 / 92



AOJP DATE 29/10/92

PCT NUMBER PCT/DE92/00108

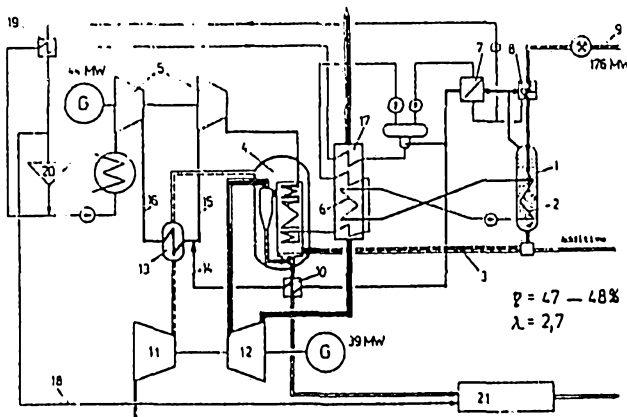
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NS (PCT)

<p>(51) Internationale Patentklassifikation <sup>5</sup> : C10F 5/00, F01K 23/06</p>	<p>A1</p>	<p>(11) Internationale Veröffentlichungsnummer: WO 92/14802 (43) Internationales Veröffentlichungsdatum: 3. September 1992 (03.09.92)</p>
<p>(21) Internationales Aktenzeichen: PCT/DE92/00108 (22) Internationales Anmeldedatum: 13. Februar 1992 (13.02.92) (30) Prioritätsdaten: P 41 05 128.9 15. Februar 1991 (15.02.91) DE (71) Anmelder: VEAG VEREINIGTE ENERGIEWERKE AKTIENGESELLSCHAFT [DE/DE]; Allee der Kosmonauten 29, D-1140 Berlin (DE). (81) Bestimmungsstaaten: AT (europäisches Patent), AU, BE (europäisches Patent), BG, CA, CH (europäisches Patent), DE (europäisches Patent), DK (europäisches Patent), ES (europäisches Patent), FR (europäisches Patent), GB (europäisches Patent), GR (europäisches Patent), HU, IT (europäisches Patent), JP, LU (europäisches Patent), MC (europäisches Patent), NL (europäisches Patent), RO, RU, SE (europäisches Patent).</p>		<p>Veröffentlicht <i>Mit internationalem Recherchenbericht. Vor Ablauf der für Änderungen der Ansprüche zugelassenen Frist. Veröffentlichung wird wiederholt falls Änderungen eintreffen.</i></p> <p style="font-size: 2em; text-align: center;">651871</p>

(54) Title: PROCESS FOR DRESSING BROWN COAL FOR COMBINED GAS AND STEAM PROCESSES

(54) Bezeichnung: VERFAHREN ZUR BRAUNKOHLENAUFBEREITUNG FÜR GAS-DAMPF-KOMBIPROZESSE



(57) Abstract

The invention concerns a process for dressing brown coal for combined gas and steam processes in heat-generating installations. The aim of the invention is to achieve substantial reduction of the CO<sub>2</sub> emission per useful effect unit by reduced use of fossil energy carriers; the devices for drying raw brown coal are to be connected to the heat-generating installation in such a manner that the energy of the exhaust vapours is fully utilized. To this end, the drying container is operated in conjunction with a pressurized fluidized bed combustor, a gas turbine, a steam turbine, a pneumatically heated steam intermediate heater and a waste heat boiler; the drying energy for the drying container is obtained from saturated steam from the waste heat boiler of the combined process; the energy content of the de-dusted exhaust vapours under medium pressure is used to evaporate a partial flow of feed water; the gas turbine is operated with exhaust gases from the pressurized fluidized bed combustor; condensed combustion air is used for intermediate superheating of the steam, with cooling of the combustion air; and the exhaust vapour condensate formed by energetic connection is prepared and used to supply water for the circulation process.

PROCESS FOR DRESSING BROWN COAL  
IN COMBINED GAS AND STEAM PROCESSES

The invention concerns a process for dressing brown coal in combined gas and steam processes of a heat or power generating plant.

Known is a plant arrangement for drying raw coal prior to its use in the generation of electricity in condensation power plants. This known arrangement enables to fully utilise the condensation heat of the exhaust vapour, but neither an exhaust vapour reverse compression nor a separate electric dedusting of the vapour is carried out. The drying is carried out in a filled shaft reactor provided with diaphragm tube walls acting as heating surfaces. Bleed steam from the main turbine of the power plant is used as heating steam and supplied to the filled shaft reactor. The exhaust vapour obtained therefrom is dedusted at the exit into the exhaust vapour channel, i.e. when leaving the dryer, by means of a filter wall which can be steam cleaned (DD-PS 281 237). According to DD-PS 281 237, the energy of the exhaust vapour is fully utilised as secondary energy only in that it is divided into several and qualitatively different applications; this division requires a complicated integration of different appliances into the overall conception of the plant. In addition, this plant arrangement is intended exclusively for power plants in which the generation of electricity is effected in "pure" condensation operation only.

Further, it is known to operate a combined gas-steam process of a power plant according to DE-OS 39 07 217. The process divides itself into two separate technological concepts or stages, of which the concept shown in Fig. 1 includes the operation of the pre-stage gas turbine with natural gas. This solution is a trivial one and has been employed commercially for a number of

years. The second concept, shown in Fig. 2, includes a pressurised fluidised bed coal gasification of a partial coal flow. Since an additional fluidised bed drying of the steam is performed prior to the partial coal gasification, and this drying is not energetically interconnected with the combined unit, the drying process has to be performed with reverse compression of the exhaust vapour and external vapour dedusting, both of which require a considerable amount of electric power. As a result, the combined unit has a low overall degree of efficiency of 42-44%. The technical complexity of equipment required by this type of combined unit is substantial since it requires, in addition to the usual equipment of a typical combined unit, a gas turbine, an intermediate air cooling unit, connecting pipelines and channels, a pressurised fluidised bed gasification reactor with associated hot gas deduster and a drying equipment which is not energetically integrated into the combined unit and requires an extra power supply.

Also known is a combined gas-steam process using a pressurised fluidised bed combustor and in which a pressurised dryer is thermally integrated into the combined unit (WO 90/00219). The pressurised exhaust vapour created in the drying process is conveyed to the steam boiler provided with the steam fluidised bed combustor, is mixed therein with the combustion gases of the solid fuel combustion and, after effecting dedusting of the waste gas, is conveyed to the waste gas turbine and expanded therein; the exhaust vapour so treated and injected into the flue gas flow accordingly generates an increased power output from the waste gas turbine without the need of proportionally increasing the power input to effect air compression. However, due to the resulting shift in the power characteristics between the gas turbine and the steam turbine, only a slight improvement of the efficiency of the combined unit is achieved. Furthermore, this arrangement does not permit any phase-

shifted recovery of the drying energy used for drying the damp fuel.

5 It would be beneficial if the present invention could achieve in a power or heat generating plant a considerable reduction of CO<sub>2</sub> emissions per effective power output unit by using smaller amounts of fossil energy carriers. Heretofore, it would be advantageous to integrate the drying devices for the raw brown coal into the heat generating unit in such a manner as to fully use  
10 the energy of the exhaust vapours.

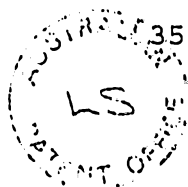
The present invention provides in one aspect thereof a process for dressing brown coal in combined gas-steam processes having a waste heat boiler and a coal dryer coupled by means of a heat transfer system, characterised  
15 by operating the coal dryer in combination with a pressurised fluidised bed combustor, a gas turbine, a steam turbine, an air-heated intermediate steam superheater and a waste heat boiler, utilising the energy content of the dedusted exhaust vapour of the coal dryer,  
20 which is under medium pressure, to evaporate a partial flow of feed water, operating the gas turbine with waste gases from the pressurised fluidised bed combustor, using compressed combustion air for intermediate steam superheating of steam in the intermediate steam  
25 superheater with cooling of the combustion air, and utilising the exhaust vapour condensate formed by the energy interconnection within the process and after treatment thereof to provide a water supply for the circulation process. A part of the exhaust vapour  
30 condensate obtained in the process can materially be utilised without any further processing as service water in an ash- or ash-binding agent reprocessing to produce a building material. The dry coal produced by the energetic interconnection process can be combusted in the  
35 pressurised fluidised bed combustor of the steam boiler with an excess of air in the range of  $2 < \lambda < 3$ ,  $\lambda$  being

the excess of air ratio.

The present invention will be more fully understood from the following description of an embodiment thereof and which is provided with reference to the accompanying drawing in which:

Fig. 1 schematically illustrates a raw brown coal dryer in a combined unit having a pressurised fluidised bed combustor.

As can be seen in Fig. 1, raw brown coal 9 reaches through a pulveriser a raw fine coal pre-heater 8 in which exhaust vapour can be condensed. A coal dryer 1 with heating surface bundle 2 is arranged in succession to the pre-heater 8. After being dried in the dryer 1, the coal and an additive are conveyed through a dry coal-additive feed system 3 into a steam boiler 4 with pressurised fluidised bed combustor. The steam boiler 4 is connected with a steam turbine 5 whose cold line 15 of an intermediate steam superheating stage is connected with its hot line 16 via the air-heated intermediate steam superheater 13. Furthermore, the steam vessel 4 is connected with the waste gas stages 12 of a gas turbine plant which itself is coupled with a waste heat boiler 17. The waste heat boiler 17 includes heating surface 6 for the production of saturated steam and which is interconnected with heating surface 2 of the dryer 1. The exhaust vapour created in the dryer 1 and in the pre-heater 8 are conveyed to a saturated steam generator 7 which condenses the exhaust vapour; the saturated steam generator 7 is itself connected to a saturated steam superheater 10 for cooling the ashes. The saturated steam superheater 10 is connected with the cold line 15 of the steam turbine 5 via the steam feeding pipeline 14 and coupled to the steam boiler 4 and the ash processing unit 21. The air-heated intermediate steam superheater 13 is connected with the steam boiler 4 as well as the



air compressor stages 11 of the gas turbine plant. The exhaust vapour condensate produced in the saturated steam generator 7 and in the pre-heater 8 is cooled in an exhaust vapour condensate cooler 19 and subsequently  
5 conveyed to the exhaust vapour condensate reprocessing unit 20. A partial flow 18 of the cooled exhaust vapour condensate can be conveyed to the ash processing unit 21 prior to being reprocessed. The remaining or all of the cooled condensate can be reused in the circulation  
10 process.

The concept according to the present invention has the advantage that the gas-steam combined plant with pressurised fluidised bed combustor can be operated with very damp brown coal, nonetheless achieving a coefficient  
15 of efficiency  $\eta$  of 47-48% for the combined process under nominal or partial loads as well as with an air excess ratio  $\lambda$  of 2.7.



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Process for dressing brown coal in combined gas-steam processes having a waste heat boiler and a coal dryer coupled by means of a heat transfer system, characterised by operating the coal dryer in combination with a pressurised fluidised bed combustor, a gas turbine, a steam turbine, an air-heated intermediate steam superheater and a waste heat boiler, utilising the energy content of the dedusted exhaust vapour of the coal dryer, which is under medium pressure, to evaporate a partial flow of feed water, operating the gas turbine with waste gases from the pressurised fluidised bed combustor, using compressed combustion air for intermediate steam superheating of steam in the intermediate steam superheater with cooling of the combustion air, and utilising the exhaust vapour condensate formed by the energetic interconnection of the process after treatment thereof to provide a water supply for the circulation process.
2. Process according to claim 1, characterised by materially utilising part of the exhaust vapour condensate formed by the energetic interconnection of the process without any further processing as service water in an ash- or ash-binding agent reprocessing to produce a building material.
3. Process according to claim 1, characterised by combusting the dry coal produced by the energetic interconnection of the process in the pressurised fluidised bed combustor of the steam boiler with an excess of air in the range of  $2 < \lambda < 3$ .
4. Process for dressing brown coal for combined gas-steam processes as hereinbefore described with reference to Fig. 1.

DATED this 12th day of April 1994

VEAG VEREINIGTE ENERGIEWERKE

By their Patent Attorneys  
GRIFFITH HACK & CO

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S:17950F/12.4.94

Quint. No. 2  
1 May 91

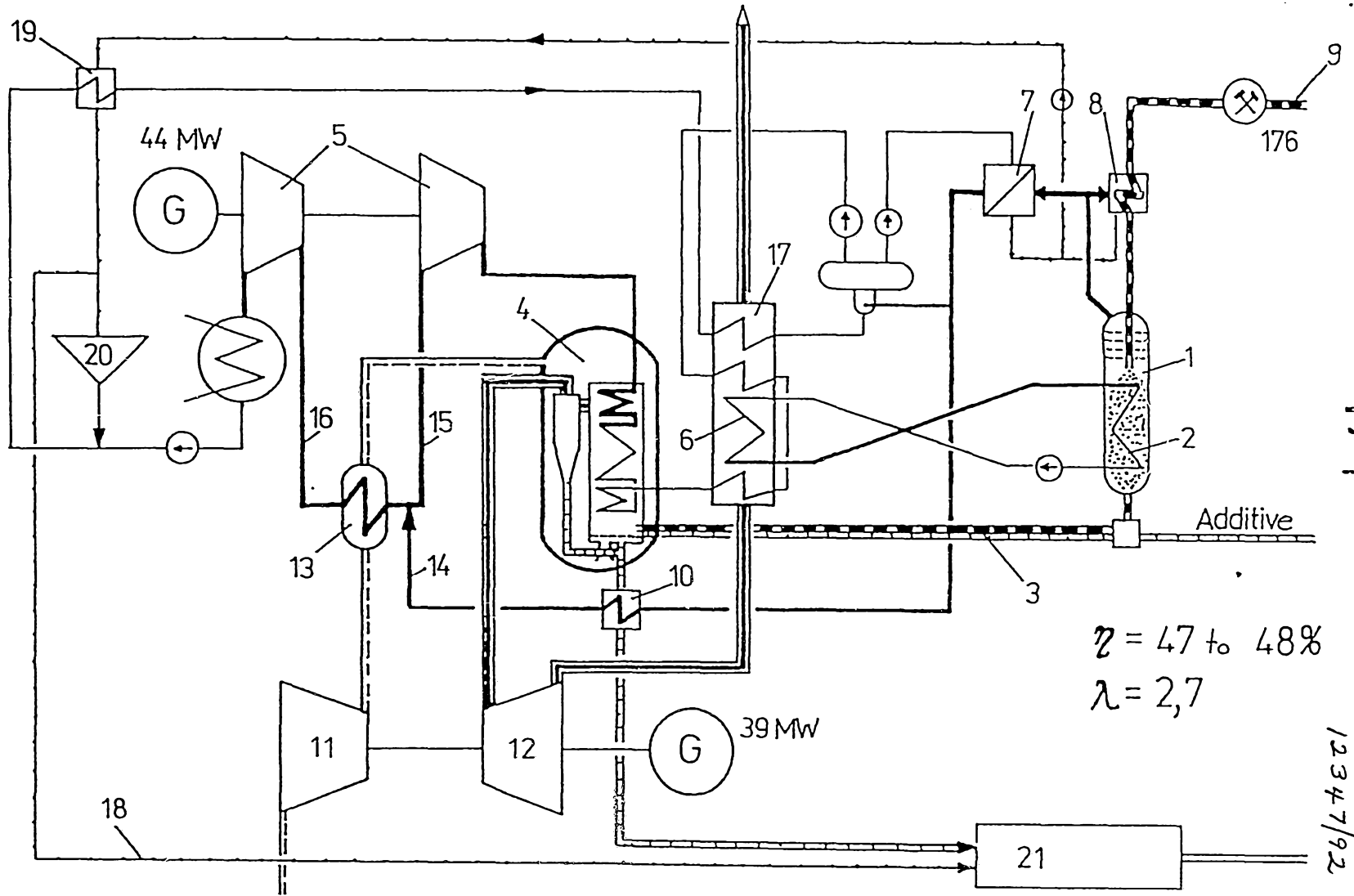


Fig. 1

# INTERNATIONAL SEARCH REPORT

International Application No PCT/DE 92/00108

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>6</sup>				
According to International Patent Classification (IPC) or to both National Classification and IPC				
Int.Cl.5      C10F5/00;      F01K23/06				
<b>II. FIELDS SEARCHED</b>				
Minimum Documentation Searched <sup>7</sup>				
Classification System	Classification Symbols			
Int.Cl.5      C10F;      C10L;      F01K				
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>				
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup></b>				
Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>		
A	DD, A, 281 237 (ORGREB) 1 August 1990 cited in the application ---			
A	DE, A, 3 907 217 (L&C STEINMULLER) 13 September 1990 cited in the application ---			
A	WO, A, 9 000 219 (IMATRAN VOIMA OY) 11 January 1990 ---			
A	EP, A, 0 273 406 (RHEINISCHE BRAUNKOHLERWERKE) 6 July 1988 ---			
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <p><sup>10</sup> Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </td> <td style="width: 50%; vertical-align: top;"> <p>"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</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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</p> <p>"A" document member of the same patent family</p> </td> </tr> </table>			<p><sup>10</sup> Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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</p> <p>"A" document member of the same patent family</p>
<p><sup>10</sup> Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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</p> <p>"A" document member of the same patent family</p>			
<b>IV. CERTIFICATION</b>				
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report			
1 June 1992 (01.06.92)	22 June 1992 (22.06.92)			
International Searching Authority	Signature of Authorized Officer			
<b>EUROPEAN PATENT OFFICE</b>				

ANNEX TO THE INTERNATIONAL SEARCH REPORT  
 ON INTERNATIONAL PATENT APPLICATION NO. DE 9200108  
 SA 56357

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 01/06/92

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DD-A-281237		None	
DE-A-3907217	13-09-90	WO-A- 9010785 EP-A- 0462137	20-09-90 27-12-91
WO-A-9000219	11-01-90	AU-B- 619025 AU-A- 3862089 EP-A- 0404854 JP-T- 3503078	16-01-92 23-01-90 02-11-91 11-07-91
EP-A-0273406	06-07-88	DE-C- 3644806 DE-A- 3724960 AU-A- 8313287	11-05-88 09-02-89 07-07-88