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A WASTE COMBUSTOR APPARATUS

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(56) Prior Art Documents
GB 2202928
GB 2199929
US 4658736

(57) Claim

1. Apparatus for utilising energy of waste matter, comprising respective gasification and combustion chambers connected by an intermediate chamber, an entry for admittance of ambient combustion air into the intermediate chamber and a jacket around the intermediate chamber through which air is passed to cool an inner and an external wall of the apparatus and heat the ambient combustion air for passage to the entry.

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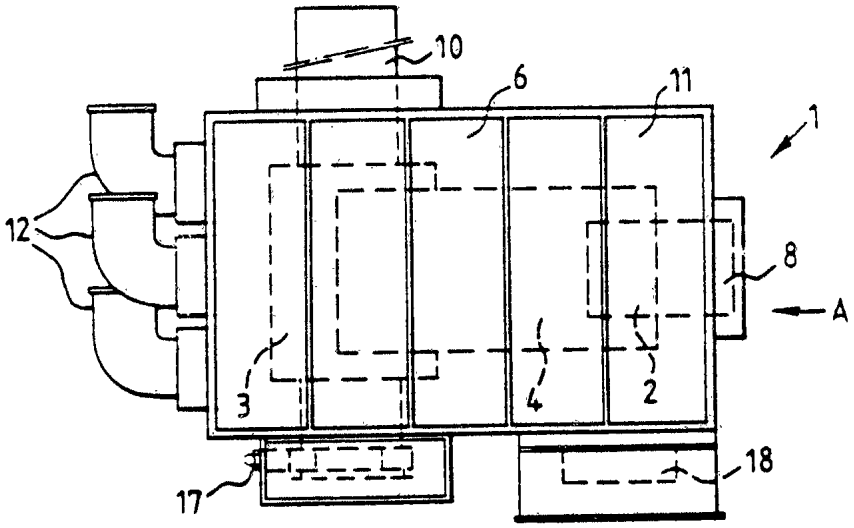
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(54) Title: A Waste Combustor Apparatus



AUSTRALIAN PATENT OFFICE

(57) Abstract

Apparatus for utilising the energy of waste matte comprises respective gasification and combustion chambers (2, 3) connected by an intermediate chamber (4), an entry (5) for ambient combustion air into at least the intermediate chamber (4), and means (6) to cool an inner and external wall of the apparatus and heat the ambient combustion air for passage to the entry (5).

A WASTE COMBUSTOR APPARATUS

The invention relates to a combustor apparatus, particularly a combustor for burning waste in order to utilise the heat produced as a source of energy.

Such combustors are of importance for both third world and developed countries alike, in disposing of waste cheaply and efficiently so as to preserve the environment and as a source of power. Unfortunately hitherto proposed combustors have only been able to burn a very limited range of solid fuel. Therefore, only a few end users have been able to use process waste the produce as fuel, or have had to buy in such waste, to provide the fuel required to produce heat.

It is accordingly an object of the invention to seek to mitigate this disadvantage.

According to the invention there is provided apparatus for utilising energy of waste matter, comprising respective gasification and combustion chambers connected by an intermediate chamber, an entry for admittance of ambient combustion air into the intermediate chamber, and a jacket around the intermediate chamber through which air is passed to cool an inner and an external wall thereof and heat the ambient combustion air for passage from the entry.

This provides a relatively simple yet efficient way of cooling the apparatus and heating the ambient air.

The entry may comprise a louvre. This construction provides a controlled inlet, which may be adjustable depending on the volume of air required. Suitably, the louvre may be situated adjacent a feed inlet for feeding fuel into the apparatus. This provides a compact construction.

AUSTRALIAN PATENT OFFICE 13

The gasification chamber may comprise a well with a grate at the base.

The combustion chamber may comprise a cylindrical chamber for cyclonic combustion. This provides for virtually complete combustion of the fuel supplied.

The gasification and combustion chambers may suitably be adapted for accommodation of thermal expansion or contraction, suitably by arranging that the chamber may be mounted on carriage means. This provides that the apparatus is not damaged if there is different thermal expansions or contractions between the chambers.

The carriage means may comprise a base of a frame of the apparatus supported on a fixed roller, that is the roller is fixed to a substrate so the apparatus can move relative to the substrate when expansion or contraction takes place. This is a relatively simple arrangement which is nevertheless efficient.

The apparatus may include a further air inlet for tertiary combustion air. This arrangement provides the provision of additional air as required.

The major proportion of combustion air may be admitted to the intermediate combustion chamber whereby to maintain the temperature in at least the gasification chamber at a low value. This provides for physical integrity of the apparatus as distortion can be obviated.

The wall temperature of the combustion chamber in use may be maintained relatively cool compared with the temperature at the core. Again, this obviates distortion.

There may be a conduit for air to the gasification chamber upstream of a grating of that chamber. This provides a compact construction.

The conduit may comprise a bifurcated pipe. This provides for ease of construction and installation.

A part of the pipe may be inclined towards a manifold upstream of the grate. This provides for ease of delivery of the air.

There may be a sensor for sensing the colour of a flame above the grate and for controlling the air supply along the conduit. This provides for control of the apparatus. Thus the sensor may, through a control unit of the apparatus, not only control the amount of air supply but also the amount of fuel to be burned as well as the exact location where the fuel is to be dropped on the grate.

A combustor apparatus embodying the invention is hereinafter described, by way of example, with reference to the accompanying drawings.

Fig.1 is a schematic side view of a first embodiment of apparatus according to the invention;

Fig.2 is a plan view of the apparatus of Fig. 1;

Fig.3 is a view in the direction of arrow 'A' of Fig.1

Figs. 4 and 5 are respective side elevational and plan views of part of a second embodiment of apparatus according to the invention.

Referring to the drawings, in which like parts are indicated by like reference

numerals, there is shown in Figs. 1 - 3, a combustor apparatus 1, comprising respective gasification and combustion chambers 2, 3 connected by an intermediate chamber 4, and means 6 to cool an inner and an external wall of the apparatus 1 and heat the ambient combustion air for passage from the entry 5.

The gasification or first chamber 2 is a deep well shaped chamber having a grate 7 at the base which is adapted to receive solid fuel of different shapes and sizes. The grate 7 is a two part flat bar grate with single or dual air delivery tubes for primary air which enters through the grate from outside the apparatus 1. The amount of primary air is regulated in such a way that the first combustion stage temperature is controlled and will be kept as low as possible to prevent sintering of the ash produced during combustion particularly of agricultural matter being used as fuel, and so that gasification of the fuel ensues.

There is a permanently open inlet 8 to the apparatus 1 through which the fuel is fed to the grate 7 and under the grate 7 there is a conveyor 9 for conveying ash away from the apparatus 1. The intermediate chamber 4 is a transition chamber between the first and second chambers 2 and 3 and is horizontal and feeds tangentially into the second combustion chamber 3 which is substantially cylindrical. The intermediate chamber 4 opens onto the second chamber 3 over substantially the whole length of the second chamber.

The inlet 5 for combustion air into the intermediate chamber 4 is a louvre inlet adjacent the fuel inlet 8. There is an outlet 10 for heat and flame from the second chamber 3, coaxial with the axis thereof. The combustion chambers 2, 3, 4 are encased in a jacket 11 through which cooling air is passed from cooling fans 12. The apparatus 1 is also mounted on a frame 13 which is able to move on thermal expansion and contraction effects by a carriage means 14 which comprises a foot 15 of the frame 13 mounted on a roller 16 over which the foot can pass, the roller

AUSTRALIAN PATENT OFFICE 3

being fixed in the sense that it is secured to a substrate such as the ground in a bracket. Adjacent the exit 10 there is an inlet 17 for tertiary air comprising an automatic damper which is set for a particular type of fuel.

The outlet 10 can be connected up with further apparatus in order to utilise the heat produced. Thus the outlet 10 itself can be connected to a power plant including a steam raising boiler, or a crop drying system, both of which have induction fans for drawing the combustion gases through the system. Thus the combustor apparatus itself does not require a stack or an I.D. fan, though such a fan can be provided where the apparatus is merely used to burn waste.

In operation, fuel is added to the grate 7 through the fuel inlet 8, and primary air is passed through the grate 7 and inlet 8 partially to fluidise the fuel bed on the grate 7. The fuel is ignited by insertion of a lance and when a flame front is seen, the lance may be removed. The fans 12 are on as is the I.D. fan. When the flame front is established, the hot products of gasification pass vertically upwards to the transition chamber 4. The flame heats the wall thereof which is cooled by the cooling air in the jacket 11, which air is itself therefore heated. The heated air sucks cool air in through the louvres 5 where because it is cooler than the flame, it tends to form a cloak or shield round the flame between the flame and the wall, thereby protecting the wall from exposure to excessive heat. At the same time, the air promotes combustion and keeps particulate matter in the flame, so that it does not scour the wall, and thereby again protects the apparatus.

Partial combustion accordingly takes place in the intermediate chamber, prior to the gas and flame passing into the second combustion chamber 3, where further

AUSTRALIAN PATENT OFFICE 13

hot air enters via the tertiary air inlet 17 to promote full combustion. The combustion in the second chamber is cyclonic, this has a long flame path and generates a very high temperature (about 2000°C) at the core. This ensures that particulate matter is virtually all burnt, that remaining being retained in the chamber by spiralling to the bottom within the cyclonic flame, so that that matter does not pass out of the exit 10 and so cannot damage downstream plant. When used to fire into a boiler (not shown) as downstream plant, the second combustion chamber 3 is provided with a downstream open flame nozzle which is directed into, or enters a furnace tube of the boiler. Flame then passes through the nozzle and rotates down the length of the furnace tube, thereby providing a similar effect to an oil or gas burner.

The chambers 2, 3, 4 are manufactured from high quality stainless steel, and the jacket is an insulated mild steel jacket 6 through which the cooling ambient air is passed prior to entry through the louvres. There is no requirement for refractory lining of the chambers 2, 3, 4 because of the efficient combustion achieved and because of the shielding effect of the heated admitted cooling air.

Most of the combustion air is supplied through the louvre 5 the remainder being supplied through the inlet, the grate 7 and the tertiary air inlet 17 which last is balanced to provide a full completion of the combustion process, leaving a negligible volume of carbon monoxide and unburnt material in the exit flame and/or flu gases.

The apparatus 1 includes a control panel 18.

Referring now to the modified apparatus 100 shown in Figs. 4 and 5, in which like parts are identified by like numerals to those in Figs. 1 - 3, those Figs. show an air feed to the gasification chamber 2 which air feed is provided by a

conduit or primary gasification air feed pipe 10 which bifurcates from an inlet 102 to by-pass structural foundation work 103 of the apparatus 100, the bifurcations 104, 105 being reunited to enter a manifold 106 which extends substantially over the width of the grate 7 of the gasification chamber 2. It will be noted from Fig.4 particularly that the bifurcated pipe has a substantially horizontal run 107 from the inlet 102, leading into an inclined run 108 which in turn leads to the manifold 106, the angle of inclination of the run 108 being about 17° to the horizontal in the embodiment.

The inlet pipe 101 is insulated by external insulation 109 such as glass wool, refractory or the like. The inlet 102, pipe 101 and manifold 106 are connected together in any suitable manner as by nuts, bolts and flanges 110.

In operation, primary gasification air is fed in under the grate 7 from the inlet 102, through the bifurcated pipe 101 onto the manifold 106 and upwardly (as viewed, Fig.4) through the grate 7 of the gasification chamber 2. The rate of gasification is controlled by the volume air passed up through the grate 7 by determining the colour of the flame in the gasification chamber 2. The colour is determined by the amount of fuel on the grate 7, the fuel being added through the fuel inlet 8. The colour of the flame is measured, electronically by a colour sensor, and this sensor in turn controls the volume of air admitted by controlling a supply such as a fan therefor. If the colour of flame is yellow/blue, there is too much oxygen for gasification, so the controller acts to reduce the air flow. If the colour of the flame is red there is too little oxygen and the volume is increased. In this way the temperature is controlled within a 700°C - 800°C temperature range which is desirable for gasification (combustion generally taking place at about 1100°C).

Thus using cool air as a feed, actual combustion is avoided but gasification is

achieved, burning it will be understood producing too high a temperature for the initial stages of the process.

Thus in all the embodiments, combustion of the feed material, which can for example be wooden pallets, takes place in three phases. In the first, gasification phase in the chamber 2, gaseous compounds are emitted from the solid fuel on the (steel) grid 7. In the second phase the gases are mixed with preheated ambient air and burned above the bed, and/or in the intermediate chamber 4. A complete burning out of the fuel and solids particles takes place in the third phase in the chamber 3 in a cyclonic fashion, and in effect as a fluidized bed. The primary air flow is adjusted continuously as described with reference to Figs. 4 and 5, for example; secondary airflow is defined through the fuel inlet in combination with the ambient cooling air flow round the firing chamber 4. In the third phase, it will be understood that it is possible to supply tertiary air through an ambient air valve 17. Thus by utilising a three stage process for combustion, of which the final stage is cyclonic, combustion efficiency is enhanced to near 100% which provides the advantage of extremely clean discharges. This is achieved by high temperature secondary combustion and extended residence time in the cyclone chamber, ensuring the destruction of PCBs when plastic and PVC is used as the feedstock. As combustion is controlled as described, this means that any downstream apparatus such as a boiler heated thereby is also controlled in a commensurate way.

CLAIMS

1. Apparatus for utilising energy of waste matter, comprising respective gasification and combustion chambers connected by an intermediate chamber, an entry for admittance of ambient combustion air into the intermediate chamber and a jacket around the intermediate chamber through which air is passed to cool an inner and an external wall of the apparatus and heat the ambient combustion air for passage to the entry.

2. Apparatus according to Claim 1, the entry comprising a louvre.

3. Apparatus according to Claim 2, the louvre being adjacent an inlet for feeding fuel into the apparatus.

4. Apparatus according to Claim 3, the gasification chamber comprising a well with a grate at the base.

5. Apparatus according to Claim 3 or Claim 4, the combustion chamber comprising a cylindrical chamber.

6. Apparatus according to any preceding claim, the gasification and combustion chambers being adapted for accommodation of thermal expansion or contraction.

7. Apparatus according to Claim 6, the gasification and combustion chambers being mounted on carriage means for accommodation of thermal expansion or contraction.

AUSTRALIAN PATENT OFFICE

8. Apparatus according to Claim 7, the carriage means comprising a base of a frame of the apparatus supported on a fixed roller.

9. Apparatus according to any preceding claim, comprising a further air inlet for tertiary combustion air.

10. Apparatus according to any preceding claim, wherein the wall temperature of the combustion chamber in use is low compared with the temperature at the core.

11. Apparatus according to any preceding claim, further comprising a conduit for air to the gasification chamber upstream of a grate of that chamber.

12. Apparatus according to Claim 11, wherein the conduit comprises a bifurcated pipe.

13. Apparatus according to Claim 12, wherein a part of the pipe is inclined towards a manifold upstream of the grate.

14. Apparatus according to Claim 13, including a sensor for sensing the colour of a flame above the grate and for controlling the air supply along the conduit.

15. Apparatus for utilising energy of waste matter substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 23rd day of January 1996.

D & C ENGINEERING B.V.
By its Patent Attorneys:

GRIFFITH HACK & CO.
Fellows Institute of Patent
Attorneys of Australia.

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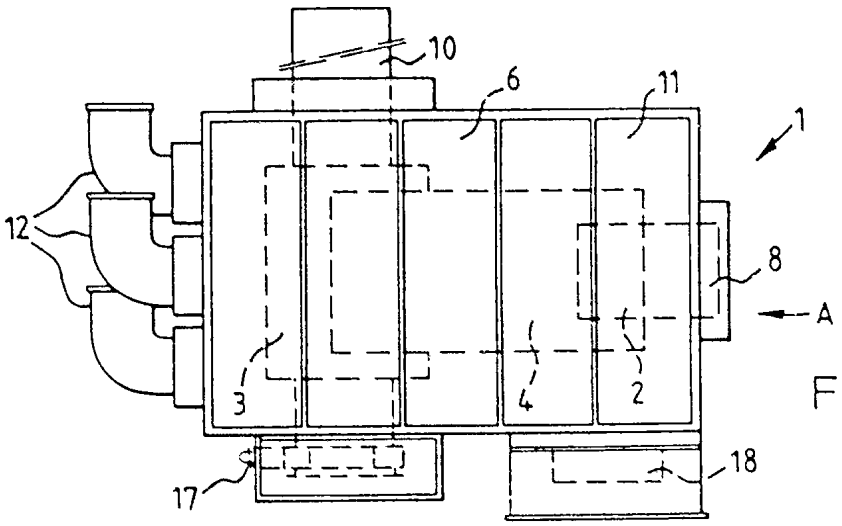


FIG.1

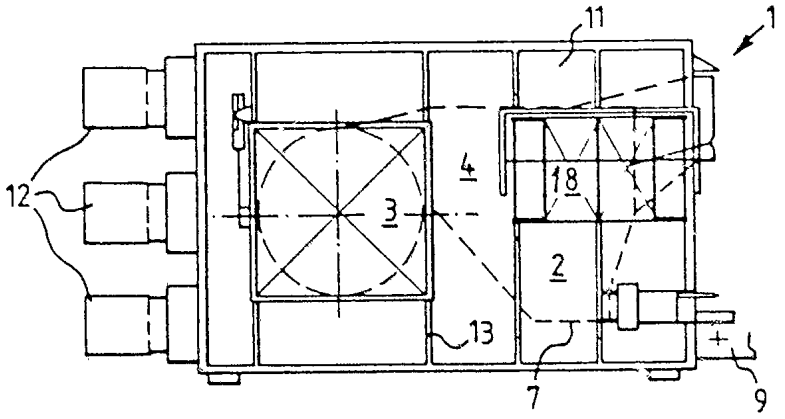


FIG.2

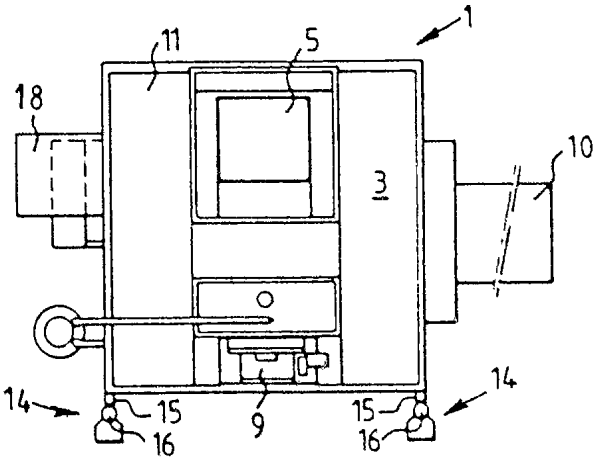


FIG 3

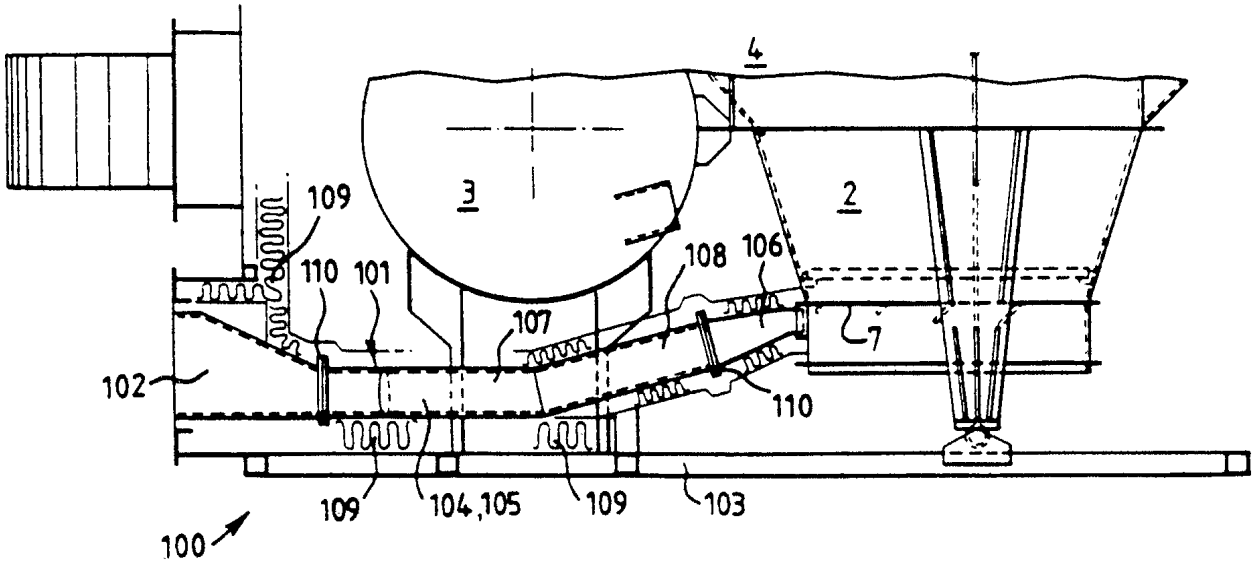

4
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104,105
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103
100

FIG.4

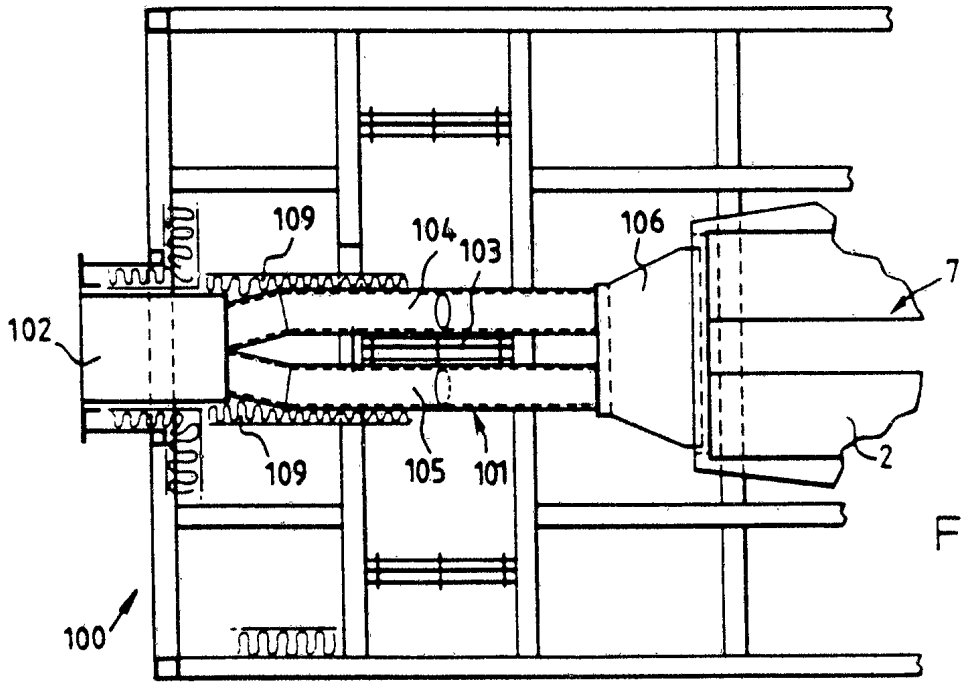

109
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FIG.5

INTERNATIONAL SEARCH REPORT

PCT/GB 92/01844

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 F23G5/027; F23M5/08; F23G5/50

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	F23G ; F23M ; F23B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
A	EP,A,0 188 073 (WILLIAMS) 23 July 1986 see page 4, line 4 - page 4, line 12 see page 5, line 10 - page 7, line 12 see page 8, line 11 - page 9, line 16 see page 10, line 16 - page 11, line 7 see page 11, line 15 - page 11, line 24 see figures 1,2 ---	1,2,6,10
A	EP,A,0 289 355 (WILLIS) 2 November 1988 see column 5, line 56 - column 6, line 38 see column 7, line 40 - column 8, line 12 see column 8, line 24 - column 8, line 48 see column 9, line 16 - column 10, line 54 see figures 1,2 ---	1,6,12,13

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° Special categories of cited documents : [10]

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

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"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
08 JANUARY 1993	15. 02. 93
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	PHOA Y.E.

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A-	WO,A,8 909 364 (HARLANDER) 5 October 1989 see page 2, paragraph 1 see page 4, last paragraph - page 5, paragraph 2; figures 1-4	1,5
A	DE,C,3 918 508 (DEILMANN) 3 May 1990 see column 4, line 65 - column 5, line 66 see column 6, line 7 - column 6, line 17; figure	1,10
A	EP,A,0 242 232 (HENRY) 21 October 1987 see abstract; figures 1-3	2

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9201844 SA 65425

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
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0188073	23-07-86	AU-B- 578322	20-10-88
		AU-A- 4990585	29-05-86
		DE-A- 3585280	05-03-92
		US-A- 4716842	05-01-88
EP-A-0289355	02-11-88	OA-A- 8877	31-10-89
WO-A-8909364	05-10-89	DE-A- 3809429	12-10-89
		EP-A- 0362348	11-04-90
		JP-T- 2504668	27-12-90
DE-C-3918508	03-05-90	WO-A- 9015287	13-12-90
		EP-A- 0431077	12-06-91
EP-A-0242232	21-10-87	AU-A- 7146187	22-10-87
		US-A- 4867078	19-09-89