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(71) Applicant: ROLLINS ENVIRONMENTAL SERVICES (TX) INC. [US/US]; 1777 Battleground Road, Deer Park, TX 77536 (US).

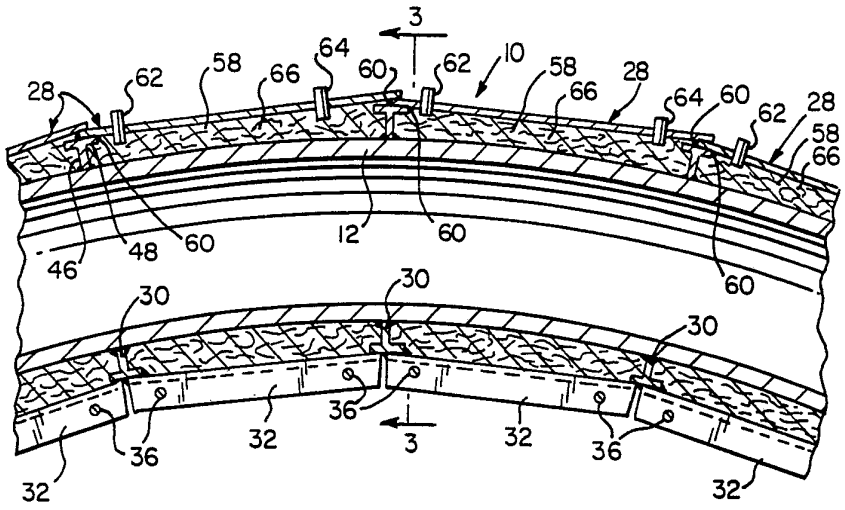
(72) Inventors: BYERLY, Harold, Lee ; 16, 606 La Avenida, Houston, TX 77062 (US). KUHN, Bruno, Richard ; 351 Lake Side Drive, #113A, Nassau Bay, TX 77058 (US).

(74) Agent: LIENESCH, Theodore, D.; Thompson, Hine and Flory, 2000 Courthouse Plaza NE, 10 West Second Street, Dayton, OH 45402 (US).

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(54) Title: RECYCLE CONDUIT INSULATION ASSEMBLY



(57) Abstract

An insulation assembly (10) for a helical recycle conduit (12) of a rotary reactor (14) having a rotating, horizontally-oriented, cylindrical chamber for burning materials therein and a quantity of particulate, inorganic material within the chamber for conveying heat energy to material to be burned. The insulation assembly includes a plurality of cylindrical shell elements (28), each enclosing a portion of the conduit and arranged in overlapping relation, a plurality of mounting rings (30), each attached to and extending radially from the conduit for supporting the shell elements at ends thereof, and a pumpable refractory mixture (58) substantially filling an insulation space between the shell elements and conduit. Preferably, only one end of each element is attached to a mounting ring, unattached ends overlapping the next adjacent shell element to form a continuous covering which contacts or expands longitudinally in response to thermal expansion and contraction of the enclosed associated conduit. The mounting rings are segmented and include slots (50) which permit expansion and contraction from the underlying conduit without destruction of the mounting ring.

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RECYCLE CONDUIT INSULATION ASSEMBLY

The present invention relates to rotary reactors which use inorganic particulate material to convey heat energy to organic material to be burned and, more particularly, to assemblies for insulating the external recycle conduit of such a rotary reactor.

A common device for incinerating hazardous materials and other toxic wastes is the rotary reactor. A rotary reactor includes a horizontally-oriented cylindrical drum or chamber which is rotated slowly about a horizontal axis concentric with the chamber by electric motors which engage ring gears mounted on the chamber. The ends of the chamber are open and are received within annular hoods. At an inlet hood, fuel is injected into the chamber and burned to provide the heat for combusting waste, and other nozzles and orifices are provided to inject the waste material to be burned.

Lifters are mounted on the interior of the chamber and rotation of the chamber brings the lifters successively through a bed of inorganic particulate material, such as sand, located in the bottom of the chamber. As the lifters, loaded with sand, are rotated upwardly and above the sand bed, they gradually empty the sand downwardly back into the bed, thereby allowing the sand to be heated and intermingled with the waste materials to be burned. This action allows the sand to convey heat absorbed from the burning fuel to the waste material.

As the reactor chamber rotates, the inorganic particulate material progresses toward the end of the chamber opposite the fuel and waste inlets. In order to convey the particulate material back to the fuel and waste inlets, rotary reactors include a recycle conduit or chute. Such an apparatus is shown in Reed et al.

US-A- 4,563,246. In one embodiment of that patent according to the preamble of claim 1, the recycle chute comprises a helical conduit coiling about the outer periphery of the cylindrical chamber. The helical conduit communicates with the chamber at its front and rear ends and coils oppositely to the direction of rotation of the chamber. Particulate material entering the recycle conduit at the "downstream" end of the chamber flows to the "upstream" end adjacent the fuel and waste inlets by the rotation of the chamber.

Such recycle conduits typically are made of 253MA stainless steel which is appropriate for withstanding the high temperatures and corrosive environment within the chamber. However, this material rapidly radiates heat from the particulate material being conveyed to the upstream end of the chamber.

Accordingly, there is a need for insulating the recycle conduits of rotary reactors to minimize the heat loss from the particulate material recycled as it travels the length of the helical conduit. Conventional fiber insulating materials rapidly deteriorate as a result of the rotating action of the recycle conduit and the expansion and contraction of the conduit, predominately in a longitudinal direction, as a result of thermal stresses. Consequently, there is a need for insulating recycle conduits with a system that can accommodate the dimensional changes resulting from thermal expansion and contractions and which is not destroyed by the rotating movement of the conduit.

The present invention is a recycle conduit insulation assembly for use with a rotary reactor which is capable of handling the high temperature levels (on the order of 870°C) as well as the stresses imposed by the expansion and contraction of the recycle conduit due

to changes in temperature. Further, the present invention is not affected by the rotating movement of the conduit on which it is mounted.

The invention is used with a rotary reactor having a rotating, horizontally-oriented cylindrical chamber for burning materials therein, a quantity of particulate, inorganic material within the chamber for conveying heat energy to material to be burned, and a helical substantially cylindrical conduit extending about said chamber and communicating with opposite ends thereof for conveying the particulate material from one end of the chamber to the other as the chamber rotates. The invention is characterized by shell means comprising a plurality of shell elements, spaced from and enclosing the conduit and forming an insulation space with the conduit; mounting means comprising a plurality of ring elements attached to the conduit and supporting the shell means; and insulating means occupying the insulation space. Preferably, the shell elements are each welded at one end to a mounting ring and are unattached at an opposite end but overlap the next adjacent shell element. Consequently, the shell elements are capable of sliding longitudinally relative to each other to accommodate longitudinal dimensional changes of the conduit resulting from thermal stresses. The insulating space preferably is filled with a pumpable refractory having insulation capabilities. Each shell element includes couplings which permit liquid, pumpable refractory mixture to be injected into the insulation space. The mounting rings are segmented so that they can accommodate changes in a radial dimension resulting from thermal stresses.

Accordingly, it is an object of the present invention to provide an insulating assembly for a recycle conduit of a rotary reactor which is inexpensive in

comparison to other insulating assemblies yet is able to withstand the dimensional changes resulting from thermal stresses imposed by the recycle conduit which it insulates and which is relatively easy to mount on a recycle conduit and to maintain and repair.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings, in which:

Fig. 1 is a somewhat schematic, side elevation of a rotary reactor having a recycle conduit fitted with the insulation assembly of a preferred embodiment of the invention;

Fig. 2 is a detail side elevation in section taken at line 2-2 of Fig. 1;

Fig. 3 is a section taken at line 3-3 of Fig. 2; and

Fig. 4 is a detail perspective view of the insulation assembly of Fig. 1 showing a mounting ring.

As shown in Fig. 1, the recycle conduit insulation assembly, generally designated 10, is mounted on the recycle conduit 12 of a rotary reactor 14. The rotary reactor 14 includes a horizontally-oriented, cylindrical chamber 16 which is supported for rotation between stationary upstream and downstream hoods 18, 20, respectively.

The recycle conduit 12 comprises segments of cylindrical pipe fabricated from 253MA stainless steel connected at mating flanges 22 and extending in a helical path about the chamber 16. The downstream end of the conduit 12 communicates with the interior of the chamber 16 at the downstream end at connection 24. Similarly, the upstream end of the conduit 12 communicates with the interior of the chamber 16 at connection 26. As the

chamber 16 rotates, particulate inorganic material within the chamber enters the conduit 12 through the connection 24 and progresses through the conduit to re-enter the chamber 16 at connection 26. The rotation of the reactor causes the particulate inorganic material to progress outwardly through the helical conduit 12.

As shown in Figs. 2 and 3, the insulation assembly 10 comprises a plurality of shell elements 28 supported by and spaced from the conduit 12 by ring members 30. Each shell element 28 consists of a substantially rectangular sheet of 16 gauge galvanized sheet metal bent to form a cylinder having mating flanges 32, 34 at its ends, joined by sheet metal screws 36.

As shown in Figs. 3 and 4, each mounting ring 30 comprises a pair of opposing ring segments 38, 40 attached to the conduit by a pair of weldments 42, 44. Each ring segment 38, 40 is substantially T-shaped in cross section (see Fig. 2) and is fabricated from 304 stainless steel. The T-shape includes a radially-extending web 46 and an axially-extending support flange 48. The webs 46 of the ring segments 38, 40 each include a radially-extending notch 50 midway between the ends 52, 54. The ends 52, 54 are bevelled to form triangular slots when they meet. The weldments 42, 44 are positioned midway between the notches 50 and the ends 52, 54. This relationship between the ends 52, 54, notches 50 and weldments 42, 44 provides a flexible mounting for the ring segments 38, 40 which accommodates expansion and contraction of the conduit 12 in a radial direction.

As shown in Fig. 2, each shell element 28 extends between and is supported by two mounting rings 30, thereby defining an insulation space 58 between the shell element 28, conduit 12 and contiguous mounting rings 30. Each shell element 28 is attached to the

support flange 48 of a single mounting ring 30 by weldments 60. The shell elements 28 are sized such that the free, unwelded ends overlap the welded end of the next adjacent shell element 28. Accordingly, the sequence of shell elements 28 is capable of expanding or contracting longitudinally in response to longitudinal dimensional changes of the conduit 12 on which they are mounted.

Each shell element 28 includes a pair of half couplings 62, 64, positioned adjacent ends thereof which enable a pumpable refractory mixture to be injected into the insulation spaces 58. The pumpable refractory mixture 66 preferably has insulation capabilities, and an appropriate type is Fiber Frax GS, produced by Carborundum Corporation.

The insulation assembly 10 is mounted on a conduit 12 in the following manner. The ring segments 38, 40 of the mounting rings 30 are first welded to the conduit at intervals corresponding to the lengths of the shell elements 28 which are to be used. It should be noted that the spacing of mounting rings 30 need not be uniform; spacing decreases with a decrease in the radius of curvature of the conduit. Accordingly, spacing of mounting rings around elbows and tight curves is shorter than for long gradual curving segments. Each mounting ring 30 is attached by four weldments spaced as shown in Fig. 3.

The shell elements are then mounted on the support flanges 48 of the mounting rings 30 and are welded at their ends in overlapping relation as shown in Fig. 2. The refractory mixture 66 is pumped through either coupling 62 or 64 for each shell element 28 until the mixture emerges from the other coupling, thereby indicating that the insulation space 58 is substantially

full. The couplings 62, 64 are then capped and the assembly is ready for use.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that other equivalent components to those shown and described may be used without departing from the scope of the invention, as defined in the appended claims.

CLAIMS

1. For use with a rotary reactor (14) having a rotating, horizontally-oriented cylindrical chamber (16) for burning materials therein, a quantity of particulate, inorganic material within said chamber for conveying heat energy to material to be burned, and a helical, substantially cylindrical conduit (12) extending about said chamber and communicating with opposite ends thereof for conveying said particulate material from one end of said chamber to an opposite and thereof as said chamber rotates, an insulation assembly (10) characterized by:

means (28) for forming a shell for substantially enclosing said conduit in a spaced relation therefrom, thereby forming an insulating space (58) between said shell means and said conduit;

means (30) for mounting said shell means as said conduit; and

means (66), contained within said insulating space, for providing an insulating layer to said conduit.

2. An assembly as claimed in claim 1 wherein said shell means comprises a plurality of contiguous shell elements (28) each of said shell elements including a cylinder enclosing a portion of said conduit (12).

3. An assembly as claimed in claim 2 wherein said mounting means includes a plurality of mounting rings (30) each of said rings being attached to and extending radially from said conduit (12).

4. An assembly as claimed in claim 3 wherein each of said shell elements (28) is attached at an end thereof to one of said rings (30) and is unattached at an opposite end thereof, whereby said assembly is capable of expanding and contracting with said conduit as said conduit expands and contracts from changes in temperature.

5. An assembly as claimed in claim 4 wherein each of said shell elements (28) includes coupling means (62,64) for receiving pumpable insulation material (66) into said insulating space.

6. An assembly as claimed in claim 5 wherein each of said shell elements (28) is made from a substantially rectangular sheet of metallic material, formed into a cylinder shape and having longitudinal ends of said sheet bent radially outwardly to form flanges (32, 34) shaped to abut each other along their lengths.

7. An assembly as claimed in claim 3 wherein each of said mounting rings (30) has a T-shape in a radial, longitudinal cross section.

8. An assembly as claimed in claim 7 wherein each of said mounting rings (30) includes radially-extending notch (50) for imparting flexibility to said mounting rings in response to thermal expansion of said associated conduit.

9. An assembly as claimed in claim 7 wherein each of said mounting rings (30) has a longitudinally-extending flange (48) attached to adjacent ones of said shell elements (28), said flange being coaxial with said conduit (12).

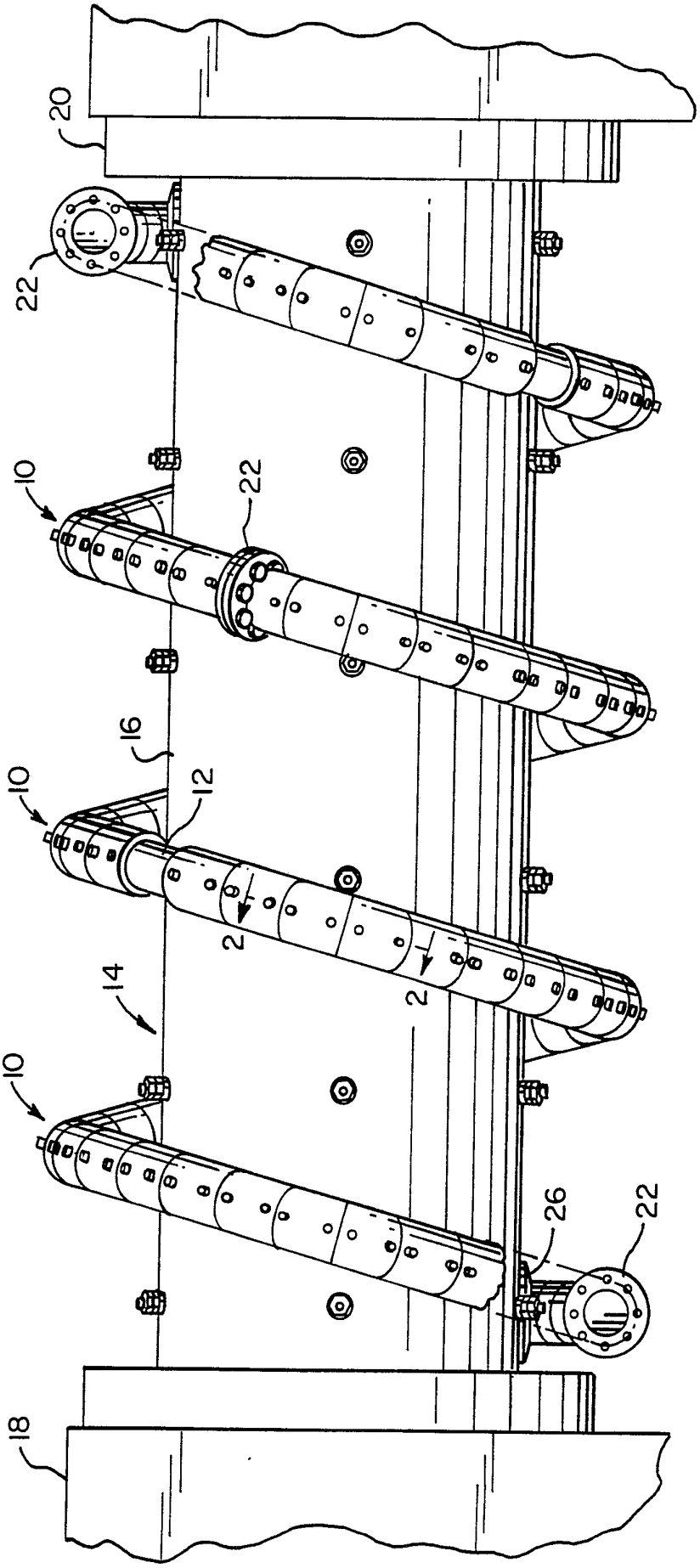


FIG-1

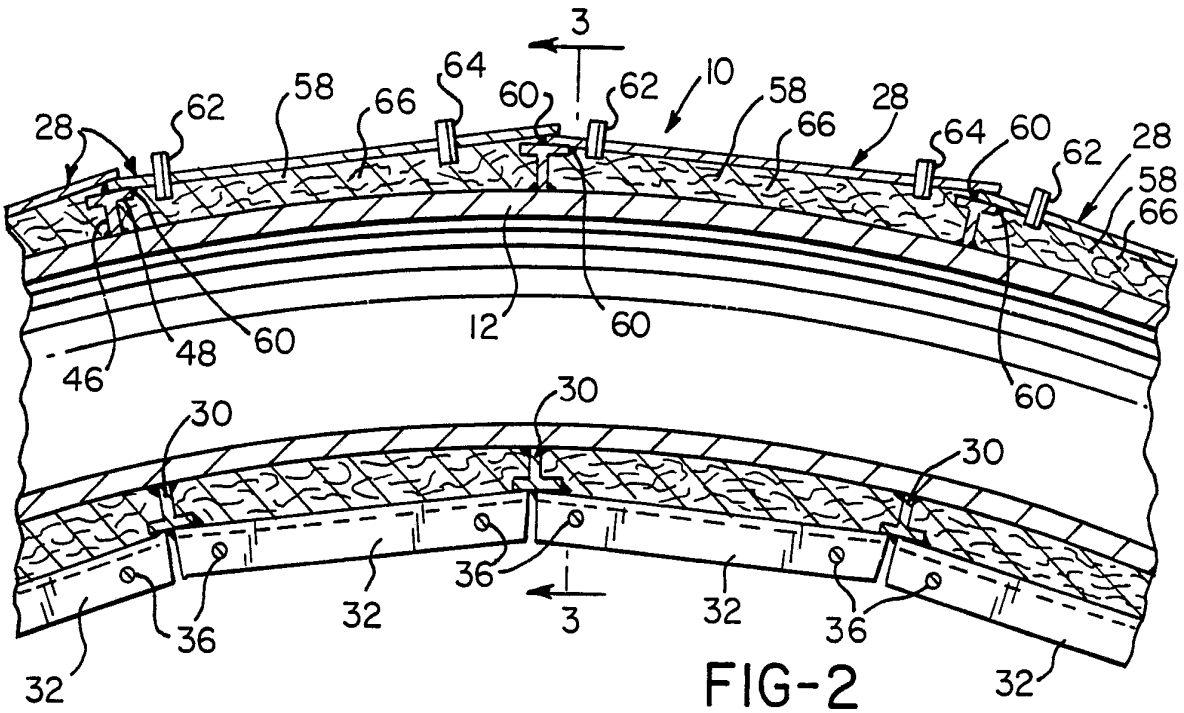


FIG-2

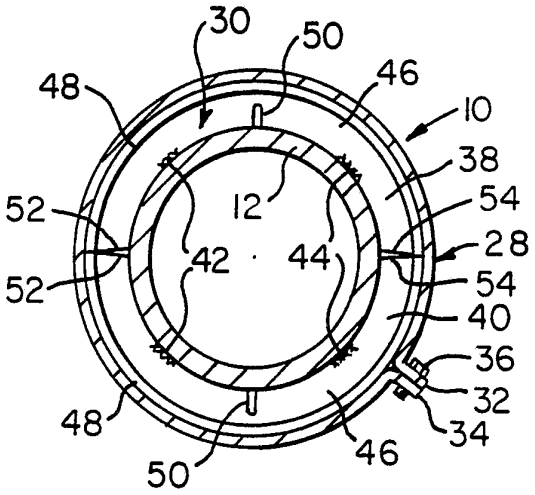


FIG-3

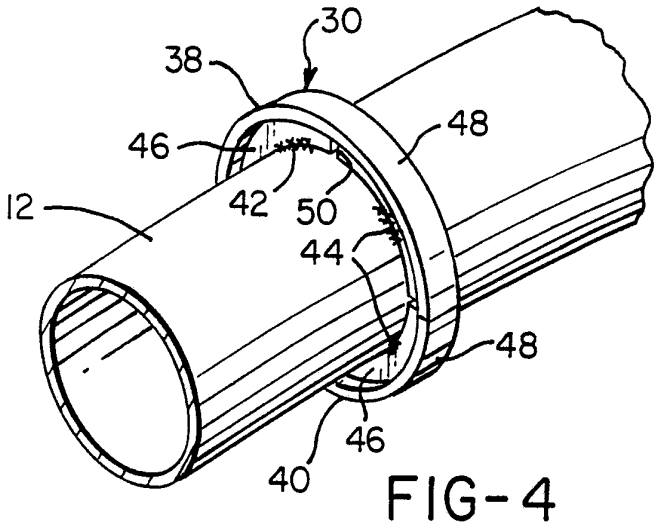


FIG-4

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 91/03057

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 F 16 L 59/12 F 16 L 59/18 F 23 G 5/20

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl.5	F 16 L F 23 G

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 °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
Y	US-A-3 559 660 (ROLLINS) 2 February 1971, see claim 1; column 2, lines 23-25,32-47; figures 1,2	1,3
A		5-9
Y	US-A-4 563 246 (REED et al.) 7 January 1986, see claims 1,9,11,14,15; column 12, lines 29-36; figure 3 (cited in the application)	1,3
A	NL-A-8 100 417 (WAVING) 1 March 1982, see claim 1; figure 2	7,9

° Special categories of cited documents : [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
20-08-1991	20. 09. 91
International Searching Authority	**Signature of Authorized Officer**
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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 9103057 SA 47634

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 11/09/91
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3559660	02-02-71	None	
US-A- 4563246	07-01-86	US-A- 4477331	16-10-84
		CA-A- 1239367	19-07-88
		EP-A- 0125929	21-11-84
		EP-A,B 0126619	28-11-84
		JP-A- 60042487	06-03-85
NL-A- 8100417	01-03-82	None	