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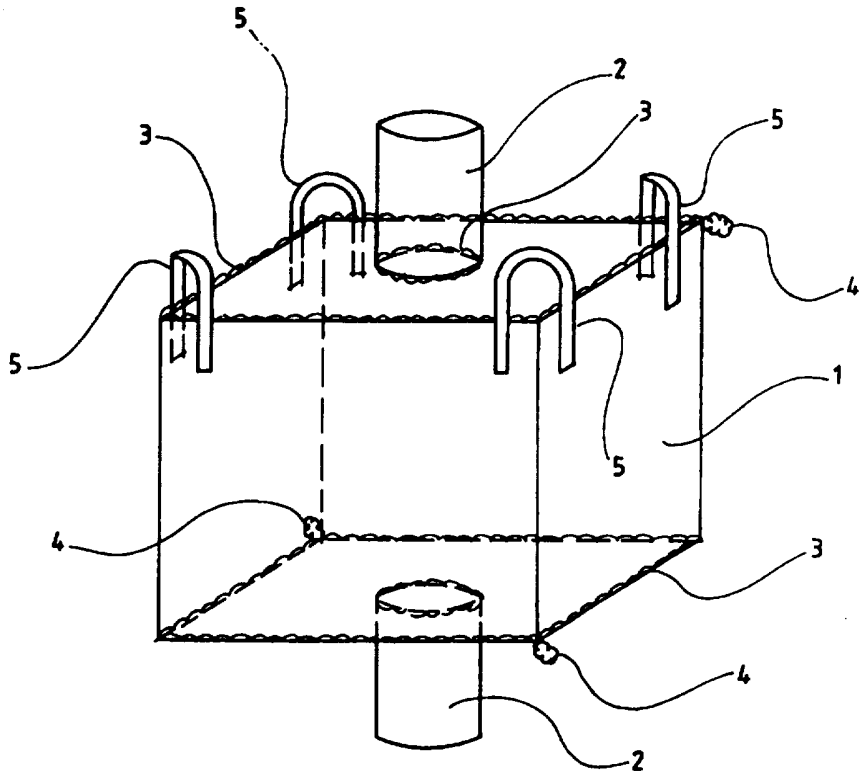
(54) Title: STATIC CONDUCTIVE FLEXIBLE INTERMEDIATE BULK CONTAINER (FIBC)

(57) Abstract

A bulk bag suitable for transporting materials, wherein at least one wall of said bag comprises a textile material including one or more thread(s) and/or yarn(s) comprising a conductive organic polymer, the thread(s) and/or yarn(s) arranged such that at least a portion of any charge caused through static generation may be dissipated from the bag. The term "thread" refers both to single continuous fibres of conductive organic polymer and also, to fine strands of twisted filaments of conductive organic polymer optionally including other suitable textile material filaments. The term "yarn" refers to a continuous twisted strand of one or more conductive organic polymer thread(s) with or without thread(s) of other suitable textile materials. The bulk bags may be FIBC's or semi-rigid bulk bags (i.e. incorporating some framing elements). The preferred conductive organic polymer is an acrylic and/or nylon to which transition metal salt(s) is chemically bonded or bound.



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STATIC CONDUCTIVE FLEXIBLE INTERMEDIATE BULK CONTAINER (FIBC)

This invention relates to bulk bags such as flexible intermediate bulk containers (FIBC's) used for transporting various industrial chemicals, food stuffs and pharmaceuticals. The bags according to the invention incorporate thread(s) and/or yarn(s) comprising a conductive organic polymer to enable the dissipation of static electricity.

FIBC's are flexible, generally rectilinear, containers which are used for transporting bulk quantities of industrial chemicals, powders, pharmaceuticals, plastics etc. Many of these materials, particularly those that are free-flowing, and based on a variety of organic and inorganic chemical structures can generate static electricity. As the bags are commonly made from materials with high electrical insulation properties, such as polypropylene, this static generation can lead to a build up of charge sufficient to cause electrostatic spark discharges, which can cause explosions (where there are flammable gases or substances near by), damage to electronic equipment and painful shocks to workers. These dangers are of particular concern during the filling and emptying of the bulk bags.

Substances which are especially prone to static generation include titanium dioxide, silica, carbon black powders, lead oxide, lead chromate, strontium chromate, zinc chromate, polyester resins and adipic acid.

One method for preventing static build up in bulk bags, is to treat the bag with a chemical anti-static. However, this kind of treatment can become ineffective after a few weeks and also requires a humid environment to be effective. Another method, involves the use of conductive spun metallised yarn woven into the bag material at regular intervals. These yarns are usually arranged such that they are interconnected with copper braids and have proven to provide an effective means for

static dissipation. However, the metallised yarns which typically comprise a metal thread twisted with one or more polymer threads, often show poor durability in use (often resulting in breakage of the metal thread) thereby limiting the life and safety of the bag.

The present inventors have now identified alternative conductive threads and yarns that may be incorporated into bulk bags which may overcome one or more of the problems associated with prior anti-static or static conductive bulk bags.

Thus, in a first aspect, the present invention provides a bulk bag suitable for transporting materials, wherein at least one wall of said bag comprises a textile material including one or more thread(s) and/or yarn(s) comprising a conductive organic polymer, the thread(s) and/or yarn(s) arranged such that at least a portion of any charge caused through static generation may be dissipated from the bag.

By the term "thread" we refer both to single continuous fibres of conductive organic polymer and also, to fine strands of twisted filaments of conductive organic polymer optionally including other suitable textile material filaments. By the term "yarn" we refer to a continuous twisted strand of one or more conductive organic polymer thread(s) with or without thread(s) of other suitable textile materials.

The bulk bags may be FIBC's or semi-rigid bulk bags (i.e. incorporating some framing elements). Preferably, however, the bulk bags are FIBC's with a substantially cuboidal or "U" shape, with all walls (e.g. sides and ends) comprising a textile material and a plurality of threads and/or yarns comprising a conductive organic polymer.

The bulk bag according to the invention may also include spouts and lift webbings as is known in the art, and these spouts and left webbings, preferably, also

comprise a textile material and a plurality of threads and/or yarns comprising a conductive organic polymer.

Preferably, the conductive threads and/or yarns are conductively interconnected and attached to at least one earthing lead. This interconnection may be achieved by conductively linking the conductive threads and/or yarns to a copper braid, however, substantial cost savings may be achieved by conductively linking the conductive threads and/or yarns to a strip incorporated into the seams of the bag, the strip comprising textile material and a plurality of threads and/or yarns comprising conductive organic polymer.

Preferably, the conductive thread(s) and/or yarn(s) comprise a typical textile fibre such as an acrylic and/or nylon to which a transition metal salt(s) (such as transition metal sulphates and sulphides) is bonded or bound. Suitable conductive organic polymer threads or yarns are described in European Patent Specification Nos. 86072, 115661 and 503189, the disclosures of which are incorporated herein by reference. Most preferably, the conductive threads and/or yarns comprise acrylic and nylon with copper sulphide bonded or bound thereto. One particular material of this kind is Thunderon™ manufactured by Nihon Sanmo Dyeing Co., Ltd. (Kyoto, Japan). This material is very durable, shows good resistance to abrasion, and is relatively inexpensive. The conductive threads and/or yarns used in a bag according to the invention may be of the same or different composition, that is, a mixture of conductive threads and/or yarns may be used.

Preferably, the conductive threads and/or yarns are yarns and particularly, two-ply yarns.

The conductive threads and/or yarns may be woven into the textile material during weaving (weft and/or warp directions), or may be sewn into the textile material. The textile material may be any of the types commonly used

in the production of bulk bags, particularly polypropylene and polyester. Where the bulk bags according to the invention include conductive strips in the seams, it is preferred that the textile material of the strips is polypropylene or polyester.

The walls of the bag and spout(s) may include conductive organic threads and/or yarns spaced every 1-10cm, preferably 2-5cm. The lift webbing of the bag may include conductive organic threads and/or yarns spaced every 2-20mm. The conductive seam strips may include conductive organic threads and/or yarns spaced every 1-20mm, preferably 3-5mm.

Preferably, the bulk bag has dimensions of approximately 90cm x 90cm x 95cm and includes sufficient conductively interconnected conductive threads and/or yarns such that an earthed bag, in operation, prevents build up of charge greater than ±20kV, more preferably, ±5kV. Most preferably, the bulk bag prevents build up of charge greater than ±3kV.

The invention will now be further described with reference to the following non-limiting examples and accompanying Figures.

Brief Description of the Figures

Figure 1 provides a perspective representation of a FIBC construction suitable for bulk bags according to the present invention.

Figure 2 provides a perspective representation of a "U"-shaped FIBC suitable for bulk bags according to the present invention.

Figure 3 provides perspective views of outlet or inlet spouts (6) incorporating conductive yarn (7) stripes and interconnecting conductive strips sewn into the seams (8).

Example 1

A polypropylene fabric was woven with polypropylene fibre and including at 4cm intervals, the Thunderon™ two-ply yarn woven in a stripe pattern. The fabric was used to produce the FIBC bag body (1) and spouts (2) (see Figure 1).

A conductive seam strip (15mm wide) was manufactured from polyester fibre with 3 stripes of Thunderon™ yarn woven into the warp of the webbing. This conductive seam strip was sewn into the bag seams (3) to provide a good connection to the Thunderon™ stripes in the bag body and spouts. The conductive seam strip was also used to provide earth loops (4).

A lift webbing (5) was made from polyester fibre woven using 2 stripes of Thunderon™ running along its length.

The bulk bag was made up to a size of 90cm x 90cm x 95cm.

Tests using polyester resin chips during a 14 minute filling operation provided the following results.

Temperature: 9°, humidity 68%
Material: polyester resin chips
Instrument: Kasuga Electrostatic Potentiometer (value in kV).

	TOP	MIDDLE	BASE
No earth connection	1.8	2.4	2.4
Earth to top seam	1.5	2.8	2.0
Earth to one only earth connection loop sewn in bag	1.8	1.5	1.4

These results indicate that the bags show excellent static dissipation. In comparison, a polypropylene bag of equivalent size and structure with no conductive fibres,

showed charge of up to 40 kV in similar filling operations.

EXAMPLE 2

Resistance and surface resistivity tests were conducted on the FIBC of Example 1, but including further interconnected Thunderon™ yarns in the filling and outlet spouts (2). The tests were conducted at 15°C and 62% humidity using an Electro-Tech Systems Wide Range Resistance Tester Model 870, Serial No. 093.

	Ohms/m^2	Comparative* Ohms/m^2
Over conductive fibres	= 3.5×10^5	> 10^{12}
Along conductive fibres	= 1.0×10^4	1×10^4
Filling spout - over fibres	= 5.0×10^{12}	-
Filling spout - with fibres	= 1.0×10^4	-
Outlet spout	= 4.5×10^8	-

Resistance Measurement taken over distance

	Ohms	Comparative* Ohms
Outlet spout to top of bag	= 5.0×10^7	10×10^{12}
Over side wall 300 mm spacing	= 3.5×10^4	10×10^{12}

(* Comparative results achieved with a commercially available FIBC of similar dimensions including Beckaert Decitex conductive stripes spaced at 2cm intervals.)

The FIBC of the present invention demonstrated markedly lower resistance levels.

EXAMPLE 3

Static field measurement tests were conducted at 18°C and 62% humidity using a Shishido Type "M" Electrostatic Fieldmaker during discharge and filling with polythene granules.

RESULTS

a) FIBC - Thunderon™ Stripes

The outlet from the bag showed charges of about -8kV, with the granules showing -3kV.

Inside the bag, initial granule charges were +30kV, shortly decaying to 8kV. In the centre of the bag decay was slower and a reading of +20kV was noted. On the body of the bag charges were very low, i.e. between zero and 2kV. When being emptied, granule charges of +2kV to +4kV were observed, but there were no charges at the outlet or on the body of the empty bag.

b) Comparative FIBC - Beckaert Decitex Conductive Stripes

The granule charges at the bag outlet were up to +30kV, remaining at that level inside the bag. The top of the bag registered charges of 10-11 kV (-) and readings of 1-2kV (-) existed around the bulk of the bag. While being emptied, the bag registered 3-4kV (-) at the outlet, with granule charges of 2-3kV (+). Zero charge existed on the main body of the bag.

c) Standard Bag - no conductive stripes

When being re-filled between tests, voltages of 10kV (+) existed at the inlet, while those at the base of the bag were 30-40kV (+). Granule voltages varied between 10 and 30kV (+). This variation could have been due to difficulty in maintaining a steady flow of material.

Persons skilled in the art will understand that the bulk bags, and components of the bulk bags, according to the invention may be of many different constructions. For example, Figure 2 shows an alternative "U"-shaped FIBC construction which is suitable. Also, alternative spout constructions are shown in Figure 3. The bags may be used

with the static generating substances mentioned above and other static generating solids and fluids.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

CLAIMS:-

1. A bulk bag suitable for transporting materials wherein at least one wall of said bag comprises a textile material including one or more thread(s) and/or yarn(s) comprising a conductive organic polymer, the thread(s) and/or yarn(s) arranged such that at least a portion of any charge caused through static generation may be dissipated from the bag.

2. A bulk bag according to claim 1, wherein all walls of said bag include one of more thread(s) and/or yarn(s) comprising a conductive organic polymer.

3. A bulk bag according to any one of the preceding claims, further comprising spouts and lift webbings which also include one or more thread(s) and/or yarn(s) comprising a conductive organic polymer.

4. A bulk bag according to any one of the preceding claims, further comprising strips of textile material including one or more thread(s) and/or yarn(s) comprising a conductive organic polymer, the strips arranged to conductively interconnect each of the conductive thread(s) and/or yarn(s) within said walls, spouts and lift webbings.

5. A bulk bag according to any one of the preceding claims wherein the conductive organic polymer is an acrylic and/or nylon to which transition metal salt(s) is chemically bonded or bound.

6. A bulk bag according to claim 5 wherein the transition metal salt is selected from copper sulphates, copper sulphides, silver sulphides, and palladium sulphides.

7. A bulk bag according to claim 6 wherein the transition metal salt is copper sulphide.

8. A bulk bag according to any one of claims 1 to 6, wherein the thread(s) and/or yarn(s) is Thunderon™ yarn.

9. A bulk bag according to any one of the preceding claims, said bulk bag being an FIBC.

10. A bulk bag according to any one of the preceding claims, said bulk bag being a semi-rigid bulk bag.

11. A bulk bag according to any one of the preceding claims wherein the conductive thread(s) and/or yarn(s) included in the bag wall(s) and/or spout(s) are in the direction of the weft or warp and are spaced every 1 to 10cm.

12. A bulk bag according to claim 11, wherein the conductive thread(s) and/or yarn(s) included in the bag wall(s) and/or spout(s) are spaced every 2 to 5cm.

13. A bulk bag according to any one of claims 3 to 12, wherein the conductive thread(s) and/or yarn(s) included in the lift webbings are in the direction of the weft or warp and are spaced every 2-20mm.

14. A bulk bag according to any one of claims 4 to 13, wherein the conductive thread(s) and/or yarn(s) included in the conductive seam strips run the length of the strip and are spaced every 1-20mm.

15. A bulk bag according to claim 14, wherein the conductive thread(s) and/or yarn(s) included in the conductive seam strips are spaced every 3 to 5mm.

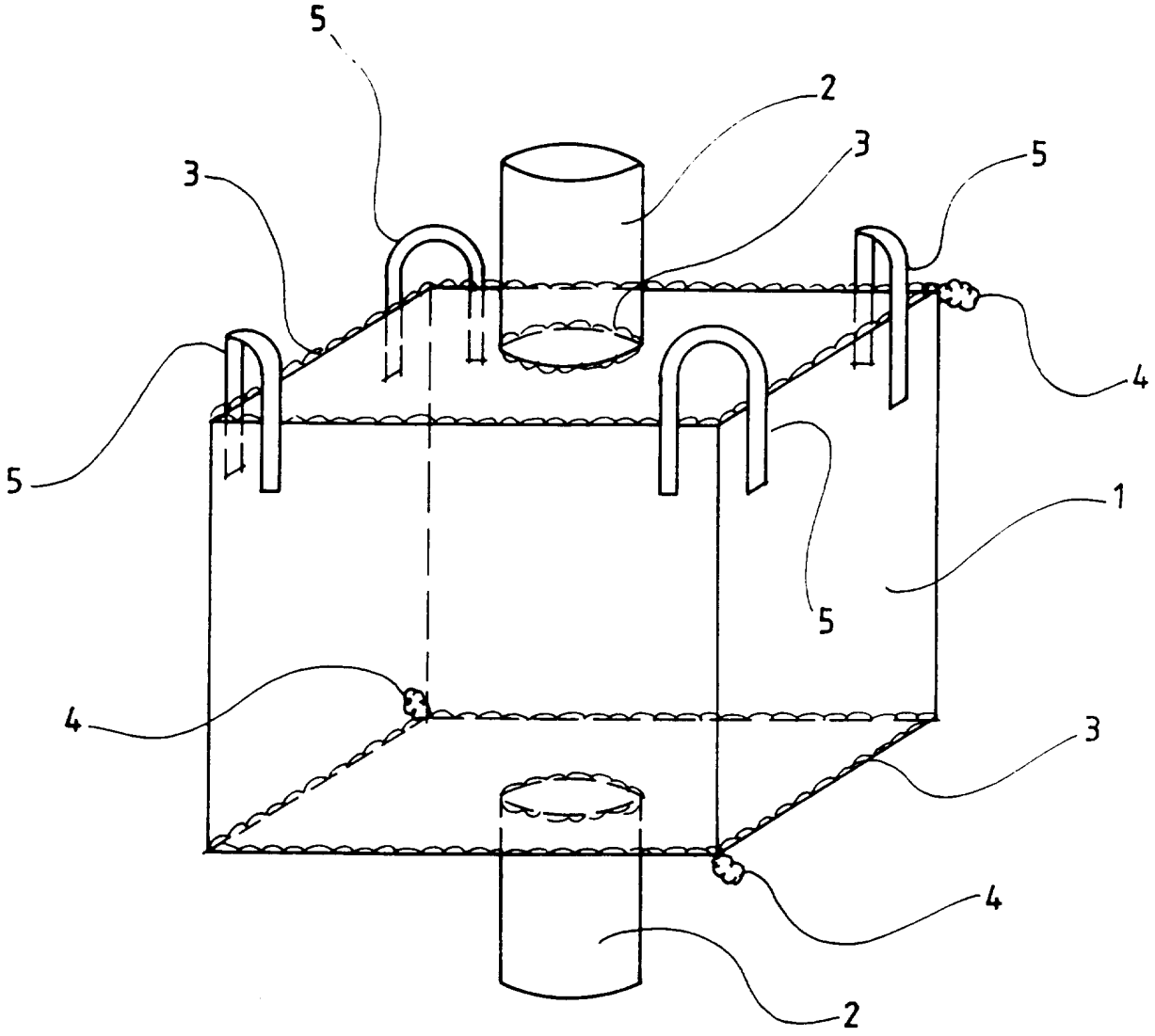

FIG. 1

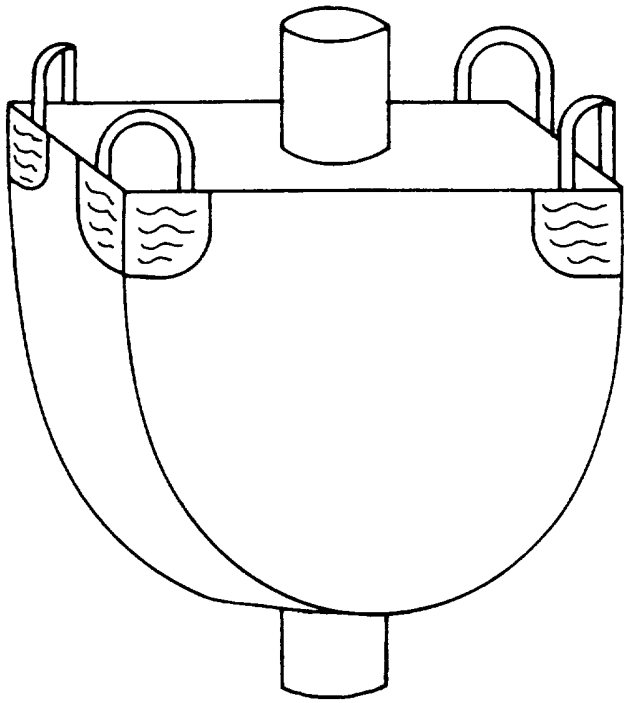

FIG. 2

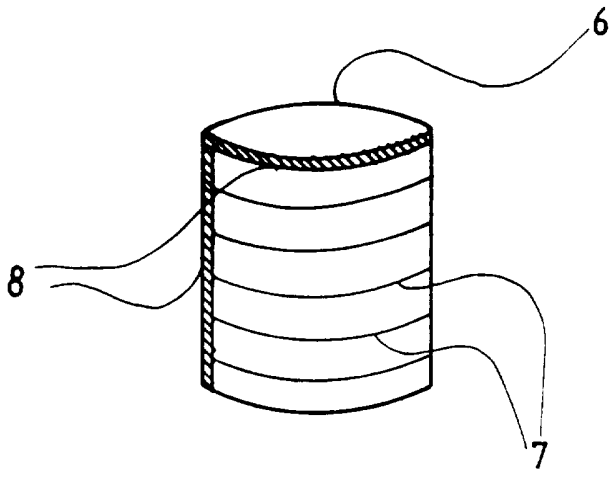

FIG. 3a

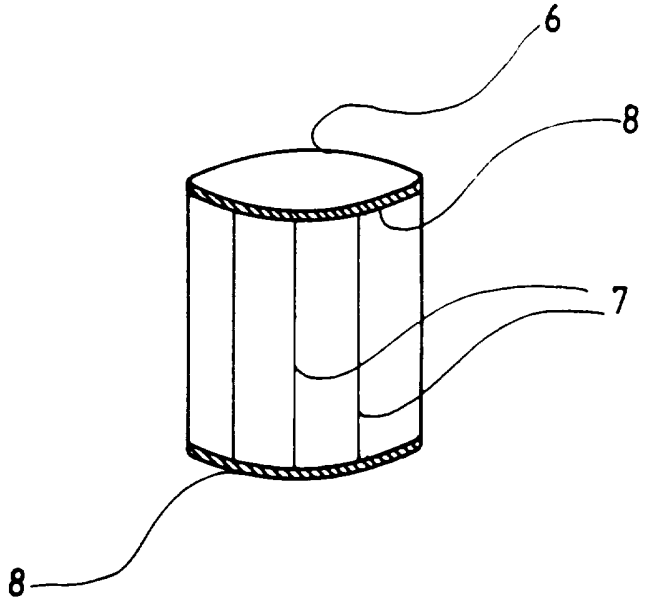

FIG. 3b

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 95/00623

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: B65D 90/46, 88/16

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: B65D 88/16, 90/46

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DERWENT: B65D-090/46/IC or [B65D-088/16/IC and (static: or electrostatic: or electro()static:)]

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	AU 60929/90 A (EUREA VERPACKUNGS GmbH & CO KG) 21 February 1991	
X	Pages 10-14	1-4, 9-15
Y	Pages 10-14	1-15
	CA 1143673 A (OSBORN) 29 March 1982	
X	Pages 4-7	1-4, 9-15
Y	Pages 4-7	1-15
	DE 4221380 A1 (EMPAC VERPACKUNGS GmbH & CO) 11 March 1993	
X	Columns 1-4	1-4, 9-15
Y	columns 1-4	1-15

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

[X] See patent family annex

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18 December 1995	22.12.95
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (06) 285 3929	Authorized officer J CARL Telephone No.: (06) 283 2543

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C (Continuation) **DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5269973 A (TAKAHASHI et al.) 14 December 1993 Columns 1-6	1-15
Y	US 5244281 A (WILLIAMSON et al.) 14 September 1993 Columns 2-9	1-15
Y	US 4556508 A (TOMIBE et al.) 3 December 1985 Columns 1-6	1-15
Y	US 4457456 A (DERBY et al.) 3 July 1984 Columns 20-22	1-15
Y,A	AU 13488/83 (553470) B (TIOXIDE GROUP PLC) 5 January 1984 Pages 2-8	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.
PCT/AU 95/00623

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
AU	60929/90	DE	3938414	CA	2023643	CS	9003981
		EP	413886	HU	59970	JP	3152238
		NO	903610	TR	25430	US	5092683
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