



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : C09K 5/06, 5/04, 5/02, B01J 2/30	A1	(11) International Publication Number: WO 97/27264 (43) International Publication Date: 31 July 1997 (31.07.97)
(21) International Application Number: PCT/AU97/00039 (22) International Filing Date: 23 January 1997 (23.01.97) (30) Priority Data: PN 7684 24 January 1996 (24.01.96) AU (71) Applicant (for all designated States except US): THERMAL ENERGY ACCUMULATOR PRODUCTS PTY. LTD. [AU/AU]; Unit 4, 28 Collingwood Street, Osborne Park, W.A. 6017 (AU). (72) Inventors; and (75) Inventors/Applicants (for US only): MURPHY, Peter, Lawrence [AU/AU]; 1/49 Davies Road, Claremont, W.A. 6010 (AU). SOLOMON, Terry, Howard [AU/AU]; 138 Swan Street, Guildford, W.A. 6055 (AU). (74) Agent: VAN WOLLINGEN, Rolf; 6th floor, 256 Adelaide Terrace, Griffith Hack, Perth, W.A. 6000 (AU).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>
(54) Title: AN ENCAPSULATED PHASE CHANGE SUBSTANCE (57) Abstract <p>The invention relates to an encapsulated phase change substance (12) comprising a substantially spherical granule (24) including a phase change substance, and one or more sealing layers (26). In one embodiment, the phase change substance (12) is a hydrate salt calcium chloride dihydrate having a melting point of approximately 22 °C, and the sealing layer (26) is constructed of a phenolic epoxy resin material being substantially impermeable to the phase change substance. The invention further comprises an apparatus (10) for producing an encapsulated phase change substance. The apparatus (10) comprises one or more loading storage vessels (14) designed to contain a phase change substance, a granulator (16), and coating means (20). The storage vessel (14) communicates with the granulator (16) via a screw conveyor (18). The granulator (16) communicates with the coating means (20) via a conveyor belt system (22). The granulator (16) comprises a granulator drum rotatably mounted about its longitudinal axis. The coating means includes a coating drum which is rotated at a controlled speed about its longitudinal axis. Coating compounds including one or more epoxy resins are delivered to a spray nozzle located inside the coating drum. The spray nozzle reciprocates back and forth longitudinally along the coating drum during the coating process.</p>		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

AN ENCAPSULATED PHASE CHANGE SUBSTANCE**FIELD OF THE INVENTION**

The present invention relates generally to an encapsulated phase change substance and relates particularly, though not
5 exclusively, to a granular phase change substance coated in one or more epoxy resin sealing layers. The present invention further relates to a method and an apparatus for producing an encapsulated phase change substance.

BACKGROUND TO THE INVENTION

10 It is generally understood that phase change substances can be encapsulated and thereafter used to store latent heat for use in heating or cooling. One technique used for encapsulating a phase change substance to form one or more phase change capsules involves the following steps:

- 15 i) forming indents within a plastic sheet using a thermo-forming head;
ii) dosing or filling each indent with a phase change substance in a liquid state;
iii) covering each indent with a laminated aluminium
20 cover which is heat sealed to the plastic sheet; and
iv) cutting the plastic sheet and aluminium cover to form one or more of the phase change capsules.

Although this encapsulation technique is well suited to production thermo-forming equipment it suffers from at
25 least the following drawbacks:

- i) the rate of production of capsules is low and thus the unit cost of the capsules is relatively high;
ii) the phase change capsules by nature of their construction and design are not robust and thus are limited
30 in their application; and
iii) the phase change capsules, primarily because of their size, are only effective in storing latent heat for a limited number of phase change cycles.

- 2 -

SUMMARY OF THE INVENTION

An intention of the present invention is to provide an encapsulated phase change substance which is relatively inexpensive to produce.

5 According to a first aspect of the present invention there is provided a method for producing an encapsulated phase change substance, said method comprising the steps of:

forming a plurality of granules each including a phase change substance having a relatively high latent heat
10 of fusion, said plurality of granules being of a predetermined size distribution; and

coating each of said plurality of granules with one or more sealing layers being substantially impermeable to said phase change substance so that the encapsulated
15 phase change substance can, for a relatively large number of cycles, change between the solid and liquid phases thereby effectively releasing and storing latent heat, respectively.

Typically, the step of forming a plurality of granules
20 involves forming said granules within a granulator drum rotationally mounted about its axis at a predetermined angle, the granulator drum being adapted to receive a quantity of said phase change substance so that the predetermined size distribution of the granules is
25 controlled by the predetermined angle at which the granulator drum is inclined.

Typically, the step of coating said plurality of granules involves spraying said one or more sealing layers onto each of said granules.

30 Preferably, the step of coating said granules involves:

feeding the granules to a coating drum which is rotationally mounted about its longitudinal axis; and

- 3 -

applying said one or more sealing layers onto each of said granules via a plurality of spray nozzles operatively communicating with the coating drum.

5 In one example, the plurality of spray nozzles reciprocate longitudinally along the coating drum.

Typically, the step of coating said plurality of granules involves controlling the rotational speed of the coating drum so the thickness of said one or more sealing layers is controlled. Preferably, the step of coating said plurality
10 of capsules involves applying between approximately 1 to 12 coats of said sealing layer to each of the granules.

According to a second aspect of the present invention there is provided an apparatus for producing an encapsulated phase change substance, said apparatus comprising:

15 a granulator adapted to receive a phase change substance having a relatively high latent heat of fusion, said granulator designed to form a plurality of granules each of a predetermined size and each including at least a portion of said phase change substance; and

20 coating means operatively communicating with the granulator, said coating means capable of applying one or more sealing layers being substantially impermeable to the phase change substance to each of said granules so that the encapsulated phase change substance can, for a relatively
25 large number of cycles, change between the solid and liquid phases thereby effectively releasing and storing latent heat, respectively.

Typically, the granulator comprises a granulator drum rotationally mounted about its axis at a predetermined
30 angle, the granulator drum being adapted to receive said phase change substance such that the predetermined size distribution of the granules is controlled by the predetermined angle at which the granulator drum is

- 4 -

inclined. In one example, the predetermined angle of inclination is between approximately 5° to 35° measured from the vertical.

Preferably, the coating means comprises:

5 a coating drum rotationally mounted about its longitudinal axis, the coating drum being adapted to receive a flow of said plurality of granules from the granulator; and

10 one or more spray nozzles operatively communicating with the coating drum and designed to spray each of the granules with said one or more sealing layers.

15 In one example the coating means further comprises a carriage connected to said one or more spray nozzles, the carriage movably cooperating with the coating drum so that, in use, the spray nozzles can reciprocate longitudinally along the coating drum.

According to a third aspect of the present invention there is provided an encapsulated phase change substance comprising:

20 a granule including a phase change substance having a relatively high latent heat of fusion, said granule being of a predetermined size; and

25 one or more sealing layers formed on the granule, said one or more layers being substantially impermeable to said phase change substance whereby the encapsulated phase change substance can, for a relatively large number of cycles, change between the solid and liquid phases thereby effectively releasing and storing latent heat, respectively.

30 Typically, each of said plurality of granules is substantially spherical in shape. More typically, the predetermined size distribution of said spherical granules ranges from a diameter of between approximately 5 to 30 mm.

- 5 -

Preferably, the volume of said phase change substance within each of said plurality of granules is less than approximately 14 millilitres (ml).

Typically, said one or more sealing layers comprise a synthetic thermosetting material. More typically, the synthetic thermosetting material is an epoxy resin. In one example, the epoxy resin is a phenolic epoxy resin.

Typically, the phase change substance is a hydrate salt or a derivative thereof. According to various examples of the present invention the hydrate salt is calcium chloride, sodium phosphate, or sodium acetate having melting points of approximately 29°C, 36°C, or 58°C respectively. However, it should be appreciated that the invention is not restricted to any one particular phase change substance, the phase change substance being selected according to the application in which the encapsulated phase change substance is to be used.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to facilitate a better understanding of the present invention a preferred method and apparatus for producing an encapsulated phase change substance will now be described in some detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a schematic of an apparatus for producing an encapsulated phase change substance; and

Figure 2 is an exploded view of an encapsulated phase change substance partly cut away.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As illustrated in Figure 1 there is an apparatus shown generally as 10 for producing an encapsulated phase change substance 12 (see Figure 2).

- 6 -

The apparatus 10 comprises one or more load-in storage vessels 14 designed to contain a phase change substance. It is envisaged that the phase change substance will be delivered to the storage vessels 14 in bags for small quantities, or sealed truck-mounted containers for relatively large quantities. Typical phase change substances processed in the apparatus 10 include but are not limited to the hydrate salts calcium chloride dihydrate (22°C), calcium chloride hexahydrate (29°C), sodium phosphate heptahydrate (36°C), sodium phosphate dodecahydrate (48°C), sodium acetate trihydrate (58°C), and magnesium nitrate hexahydrate (90°C). The majority of the hydrate salts are hydrophilic and thus require specific handling procedures and controlled environment storage. For example, it is recommended that storage is maintained at a constant dry temperature suited to the particular hydrate salt.

The storage vessel 14 operatively communicates with a granulator 16 via a screw conveyor 18. Rotational speed of the screw conveyor 18 is controlled so that an accurate flow rate of the phase change substance can be maintained into the granulator 16.

The granulator 16 comprises a granulator drum rotatably mounted about its longitudinal axis. The granulator drum, in this example, is approximately 2.5 metres in diameter and 0.5 metres high, and is designed to rotate at a controlled speed and a variable inclination of between approximately 5° to 35° measured from the vertical. The degree of inclination of the granulated drum controls the diameter of granules produced from the granulator 16. The granulator 16 includes an electronically controlled hydration system (not illustrated) used to add demineralised water to the phase change substance granulated within the granulator 16. For example, a granule containing the phase change substance calcium

- 7 -

chloride may comprise approximately two thirds by weight calcium chloride and approximately one third by weight demineralised water. The granulator also comprises a dust extraction system (not shown) located in the vicinity of the granulator drum. Typically, phase change granules produced from the granulator 16 will be from between 5 to 30 mm in diameter.

The granulator 16 operatively communicates with coating means shown generally as 20 via a conveyor belt system 22. The coating means 20 includes a coating drum of approximately 1.2 metres in diameter and 8 metres in length set at an angle of declination of approximately 2° to 3° toward its output. The coating drum is rotated at a controlled speed about its longitudinal axis. The conveyor belt system 22 is set at a speed which will handle the quantity of phase change granules discharged from the granulator 16. The rate of granules discharged onto the conveyor 22 will depend largely on the size of the granules. Dust extraction is also provided in the vicinity of the coating drum.

The coating means 20, in addition to the coating drum, comprises the following components:

1. a compressed air vessel with a 5 kilowatt (kW) driven compressor;
2. a water tank and a 1 kW delivery pump;
3. one or more storage vessels containing coating compounds, in this example two (2) epoxy resins held at a temperature of approximately 60°C;
4. one or more pumps located between the storage vessels and the coating drum.

Dye is added to the coating compounds so that the phase change substance and its approximate melting point can be identified by the colour of the encapsulated phase change substance 12. The coating compounds are delivered to a

- 8 -

spray nozzle located inside the coating drum via a multi-core hose. The spray nozzle reciprocates back and forth longitudinally along the coating drum during the coating process.

5 Once the granulated phase change substance has been coated in the coating drum, the encapsulated phase change substance 12 is then conveyed from the coating drum to load-out storage vessels. Each phase change substance will require a separate load-out storage vessel.

10 A typical encapsulated phase change substance 12 produced from the apparatus 10 described above is illustrated in Figure 2. The encapsulated phase change substance 12 comprises a substantially spherical granule 24 including a phase change substance such as the hydrate salt calcium
15 chloride dihydrate (22°C). The granule 24 is between approximately 5 to 30 mm in diameter and includes approximately 30% by weight demineralised water. The volume of phase change substance within the granule 24 is thus relatively low, typically being less than 14
20 millilitres (ml). Thus, the tendency of the phase change substance to break down into salt and water after a limited number of phase changes is minimised.

The encapsulated phase change substance 12 further comprises a multi-skin sealing layer 26 formed on the
25 granule 24. The sealing layer 26 is constructed of a phenolic epoxy resin material being substantially impermeable to the phase change substance. In this example, the sealing layer 26 comprises from between approximately 1 to 10 layers of the epoxy resin coating
30 material. The sealing layer 26 constitutes approximately 10% by weight of the encapsulated phase change substance 12. When the phase change substance is in a solid state the encapsulated phase change substance 12 will support a mechanical pressure of approximately 340 kilograms (kg) and

- 9 -

in a liquid state will support a mechanical pressure of approximately 50 kg. This robust sealing layer 26 also has relatively high heat transfer properties.

5 The encapsulated phase change substance 12 can be used in a variety of applications, the phase change substance being selected according to the chosen application. For example, an encapsulated phase change substance 12 comprising the hydrate salt calcium chloride dihydrate (having a melting point of approximately 22°C) can be introduced into a
10 concrete wall or floor as part substitution for aggregate within the concrete. The hydrate salt will absorb heat when ambient temperatures are in excess of 23°C and will release energy when ambient temperatures are less than approximately 21°C. Thus, the encapsulated phase change
15 substance 12 located within the concrete wall or floor maintains the structure at a constant temperature of approximately 22°C thereby producing a constant temperature using passive heating.

20 The encapsulated phase change substance 12 can also be included in other concrete structures such as a footpath, swimming pool, or road. The phase change substance is then selected in each application according to its purpose. For example, an encapsulated phase change substance 12 including a relatively low temperature phase change
25 substance such as calcium carbonate (having a melting point of approximately 6°C) could be used for de-icing roads.

Now that a preferred embodiment of the present invention has been described in some detail it will be apparent to those skilled in the relevant arts that the encapsulated
30 phase change substance has at least the following advantages over the admitted prior art:

1. the encapsulated phase change substance can perform a relatively large number of phase changes without a breakdown of the phase change substance;

- 10 -

2. the encapsulated phase change substance is relatively inexpensive to manufacture;
3. the encapsulated phase change substance is adaptable and robust thus lending itself to a variety of applications;
4. the encapsulated phase change substance by nature of its design has relatively high heat transfer properties and thus is relatively effective in use; and
5. the encapsulated phase change substance has a high latent heat storage capacity.

It will be apparent to persons skilled in the relevant arts that numerous variations and modifications can be made to the invention described above in addition to those already mentioned without departing from the basic inventive concepts. For example, the encapsulated phase change substance may not be shaped spherical but rather capsule-shaped. The encapsulated phase change substance is not restricted to any one particular phase change substance, the phase change substance being selected according to the application in which the encapsulated phase change substance is to be used. Where the phase change substance selected has a melting point below ambient temperature the granulator is refrigerated so that phase change granules are formed in the solid state. All such variations and modifications are to be considered within the scope of the present invention the nature of which is to be determined from the foregoing description.

- 11 -

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for producing an encapsulated phase change substance, said method comprising the steps of:

5 forming a plurality of granules each including a phase change substance having a relatively high latent heat of fusion, said plurality of granules being of a predetermined size distribution; and

10 coating each of said plurality of granules with one or more sealing layers being substantially impermeable to said phase change substance so that the encapsulated phase change substance can, for a relatively large number of cycles, change between the solid and liquid phases thereby effectively releasing and storing latent heat, respectively.

15 2. A method for producing an encapsulated phase change substance as defined in claim 1 wherein the step of forming a plurality of granules involves forming said granules within a granulator drum rotationally mounted about its axis at a predetermined angle, the granulator drum being adapted to receive a quantity of said phase change substance so that the predetermined size distribution of the granules is controlled by the predetermined angle at which the granulator drum is inclined.

25 3. A method for producing an encapsulated phase change substance as defined in either claim 1 or 2 wherein the step of coating said plurality of granules involves spraying said one or more sealing layers onto each of said granules.

30 4. A method for producing an encapsulated phase change substance as defined in any one of the preceding claims wherein the step of coating said granules involves:

- 12 -

feeding the granules to a coating drum which is rotationally mounted about its longitudinal axis; and

5 applying said one or more sealing layers onto each of said granules via a plurality of spray nozzles operatively communicating with the coating drum.

5. A method for producing an encapsulated phase change substance as defined in claim 4 wherein the plurality of spray nozzles reciprocate longitudinally along the coating drum.

10 6. A method for producing an encapsulated phase change substance as defined in either claim 4 or 5 wherein the step of coating said plurality of granules involves controlling the rotational speed of the coating drum so the thickness of said one or more sealing layers is controlled.

15 7. A method for producing an encapsulated phase change substance as defined in any one of the preceding claims wherein the step of coating said plurality of capsules involves applying between approximately 1 to 12
20 coats of said sealing layer to each of the granules.

8. An apparatus for producing an encapsulated phase change substance, said apparatus comprising:

25 a granulator adapted to receive a phase change substance having a relatively high latent heat of fusion, said granulator designed to form a plurality of granules each of a predetermined size and each including at least a portion of said phase change substance; and

30 coating means operatively communicating with the granulator, said coating means capable of applying one or more sealing layers being substantially impermeable to the phase change substance to each of said granules so that the encapsulated phase change substance can, for a relatively large number of cycles, change between the solid and liquid

- 13 -

phases thereby effectively releasing and storing latent heat, respectively.

9. An apparatus for producing an encapsulated phase change substance as defined in claim 8 wherein the granulator comprises a granulator drum rotationally mounted about its axis at a predetermined angle, the granulator drum being adapted to receive said phase change substance such that the predetermined size distribution of the granules is controlled by the predetermined angle at which the granulator drum is inclined.

10. An apparatus for producing an encapsulated phase change substance as defined in claim 9 wherein the predetermined angle of inclination is between approximately 5° to 35° measured from the vertical.

11. An apparatus for producing an encapsulated phase change substance as defined in any one of claims 8 to 10 wherein the coating means comprises:

a coating drum rotationally mounted about its longitudinal axis, the coating drum being adapted to receive a flow of said plurality of granules from the granulator; and

one or more spray nozzles operatively communicating with the coating drum and designed to spray each of the granules with said one or more sealing layers.

12. An apparatus for producing an encapsulated phase change substance as defined in claim 11 wherein the coating means further comprises a carriage connected to said one or more spray nozzles, the carriage movably cooperating with the coating drum so that, in use, the spray nozzles can reciprocate longitudinally along the coating drum.

- 14 -

13. An encapsulated phase change substance comprising:

5 a granule including a phase change substance having a relatively high latent heat of fusion, said granule being of a predetermined size; and

10 one or more sealing layers formed on the granule, said one or more layers being substantially impermeable to said phase change substance whereby the encapsulated phase change substance can, for a relatively large number of cycles, change between the solid and liquid phases thereby effectively releasing and storing latent heat, respectively.

14. An encapsulated phase change substance as defined in claim 13 wherein each of said plurality of granules is substantially spherical in shape.

15. An encapsulated phase change substance as defined in claim 14 wherein the predetermined size distribution of said spherical granules ranges from a diameter of between approximately 5 to 30 mm.

20 16. An encapsulated phase change substance as defined in either claim 14 or 15 wherein the volume of said phase change substance within each of said plurality of granules is less than approximately 14 millilitres (ml).

25 17. An encapsulated phase change substance as defined in any one of claims 13 to 16 wherein said one or more sealing layers comprise a synthetic thermosetting material.

18. An encapsulated phase change substance as defined in claim 17 wherein the synthetic thermosetting material is an epoxy resin.

- 15 -

19. An encapsulated phase change substance as defined in claim 18 wherein the phase change substance is a hydrate salt or a derivative thereof.

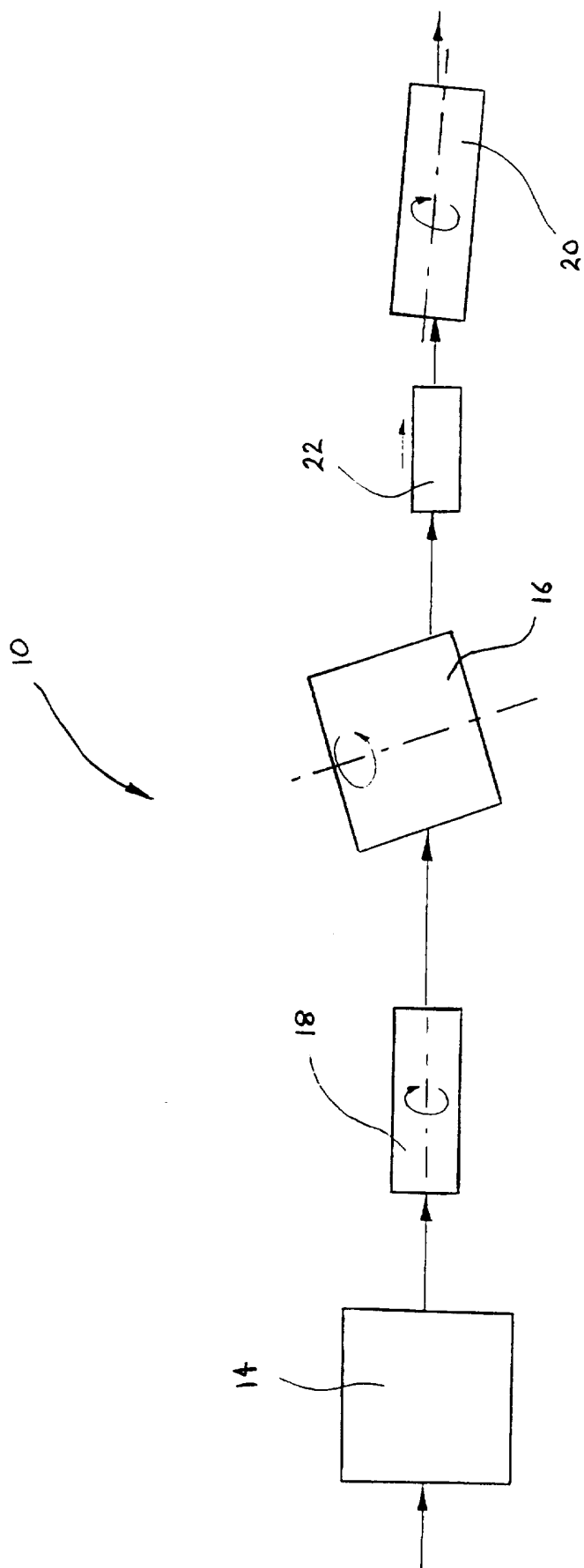


FIGURE 1

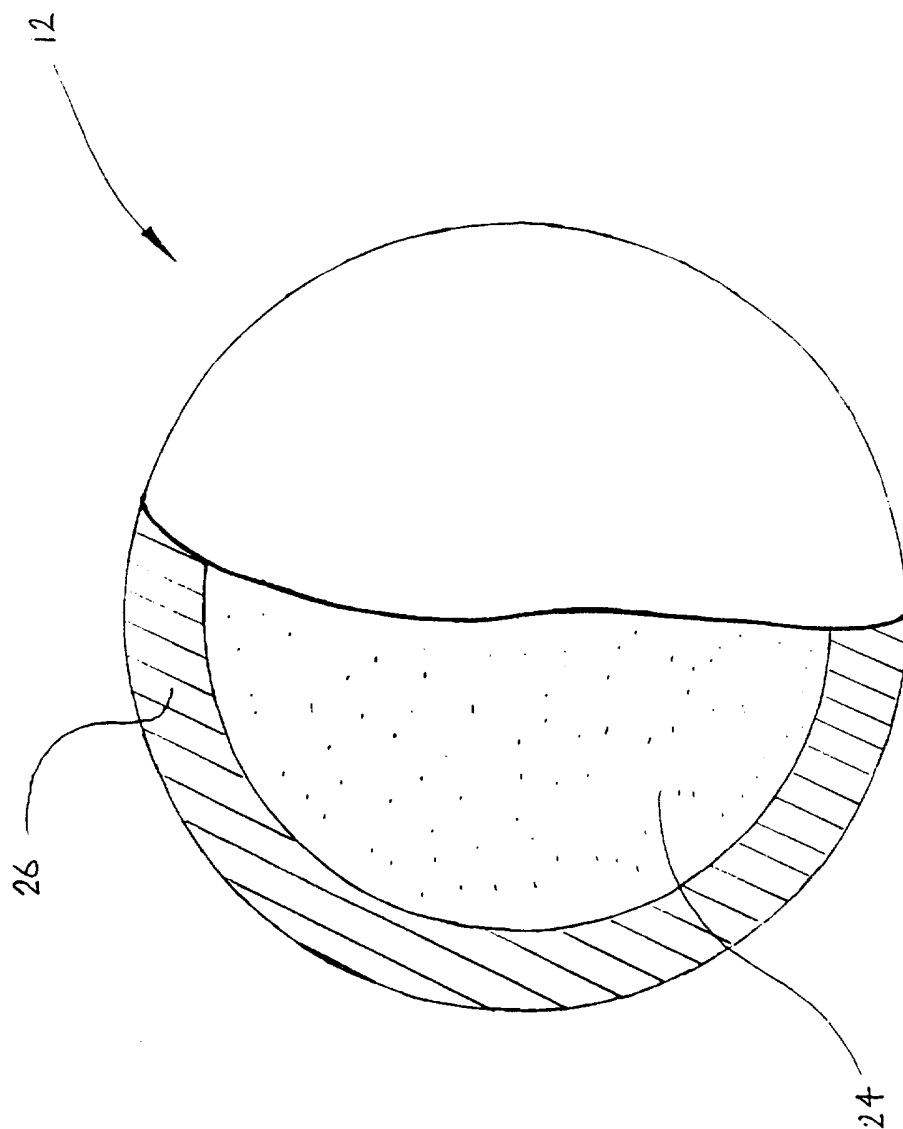


FIGURE 2

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/AU 97/00039

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl⁶: C09K 5/06 5/04 5/02 B01J 2/30

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 C09K 5/06 5/04 5/02 B01J 2/30

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)

WPAT: coat: encapsul: with IPC as above

JAPIO: coat: encapsul: with IPC as above

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU-A-60932/86 (STIFFLER), 6 August 1986 P. 2, line 21 - P. 5 line 5	1-19
X Y	US 5376175 A (Long Jr. et al.), 27 December 1997 Col. 2 lines 7-49	1-12 13-19
X	JP-A-5-295356 (NTC KOGYO K.K.) 9 November 1993 The Abstract	1, 13-19



Further documents are listed in the continuation of Box C



See patent family annex

<p>* Special categories of cited documents:</p>	
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"E" earlier document but published on or after the international filing date	"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
"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)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

25 March 1997

Date of mailing of the international search report

09.04.97

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

Sudath Kumarasinghe

Telephone No.: (06) 283 2269

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/AU 97/00039

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP-A-3-195794 (MATSUSHITA ELECTRIC WORKS LTD), 27 August 1991 The abstract	1, 13-19
X	JP-A-58-189285 (KOGYO GIJUTSUIN), 4 November 1983 The abstract	1, 13-19
X	JP-A-57-73071 (MATSUSHITA DENKO), 7 May 1982 The abstract	1, 13-19
X	EP 063348 A1 (THE DOW CHEMICAL CO), 27 October 1982 P. 5, line 8 - P. 9, line 25	1, 13-19
X	US 4637888 A (LANE et al.), 20 January 1987 Col. 3 line 6 - col 4, line 61	1, 13-19
X	US 4708812 (HATFIELD), 24 November 1987 Examples	1, 13-19
X	US 4412931 A (LANE et al.), 1 November 1983 Col. 3, lines 33-48	1, 13-19
Y	GB 1318970 A (STAMICARBON NV), 31 May 1973 The whole document	1-19
Y	JP-A-62-124182 (MASUSHITA ELECTRIC IND CO), 5 June 1987 The abstract	1-19
Y	US 4241692 A (Van Hijfte et al.), 30 December 1980 Col. 1, line 4 - Col. 2, line 59	1-12

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.

PCT/AU 97/00039

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	6093286	AU	589987	EP	237613	IT	8521904
		IT	1184806	JP	62089787	NZ	217104
US	5376175	CA	2130324	US	5494709		
US	4637888	AU	2928184	AU	561130	CA	1243195
		DE	3468044	DK	294884	DK	163998
		EP	139829	ES	533404	ES	8607047
		IL	72059	IN	161357	JP	60035077
		JP	4046994	KR	9107090	NO	161007
US	4708812						
US	4412931	KR	8501786				
US	4241692	AT	356151	BE	866432	CA	1095706
		DE	2817652	DK	184178	ES	469176
		FI	781322	FR	2388603	GB	1586147
		GR	64071	IE	46616	IT	1095339
		JP	53135890	JP	54026581	MX	144914
		NL	163973	NO	781499	PT	67954
		SE	7804452	TR	20151		
JP	5295356						
JP	3195794						
JP	58189285						
JP	57073071						
JP	62124182						
END OF ANNEX							

INTERNATIONAL SEARCH REPORT

Patent Document Cited in Search Report				Patent Family Member			
EP	063348	AU	8198382	CA	1173642	DE	3264527
		DK	157883	EP	63348	ES	511419
		IL	65467	IN	158209	JP	57170977
		KR	8501785	NO	159939	NZ	200274
		US	4415466	US	4613444	ZA	8202532
GB	1318970	AT	299272	BE	756882	BG	18419
		DE	2048621	ES	384187	FR	2068267
		JP	49037630	NL	6914947	NO	125846
		RO	63890	ZA	7006584		

END OF ANNEX