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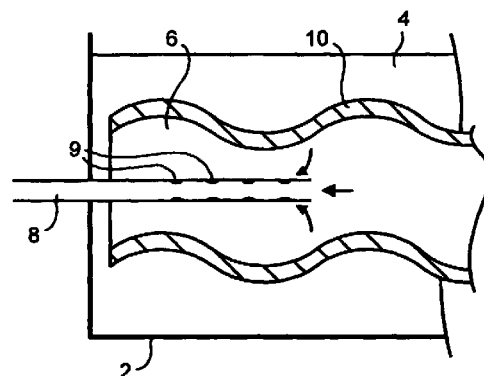
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(54) **Preparation of metal foam containers**

(57) A method of treating the skin (10) of a gas container (6) made from reticulated foam material to render the skin gas impervious comprising treating the skin of the container with a liquid sealant (4) and subsequently applying a vacuum to the interior of the container to draw the liquid sealant so that it flows inwardly from the skin into any open pores; and subsequently allowing the liquid sealant to solidify.



EP 1 036 616 A1

Description

[0001] Foam structures are known in industry and the number of applications for metallic foam structures is continually increasing. For example, aluminium foam metal having a continuously connected, open celled (reticulated) geometry is available and employed in :-

- a) energy/ impact absorbers;
- b) heat exchangers; and
- c) lightweight composite panels.

[0002] When used with heat exchangers the high surface to volume ratio allows for a compact design and the high specific stiffness, that is, high strength to weight ratio makes the material useful in aerospace and car applications.

[0003] Foam structures are now proposed for high pressure gas containers and in particular high pressure gas containers which have an irregular shape. When irregular or complex shapes are required then foam material such as metal foams are formed typically by mixing small quantities of a gasifier e.g. titanium nitride with aluminium powder and subjecting the mixture to heat and pressure to form a sintered sheet.

[0004] The sintered sheet or a portion thereof is then placed in a mould which is then heated to higher temperature at which the metal melts and nitrogen is released from the titanium nitride to provide an even dispersion of bubbles. The moulded object is then allowed to solidify and subsequently shock quenched in a cryogen for example liquid nitrogen.

[0005] This procedure often leaves the metal foam object with an outer skin in which are formed pores. If the object is to be used as a gas container then said pores will, if not removed or filled, allow the gas to escape from the container.

[0006] It is an aim of the present invention to provide a method of making a gas container from reticulated foam material which has a skin impervious to gas.

[0007] According to the present invention, a method of treating the skin of a gas container made from reticulated foam material to render the skin gas impervious comprises treating the surface skin with a liquid sealant and subsequently applying a pressure differential across the skin to draw the liquid sealant so that it flows inwardly from the skin into any open pores, and subsequently allowing the sealant to harden.

[0008] In one embodiment, a vacuum is applied to the interior of the container to create the pressure differential.

[0009] Preferably, the gas container is immersed in a vessel containing liquid epoxy resin which is heat settable and heat is applied to set the resin subsequent to the drawing operation.

[0010] According to a further aspect of the present invention, in a gas container made from reticulated foam material the skin of the container is treated to render it

gas impervious.

[0011] An embodiment of the invention will now be described, by way of example, reference being made to the Figure of the accompanying drawing which is a schematic sketch of apparatus for treating the skin of a gas container made from reticulated foam material.

[0012] As shown, a vessel 2 is filled with a liquid sealant such as a liquid heat settable epoxy resin 4.

[0013] Immersed in the epoxy resin 4 is a container 6 of an irregular shape made from a metal foam material. The interior of the metal foam material container is in communication with a source of vacuum by means of a tube 8 formed with perforations 9.

[0014] In use, a pressure differential is applied across the skin 10 of the container 6 by means of a vacuum applied via the tube 8 to the interior of the container 6 for a short period of time so that the liquid epoxy resin 4 flows into any open pore at the skin 10 of the container. Subsequently, the container 6 is heat treated to set the epoxy resin.

[0015] The skin of the container will thus become impervious to gas flow therethrough. The liquid sealant could be molten metal solder or aluminium oxide.

[0016] It will be apparent that the pressure differential across the skin 10 could equally be created by applying a higher pressure to the outside of the container 6 than that existing in the interior of the container.

Claims

1. A method of treating the skin of a gas container made from reticulated foam material to render the skin gas impervious comprising treating the skin of the container with a liquid sealant and subsequently applying a vacuum to the interior of the container to draw the liquid sealant so that it flows inwardly from the skin into any open pores; and subsequently allowing the liquid sealant to solidify.
2. A method as claimed in Claim 1, in which a vacuum is applied to the interior of the container to create the pressure differential.
3. A method as claimed in Claim 1 or Claim 2, in which the container is immersed within a liquid epoxy resin which is contained within a vessel.
4. A method as claimed in Claim 1, Claim 2 or Claim 3 in which the epoxy resin is heat settable and heat is applied to set the epoxy resin subsequent to the drawing operation.
5. A gas container made from reticulated foam material in which the container skin is treated to render it gas impervious.
6. A method of treating the skin of a gas container made from reticulated metal foam material substan-

tially as hereinbefore described.

7. A gas container made from reticulated metal foam substantially as hereinbefore described.

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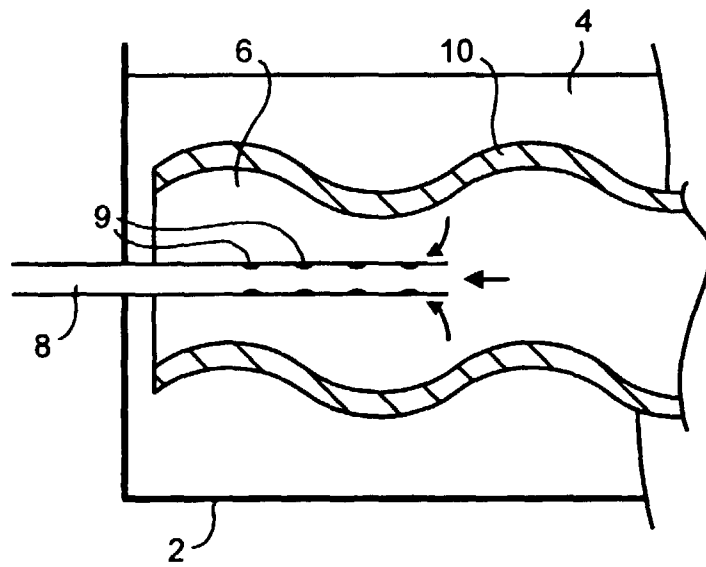
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EUROPEAN SEARCH REPORT

Application Number
EP 00 30 1570

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	DE 197 04 968 A (MANNESMANN AG) 30 July 1998 (1998-07-30) * column 3, line 45 - line 56; claims 1,11 *	1-7	B22F3/11 B22F7/00 F17C1/08
Y	WO 92 13982 A (SANDVIK AB ;ASEA CERAMA AB (SE)) 20 August 1992 (1992-08-20) * claims 1,10 *	1-7	
A	DE 196 51 197 A (DIETZSCHOLD DIRK DR ING ;DIETZSCHOLD SUSAN (DE)) 19 June 1997 (1997-06-19) * claim 21 *	1-7	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B22F F17C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 29 June 2000	Examiner Schruiers, H
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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29-06-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19704968 A	30-07-1998	AU 6608898 A	18-08-1998
		WO 9833004 A	30-07-1998
		EP 0956470 A	17-11-1999
WO 9213982 A	20-08-1992	EP 0570456 A	24-11-1993
		JP 6505303 T	16-06-1994
		US 5441764 A	15-08-1995
DE 19651197 A	19-06-1997	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82