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(71) Applicant *(for all designated States except US)*: **NEL TECHNOLOGIES LIMITED** [GB/GB]; Westway Industrial Park, Throckley, Newcastle Upon Tyne Tyne and Wear NE15 9HW (GB).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **FERGUSON, Patrick** [GB/GB]; 22 Wenlock Drive, North Shields Tyne and Wear NE29 9HD (GB).

(74) Agents: **NAYLOR, Matthew** et al.; Mewburn Ellis LLP, York House, 23 Kingsway, London, Greater London WC2B 6HP (GB).

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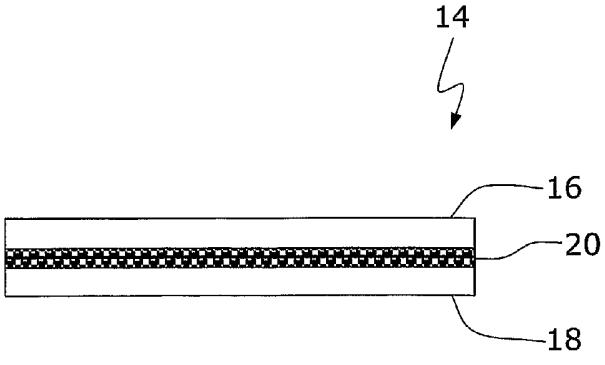
(54) Title: FUNCTIONAL HEATER FOR FORMED COMPONENTS



(57) Abstract: A heater element for formed components is disclosed, along with the final formed component itself. The heater element is produced by photochemically etching a suitable heater track pattern from porous metallised fabric such a nickel coated woven polyester. The heater element is located within a mould. Thermo-formable material is then applied to the mould and the final component is shaped according to the shape of the mould. The final component has a heater element located within it. The component may have microencapsulated agents for initiation by operation of the heater element. Furthermore, the final component may have one or more digital images printed onto the surface for the purposes of decoration or personalisation.

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FUNCTIONAL HEATER FOR FORMED COMPONENTS

BACKGROUND TO THE INVENTION

Field of the invention

The invention relates to a formed component heater element. In a preferred embodiment it relates to a porous flexible heater and associated functional chemical delivery system for incorporation into formed components.

Related art

The designs of various active heating systems, capable of evolving heat in response to an energy input are known. These systems incorporate electrically conductive materials in sheets, wires or filaments as heating elements. Such elements generate heat when carrying an electrical current. The ability to incorporate such elements into products varies greatly depending on the element type and the typically operating temperature of the element in use. In the case of heating products made using forming techniques such as casting, calendaring, pressing or compression, extrusion and injection moulding, the heating elements used are typically trace elements which comprise insulated conductive wires, yarns and filaments. Examples of such products include

undertile heaters used in flooring applications and toilet seat heaters.

SUMMARY OF THE INVENTION

The present inventor has realised that there is a need for a versatile, low cost, flexible heater which is capable of reliably being incorporated into formed components made from polymeric and other formable materials.

Accordingly, in a first aspect, the present invention provides a formed component heater element formed from flexible metallised fabric.

Preferably, the heater element is porous.

The heater element can be utilised in numerous product applications. Suitable product applications include, for example, wall tiles, plasterboard, floor tiles, toilet seats, insect repellent traps, air fresheners etc.

Preferably, the heater element is formed by etching (e.g. photochemical etching) of metallised mesh. Subsequently, the heater element may be incorporated as an integral part of the formed component during the product manufacturing process.

Details of the construction, manufacture and heating performance of a suitable flexible, porous etched metallised fabric heater are described in WO03/053101, the content of which is incorporated by reference in its entirety. WO03/053101 claims priority from UK Patent Application No. 0228999.9, filed 14 December 2001.

Conveniently, the metal coating is nickel, although any suitable resistive metal can be used. The mesh may have one of various weave types. The threads of the mesh may have various diameters up to 1000 microns. The thread counts may be between 5 and 1500 per cm. The metal coating may be of various weights per square metre which can be applied to the mesh by various coating techniques.

The material used in mesh production can be any suitable material which has a softening point in excess of the temperature of that used in the end product manufacturing process, and the desired operating temperature of the heater in the formed product.

The open porous nature of the heater element allows the flow of materials during the end product manufacturing process. This allows the substantial elimination of trapped air to provide intimate contact with the materials used in the product.

The heater is typically connectable by the use of a suitable connector to a battery or mains voltage supply and can deliver significant thermal energy to the component.

The width, length and shape of the etched heater track can be selected during manufacture from a wide range so as to optimise the heater element performance or to provide differential heating.

Preferably, the heater element has termination pads. These are at the end of the etched track and allow connection of the heater element to a battery/control system, which may be stored in the formed component or elsewhere.

The termination pads for the track or tracks may be formed on the fabric at an elongate flexible tail portion of the fabric. In this way, the heat-generating tracks may be connected to a suitable power supply via the termination pads at the tail portion. This avoids the need for conventional wires to be trailed through the formed component from the power supply to the fabric heater embedded in the formed component.

Preferably, the heater element is capable of being controlled to regulate the rate of heating and/or its maximum heat output. Regulation can be achieved either manually via a suitable control device e.g. incorporating a surface mounted thermistor or automatically by limiting the resistance of the heater itself.

If required, differential heating can be achieved in the formed component by appropriate adjustment of the heater element geometry.

The heater element is intended to be incorporated into formed components by the component manufacturer without the need for major modifications to the construction and design of existing equipment.

In another aspect of the invention, there is provided a formed component having incorporated in it a heater element according to the first aspect of the invention.

The present inventor has realised that the present invention may have a further advantage over known formed components. It is preferred to incorporate functional chemicals or agents into a formed component according to an embodiment of the invention, said functional chemicals being ones that are capable of being initiated by operation of the heater element.

Preferably, the invention provides a formed component as set out above having heat-activatable agents for release due to heat generated by the heater element.

The chemicals (or agents) of interest include antimicrobials (for suppressing or killing microbiological activity, e.g. bacteria), insect repellants (for repelling insects such as mosquitoes etc.), fragrances and perfumes.

In a preferred approach, the chemicals (or agents) of interest are microencapsulated in microcapsules. Suitable microcapsules are those that melt at a particular initiation temperature. Alternative microcapsules are those that allow diffusion of the active chemicals through their walls to effect a slow release mechanism from the formed component. By appropriate temperature control, the heater element may then be used to initiate the delivery of such active chemicals or agents.

It will be understood that by the encapsulation of various active chemicals and the use of microcapsules having different thermal characteristics, the timing of the delivery of each chemical can be controlled as required. Normally, the microencapsulated components

will not form part of the heater element itself. Instead they will typically be contained within other parts of the formed component. The release of the chemicals is typically achieved using the heater, which is preferably adjacent the part containing the microencapsulated components.

When the material used for the formed component is a compatible polymer (e.g. polyamide, polyester or blends thereof), the formed component may be thermostatic printed (Registered Trade Mark) or dye sublimation printed in order to improve its aesthetic design and appearance for the purpose of personalisation. Ink jet printing can also be used for the same purpose. The high resolution digital imaging printing processes typically do not interfere with the performance of the heater unit.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the present invention are set out below by way of example, with reference to the accompanying drawings, in which:

Fig. 1 shows a schematic perspective view of a moulded toilet seat and lid. The toilet seat is according to an embodiment of the invention.

Fig. 2 shows a schematic cross-sectional view of part of a moulded toilet seat according to an embodiment of the invention.

Fig. 3 shows a scanning electron microscopy image (SEM) of a fracture surface of a formed component according to an embodiment of the invention.

Fig. 4 shows a scanning electron microscopy image (SEM) of a polished cross-section of a formed component according to an embodiment of the invention.

Fig. 5A shows an enlarged SEM secondary electron image of a part of the image shown in Fig. 4.

Fig. 5B shows an image corresponding to that of Fig. 5, but taken using elemental analysis (EDX) for nickel.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 shows a combination 10 of a toilet seat 14 attached via a hinge (not shown) to a toilet lid. Both the toilet seat and the lid are formed by compression moulding of urea formaldehyde (a thermoset polymeric material). Particularly preferred materials for compression moulding include urea formaldehyde, urea formaldehyde resin, melamine formaldehyde and

polypropylene. In alternative embodiments, these components are formed by injection moulding from thermoplastic materials.

The toilet seat 14 has a heater element 20 located within it. Part of the toilet seat 14 is shown in schematic cross-section in Fig. 2. Upper layer 16 and lower layer 18 of compression moulded thermoset urea formaldehyde retain the heater element mesh 20 in position. To form the toilet seat, the heater element 20 is located in a suitable mould and the material of layers 16 and 18 is compression moulded around the heater element. The porous nature of the heater element allows the material of layers 16, 18 to flow into the open pores of the heater, eliminating air bubbles in the heater element and ensuring good thermal contact between the heater element and the material of the layers 16, 18. In this way, the heater element is fully integrated into the toilet seat.

Fig. 3 shows an SEM image of a fracture surface of a heater element according to an embodiment of the invention embedded in compression moulded urea formaldehyde. The heater element is woven polyester coated with nickel. The part of the heater element shown in Fig. 3 protruding from the urea formaldehyde matrix is part of a conductive track. The continuous nickel coating on the threads is clearly visible. Other parts

of the heater element (not shown) will have had their nickel coating etched away, as described below. The sample of Fig. 3 was fractured by freezing it in liquid nitrogen and performing a brittle fracture on the sample.

Fig. 4 shows a similar sample to that of Fig. 3, but here the sample has been polished. Four threads of the heater element are shown in cross section, embedded in the urea formaldehyde matrix.

Fig. 5A shows a magnified view of the right hand thread shown in Fig. 4. Fig. 5A, like Figs. 3 and 4, is a secondary electron SEM image.

Fig. 5B is an image corresponding to that of Fig. 5A, except that this image was taken using EDX analysis, in a known way. The bright areas on the image correspond to areas having a significant concentration of nickel. It is clear that the nickel coating of the threads (for those parts of the heater element that have not been etched) survives the compression moulding of the component, so that the heater element is operational even after the compression moulding.

The way in which the heater element 20 is formed will now be set out.

Heater element 20 is formed by taking a nickel coated polyester woven fabric and cutting it to the desired shape. A suitable material is the commercially available metallised fabric Metalester (Registered Trade Mark), a woven electroless nickel plated polyester mesh. Such fabrics are available with a variety of thread thicknesses, thread spacings, type of weave and weight of nickel. Threads may typically have a diameter within the range 24 to 600 micrometers (microns), a thread count of between 4 and 737 per cm, and a metal coating of varying weight per square metre.

Suitable fabrics may be coated with a continuous layer of metal after manufacture, for example by sputtering, by chemical reduction or by electro-deposition, which results in total encapsulation of all the threads of the mesh in metal. In an alternative mesh, the individual warp and weft threads may be metallised prior to fabric production, for example by sputtering, by chemical reduction or by electro-deposition.

After selecting the desired metallised fabric and cutting it to the required shape, the desired track pattern is then photochemically etched from the fabric. This is done by first designing and generating a suitable phototool, in a way well known to the skilled person. Next, the fabric is mounted onto a hinged frame of brown

styrene board, so that the otherwise flimsy fabric can be more readily handled. The fabric is then cleaned with a commercial surface cleaning agent to assist in the adhesion of the photoresist. Then, the photoresist is applied, typically by dip-coating the fabric into a liquid photoresist to ensure application of the photoresist to all parts of the fabric by immersion.

Next, the fabric is exposed to a suitable image pattern of ultraviolet light from the phototool. This image is developed. The unrequired metal is then progressively etched away. Then, the photoresist is removed to leave the required metallic track shape for the heater element. These steps will be clear to the skilled person.

The heater element is formed with a flexible tail portion. The tail has conductive tracks formed in the same way as the remainder of the heater element. At the end of the tail are formed termination pads for electrical connection of the heater element to a suitable power supply and control circuitry.

A suitable power supply (not shown) is mains power, transformed to an appropriate voltage as necessary.

In a preferred embodiment, functional chemicals are incorporated into the toilet seat. These functional

chemicals are for initiation by operation of the heater element. Suitable chemicals include antimicrobials (to suppress or kill microbiological activity), insect repellents (to repel mosquitoes etc.), fragrances and perfumes. In a preferred approach such chemicals are microencapsulated in microcapsules, which melt at a particular initiation temperature or others, which allow diffusion of the active chemicals through their walls to effect a slow release mechanism within the formed component.

By appropriate temperature control, the heater element in the formed component for example may be used to initiate the delivery of the active chemicals. It will be understood that by the encapsulation of various active chemicals and the use of microcapsules having different thermal characteristics, the timing of the delivery of each chemical can be controlled as required. Normally, the microencapsulated components will not form part of the heater element itself rather they will be contained within the component material, e.g. in layer 16 and /or layer 18. The release of the chemicals is however achieved using the heater.

For a specific example of a microencapsulated insect repellent, the microcapsules of US-A-20030124167 are applied to a surface layer of the formed component.

Suitable materials for encapsulating suitable agents include lipids such s wax, paraffin, tristearin, stearic acid, monoglycerides, diglycerides, beeswax, oils, fats and hardened oils.

Suitable perfumes and fragrances are known. These may be encapsulated in wax, for example.

Suitable microencapsulated fragrances are available from Celessence International, of Hatch End, Pinner, Middlesex, HA5 4AB, UK.

In a further preferred embodiment, one or more high resolution digital images are applied to the formed component (in this case, a toilet seat). This can improve the aesthetic design and appearance for the purpose of personalisation. Suitable methods for application of such digital images include thermostatic printing (Registered Trade Mark) or dye sublimation if the component is composed of a compatible polymer (e.g. polyester PBT) or has a suitable polymer coating (e.g. acrylic, polyester, polyurethane etc.). Alternatively, the product may be ink jet printed directly for the purpose of decoration. These high resolution digital imaging printing processes do not interfere with the

performance of the formed component with or without a heater element.

The embodiments above have been described by way of example. Modifications of these embodiments, further embodiments and modifications thereof will be apparent to the skilled person on reading this disclosure and as such are within the scope of the invention.

CLAIMS:

1. A formed component heater element formed from porous flexible metallised fabric, for use in a formed component.

2. A formed component heater element according to claim 1 formed by photochemical etching of the metallised fabric.

3. A formed component heater element according to claim 1 or claim 2 wherein the pattern of the heater element is selected so that a first part of the heater element provides a different heat output in use to that of a second part of the heater element.

4. A formed component heater element according to any one of claims 1 to 3 having a thermal protection device to provide temperature control of the heater element.

5. A formed component heater element according to claim 4 wherein the thermal protection device is a surface mounted thermistor.

6. A formed component heater element according to any one of claims 1 to 5 wherein the metallised fabric is coated with a continuous layer of metal.

7. A formed component heater element according to any one of claims 1 to 6 wherein the fabric comprises yarns and/or fibres, the individual yarns or fibres being encapsulated in metal prior to manufacture of the fabric.

8. A formed component heater element according to any one of claims 1 to 7 wherein the fabric is any one of woven, non-woven, knitted, a laminated composite, pressed felt, braid.

9. A formed component heater element according to any one of claims 1 to 8 wherein the fabric is woven from polyester threads and the metal is nickel.

10. A formed component heater element according to any one of claims 1 to 9 having termination pads for connection of the heater element to a battery/control system.

11. A formed component heater element according to any one of claims 1 to 9 having a flexible fabric connection member for protruding from the final formed component so as to provide connection of the heater element to a battery/control system.

12. A formed component incorporating a heater element according to any one of claims 1 to 11.

13. A formed component according to claim 12 wherein the heater element is formed integrally with the remainder of the formed component.

14. A formed component according to claim 12 or claim 13 having heat-activatable agents for release due to heat generated by the heater element.

15. A formed component according to claim 14 wherein the agents are selected from antimicrobials, insect repellents, fragrances, perfumes.

16. A formed component according to claim 14 or claim 15 wherein the agents are microencapsulated in microcapsules.

17. A formed component according to claim 16 wherein the microcapsules melt at an initiation temperature.

18. A formed component according to claim 16 wherein the microcapsules allow diffusion of the agent through their walls to effect a slow release mechanism from the formed component at an initiation temperature.

19. A formed component according to any one of claims 12 to 18 selected from wall tiles, plasterboard, floor tiles, toilet seats, insect repellent traps and air fresheners.

20. A method of manufacturing a shaped component including the steps of moulding a formable material around a heater element according to any one of claims 1 to 11 to locate the heater element within said shaped component.

21. A method according to claim 20 further including the step of printing an image onto the surface of the shaped component.

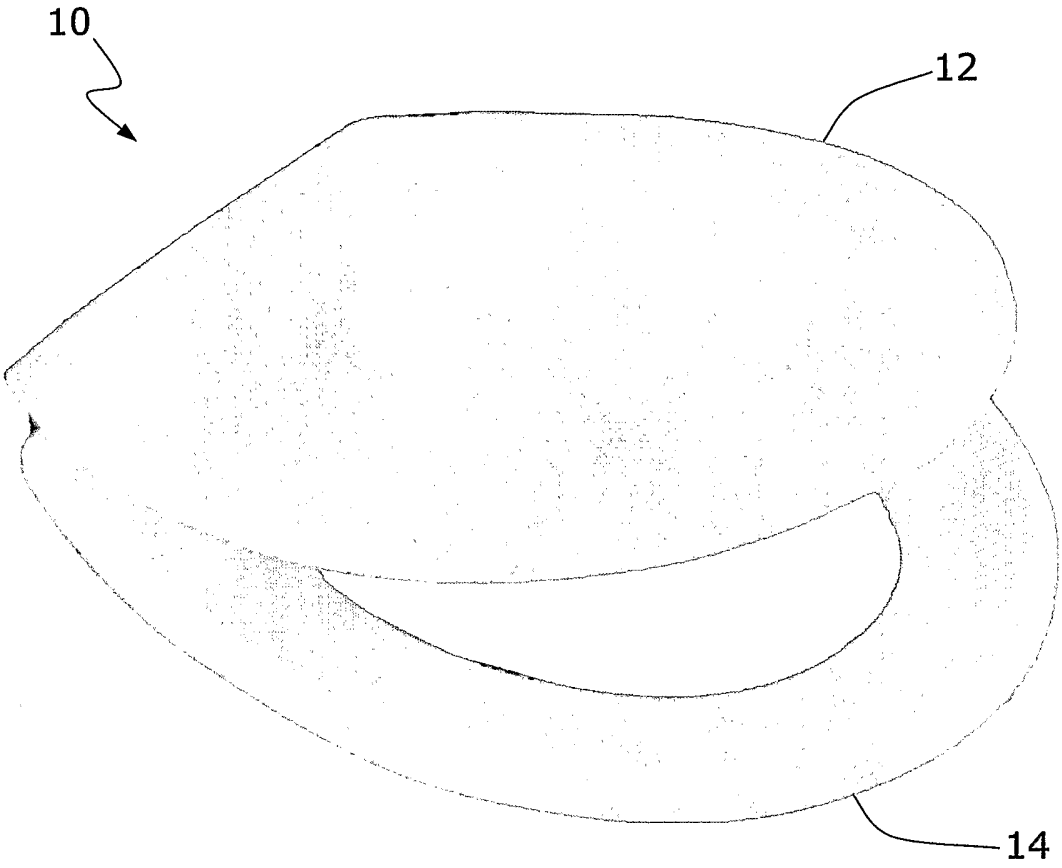


Fig. 1

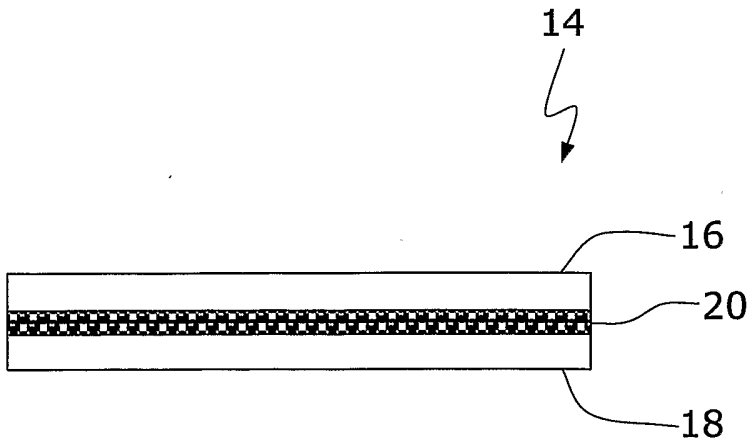


Fig. 2

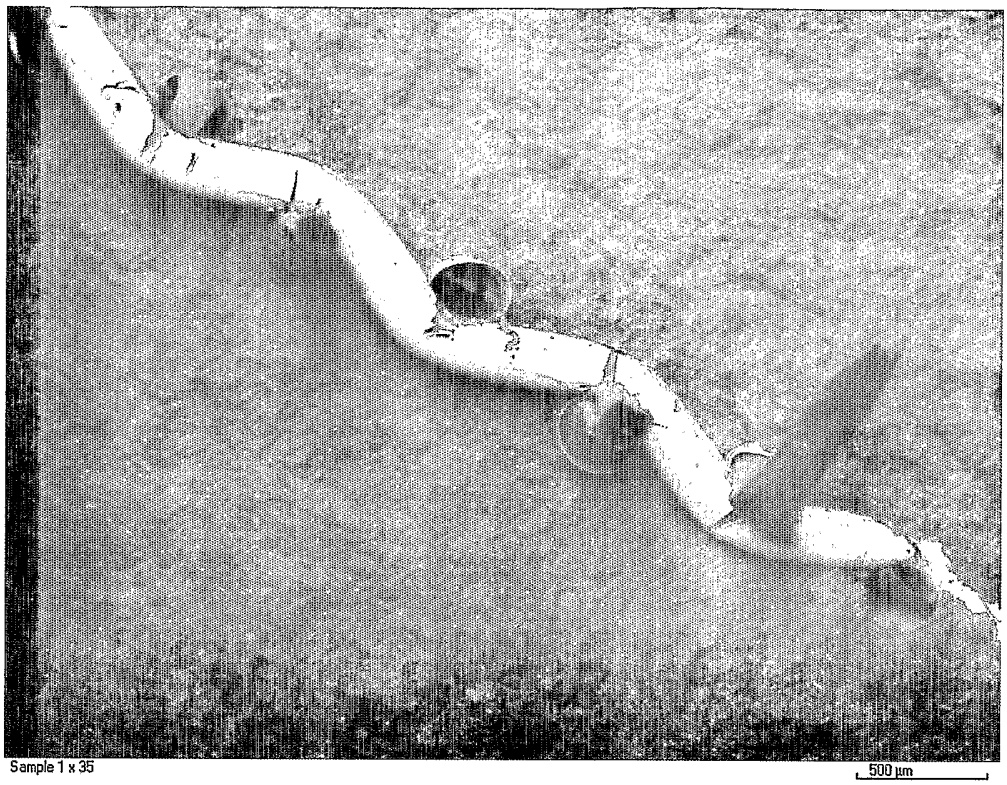
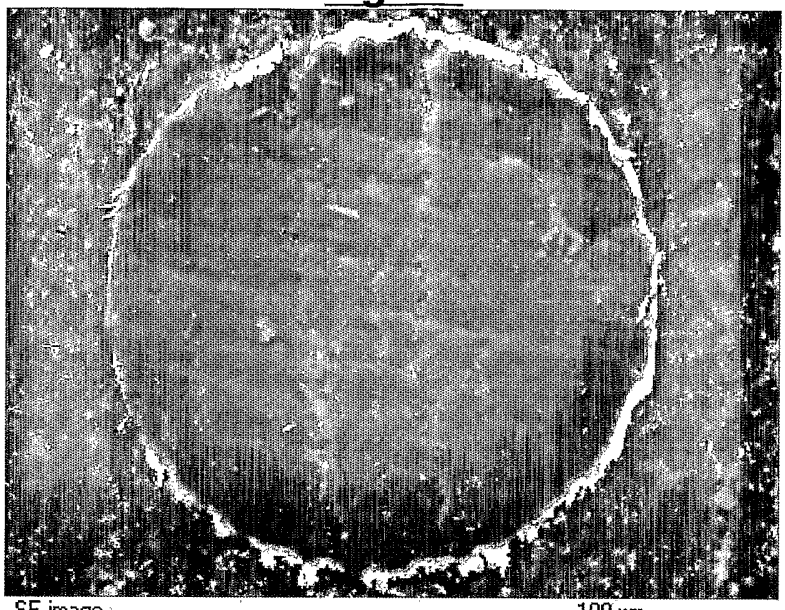


Fig. 3

Fig. 4

Fig. 5A



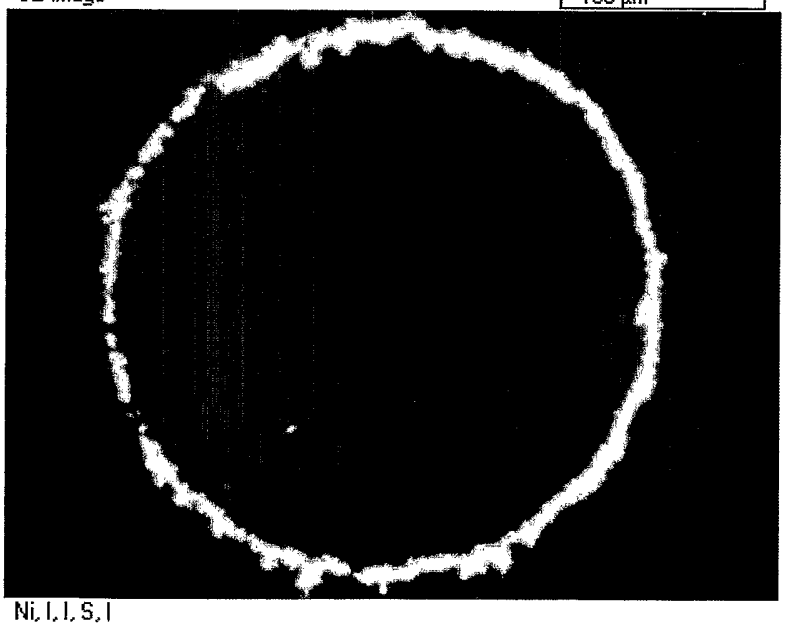


Fig. 5B

INTERNATIONAL SEARCH REPORT

ational Application No
PCT/GB2004/002335

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H05B3/34 A61L9/16 A61K7/46

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 7 H05B A61L A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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

[X] Patent family members are listed in annex.

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

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Date of the actual completion of the international search	Date of mailing of the international search report
17 August 2004	26/08/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Gea Haupt, M

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INTERNATIONAL SEARCH REPORT

	national Application No
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