(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 084 948 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.03.2001 Bulletin 2001/12

(51) Int Cl.^{7}: **B63B 59/04**

(21) Application number: **99440252.7**

(22) Date of filing: **17.09.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(71) Applicant: **Kvant, Magnus**
67470 Niederroedern (FR)

(72) Inventor: **Kvant, Magnus**
67470 Niederroedern (FR)

(54) Method for inhibiting fouling of an underwater surface

(57) A long-lasting, practical, effective and economic method of rendering a surface antifouling properties is achieved by attaching very thin copper-containing sheets directly to said surface. It was found, surprisingly and contrary to common belief, that such very thin sheets, because of their low weight, flexibility and feeble thickness, could be made to follow any shape so closely, that many commercially available water-resistant adhesives are sufficient to exclude water from penetrating in-between the surface and the copper containing sheet so that said sheets are basically held in place by the hydraulic pressure exerted on the sheet, once the structure is submerged.

The new method avoids all the disadvantages of the more common use of toxic paints, as the surface will have a lower degree of roughness, be smear-free, offers long-term protection, much reduces the environmental hazards and further protects the surface from other effects of its contact with water.

EP 1 084 948 A1

Description

Background of the Invention

[0001] The problem of preventing the biological growth on ships' hulls, so called fouling, is a serious one with a considerable economic impact. This growth of biological films, shells, algae and other species constitute a major drawback in as much as it adds significantly to the water resistance, reducing speed and adds to the overall costs of propagation. Unhindered growth may also lead to damage of the hull, causing pitting and corrosion. Thus, over the years, several methods have been found to counteract this growth and effectively prevent it. Although effective these methods still prove insufficient with regards to durability and long time efficiency, environmental safety, health and security for the people carrying out the work of preparing the operation of protection as well as further aspects of overall economics.

Antifouling paints.

[0002] Today the most common method of antifouling constitutes of painting the hull with paint containing one or several toxic substances. Such toxic substances are typically based on copper, tin or more recently also biocides having a low solubility in water thus leaching only slowly. Substances of high toxicity have been used but their use has been shown to pose unacceptable environmental hazards and they have consequently been banned from use in many countries. Thus today practically all antifouling paints are based on copper-containing and copper-containing derivatives. The above mentioned high toxicity products had the advantage of being effective over a range of years whereas the copper-containing based paints in realty rapidly loose so much of its potency that a new layer of paint have to be applied mostly every year.

[0003] As the toxic pigments or components are imbedded in a paint matrix, its rate of leaching is not constant. The layer exposed to the water is first exhausted, later followed by deeper laying layers. For this reason the antifouling paints becomes less and less effective with exposure time. This is particularly true for pleasure boats, many of which spend most of their time at rest at their moorings. Hence the antifouling is subdued to little attrition and the active antifouling components have to diffuse through the paint layer to reach the water.

[0004] To compensate for the loss of antifouling efficiency with time, the paint matrix is frequently made of components permitting the release of the toxic substance when in contact with water. The matrix thus assumes an open structure actually absorbing the water. This inevitable and necessary property of constituting an open structure strongly reduces the paints protective qualities in all other respects than its antifouling properties. It is well known that such paints offer no protection against so called "osmosis", the uptake of water by the polyester laminate, frequently being the preferred material for boat construction. The antifouling paints, equally, offers no or very poor additional protection of the hull against mechanical chocks.

[0005] Also, antifouling paints, because of its open structure, are mat, giving the underwater surface a rough finish. This roughness, which is in the order of 250 microns, adds significantly to the water resistance and the cost of propelling the vessels.

[0006] The work involved in repainting a ship or boat is a cumbersome one. First the boat or ship has to be docked or lifted out of water by means of a crane or similar device. Secondly, it has to be cleaned thoroughly. This is frequently done by high-pressure water jets or by brushing. Any residual shell or algae growth has to be removed separately or manually. After drying, a refurbishing of the primary layer of protective paint may be necessary followed by the application of one or several new coats of antifouling paint. The annual cost for this operation is considerable, with inconvenience and immobilisation of the vessel not mentioned.

[0007] The use of antifouling paints is highly questionable also from another, environmental, point of view. As the hulls need to be repainted regularly, they have to be cleaned and rinsed prior to the application of a new coat of antifouling paint. Such cleaning is frequently performed with the boat standing on land. Pleasure boats, for instance, are assigned the same area for "winter" storage every year and it's here that the cleaning takes place. It goes without saying that such an area becomes heavily polluted from the yearly accumulation of antifouling paint residues and that such a practice poses a potential risk to the surrounding environment and to the health of people staying there.

[0008] A further inconvenience with antifouling paints is its property to smear on contact. Whilst the boat in water, any contact with the antifouling paint will cause smearing of the object with the paint leaving patches that are difficult to remove. Many have had their ropes, fenders and bathing suits destroyed by contact with antifouling paint.

[0009] It is clear that a whole range of serious drawbacks and disadvantages accompanies the use of antifouling paint. Its abundant and common use is solely explained by the present lack of practical alternatives.

Other methods.

[0010] Before the evolution of shipbuilding permitting to use materials like steel, aluminium or various plastics, hulls were made of wood. The underwater parts were protected by covering the hull beneath the water line by nailing sheets of copper by the use of copper nails to the wooden hull. Experience using steel nails rapidly proved fatale as the steel nails corroded away within short and the sheets ran the risk of falling off. The copper-containing plates were thick, to be handled and hence heavy. However, the antifouling effect was very satisfactory indeed not to say outstanding. Its antifouling properties lasted unchanged, year after year.

[0011] With the arrival of steel hulls the use of copper-containing plates became impracticable as no reliable and yet sufficiently uncomplicated way of attaching the plates to the hull had been developed. As late as in the 1980es, though, full-scale tests were made using a welding technique, which is reported to have been successful. (Review ***of Copper-containing-Nickel Alloy Sheathing of Ship Hulls and Offshore Structures,*** Dale T. Peters, Copper-containing Development Association). No fouling could be detected after several years of use and the plates had only lost about 10 microns of its thickness per year in spite of its exposure to the high speeds and prolonged harsh conditions accompanied with the activities of commercial vessels.

[0012] Thus, the use of copper-containing plates is known to constitute an efficient way of protecting underwater surfaces against fouling. Until now, however, its use has been hampered by the lack of methods of bonding the copper-containing plates to the surfaces. Yet, some attempts have been reported to enable the bonding of copper-containing plates to the underwater parts. These reported methods all include the prior bonding of the copper-containing plates to some supporting sheet or layer.

[0013] Two Japanese patents (EP0562441 and EP0562442) describe a way of using copper or copper beryllium sheets as antifouling primarily for tubes. The patents claim that the use necessitates the attachment of an "insulating layer" to the copper sheets. The composite nature of this product hampers its application on complicated shapes like boot hulls. No reference was given to the thickness of the sheets, or to the nature of the bonding.

[0014] The US patent US4987036 describes a method trying to overcome the problem of using copper-containing sheets to surfaces for their protection against fouling. Also this method necessitates the prior bonding of the copper-containing sheets to a supporting structure, made of a mesh, grid or an elastic material, for subsequent bonding of this laminate, using exclusively a curable neoprene rubber, to the surface to be protected. This method overcomes the problem of covering curved shapes by first bonding, to the above mentioned supporting structure, narrow copper or copper nickel sheets **comprising a plurality of individual strips of copper or a copper-nickel** alloy in the form of substantially parallelogram in shape.

[0015] It appears that the problem, which has not yet been overcome, is the direct bonding of copper-containing sheets to surfaces exposed to water and fouling conditions, such as ship or boat hulls. To add to the problem, copper is a rather heavy metal with a density of 8.8 kg/l. A plate of 4 mm thickness, which was often used during the above-mentioned full-scale tests, thus weighs a full 35 kg/m2. This considerable weight adds to the complications of assuring a firm bonding of the copper-containing sheet to the surface to be sheeted. The use of epoxy or polyurethane patty also proved unsatisfactory in the above-mentioned study ***(Review of Copper-containing-Nickel Alloy Sheathing of Ship Hulls and Offshore Structures,*** Dale T. Peters, Copper-containing Development Association).

[0016] Thus until now, in spite of the colossal economic impact such a practice would have, no method has been presented permitting the effective or commercial use of copper-containing sheets for antifouling purposes for complicatedly shaped surfaces like ship or boat hulls.

Description of the invention.

[0017] The present invention describes a method, a product and its application, permitting an effective and practical use of copper-containing sheets to counteract biological fouling on any surface including complicatedly shaped surfaces such as boat-or ship hulls in particular.

[0018] The method overcomes the difficulties of bonding copper-containing sheets to surfaces, curved in three dimensions.

[0019] The method also and additionally provides further protection of the underwater surfaces against damages caused by the surfaces contact with water such as so called osmosis and the method adds to the strength of the structure and its resistance to mechanical shock.

[0020] The use of the method further reduces the roughness of the hulls thus permitting improved fuel economy or higher speeds.

[0021] The protected surface, moreover, becomes essentially smear-free thus offering enormous advantages both when it comes to handling of the protected surface and the almost total absence of environmental impact when cleaning.

[0022] The method provides protection from fouling over a period of several years.

[0023] In fact the solution to be previously described problems is the following : by the use of very soft and very thin copper-containing sheets, yet thick enough to last several years under harsch marine conditions and to give long-term protection against fouling, these sheets can successfully be shaped and bonding to any surface without the use of welding, fasteners like nails or prior bonding to insulating layers, supporting films or structures. Equally, the use of such thin sheets avoids the otherwise necessary use of narrow strips to cover complicated shape. The thin copper-containing sheets bonded to the surface form with the said surface an essentially homogeneous surface composites.

[0024] As thin copper-containing sheets are lightweight its bonding to the surfaces to be protected becomes much less complicated. Such thin sheets are basically held in place by the action of the hydraulic pressure exerted on it by the water, provided that no water is allowed to trickle in between the sheets and the hull.

In fact this idea permit the use of most commercially available water resistant adhesives suitable for the bonding of copper-containing onto the surface in question to be protected. These copper-containing sheets are so light-weight that the pressure exerted by the depth of water helps to keep them in place, easing the strain in the bonding adhesive.

Detailed description of the invention :

[0025] It was felt that not enough consideration had been taken to ensure a practical use of copper-containing sheets for boat-or ship coating. Thus a copper-containing sheet must be so soft to be able to follow the geometry of the surface to be sheeted regardless of its shape. Hence a very thin sheet or foil indeed should be used. To ensure a permanence bonding to the surface to be sheeted, it must in fact be so soft as to form essentially water-tight agglomerate with the surface so that no or very little water may trickle in between the copper-containing sheet and the surface.

[0026] Copper-containing materials are heavy and thick plates may not become sufficiently bonded to withstand its tendency to fall down by its own weight. Also this is avoided using very thin sheets or foils. Such thin sheets may basically be held in place by the hydrostatic pressure exerted on them by the water pressure, provided that essentially no water is permitted to enter between the surface to be protected and the copper-containing sheet itself. Such close contact can be achieved by the use of one or several commercially available adhesives.

[0027] However, the sheets must not be too thin. They should of course be sufficiently thick so as not to corrode away too quickly, making the use impractical. As it has been reported that, under realistic conditions on commercial vessels, the rate of corrosion is in the order of 10 pm per year, the practical absolute minimum thickness would be some 10 μm.

[0028] The copper-containing sheets must additionally have properties such as to permit its firm bonding to the surface to be sheeted. Also this is facilitated by the use of very thin and soft sheets. Copper-containing materials have a high thermal expansion coefficient, which differs much from that of the materials normally used for ship- and boat hulls. A thin and soft copper-containing sheet exerts less global strain on the bonding than a thick one as the temperature changes.

[0029] Likewise, which has been totally neglected in previous attempts, the surface to be coated must also be prepared so as to enable its sheathing. Also this aspect is covered by the new invention. Then, the adhesive means used to bond the sheets to the surface must have a high bonding power between the copper-containing sheets and the surface to be treated.

[0030] Finally, to be practical, the sheathing must be reversible, i.e. some day, eventually, all hulls must be refurbished and the removal of the sheathing must not be virtually impossible, risk to destroy the hull itself or otherwise cause damage to it. One aspect of the new invention takes full account of this must important aspect.

[0031] In one aspect of the present invention, thin soft copper-containing sheet or foil is bonded directly, without the need of supporting films or structures, to the curved surfaces to be protected by the use of any commercially available adhesive suitable for the water resistance bonding of copper-containing sheets onto the surface to be protected. Because of the softness and the low weight of such thin copper-containing foils, the strain on the bonding is low and the bonding itself, with the proper selection of adhesive, becomes stronger than the foil itself. The practical thickness of the foils was found to be in the range of 20 to 250 μm, preferably between 10 and 100 μm.

[0032] In a further aspect of the invention, thin copper-containing sheets or foils can be prepared in advance with a water resistance adhesive, which can be activated at a later time when the actual sheathing has to take place. Such adhesives can be of any of the types found among the group of "tapes", known under the commercial names "SCOTCH", "TESA", etc. Such adhesives are frequently derivatives of acrylics but the invention is in no way limited to the use of such acrylics as any water resistant adhesive can be used. The foils may thus be prepared in advance to form a composite tape where the adhesive side would covered by a so-called release cover to be removed just prior to the sheathing. Also other suitable adhesives can be used as those activated by heat, solvents or other methods.

[0033] In yet another aspect of the invention, thin copper-containing sheets can be used to constitute an integral part of a ship's or boat's hull. Boats made of glass fibre reinforced resins, like polyester, epoxy etc. are produced by laminating the fibreglass with the resin in moulds. When the laminate has hardened and cured, the mould is removed and the hull is then fitted with such further details as to make it complete. The bottom must then be painted with antifouling. However, the present invention facilitates the completion of the hulls. In this aspect of the invention, the copper-containing sheet is first placed on the part later of the mould later to hold the underwater part of the hull, then the laminating proceeds as usual, taking into full account to use a laminating resin having a sufficient adhesion to the copper-containing foil. When the laminate has hardened and cured and the mould has been removed, the hull already has its underwater part sheathed with the copper-containing sheet. In this way the finished hull will have an incorporated antifouling treatment. The same technique can be used for any item, produced in moulds and which should possess antifouling properties

[0034] In one especially efficient aspect of the invention, the copper-containing sheets are mounted to the surface in such a way as not to expose any edge of copper-containing sheet to the main direction of the water flow. This may be achieved by ensuring to overlap the sheets "downstream" thus effectively reducing the risk of the sheets being peeled off by the action of the flow of water over the surface when the vessel is making headway.

Example 1.

[0035] It was surprisingly found that copper-containing foil as thick as typically 100 micron of the soft quality, supplied by the company Outokompu, Västeras, Sweden could be shaped to follow any curvature present on boat hulls. This thickness would correspond to about ten years of heavy use, a considerable advantage compared to antifouling paint practice of repainting mostly every year. The roughness of the copper-containing foil was in the order of 5 microns.

[0036] It was also surprisingly found that this relatively thin foil, after having been cleaned from grease, loose oxides and dust, permitted a strong adherence to surfaces using simple "contact" glue", commercially available from the Companies 3M, Henkel and others.

[0037] Thus a surface (in the form of a centreboard keel) was sheathed using the above-mentioned method. To ensure an optimal adherence, the surface to be protected was prior to the sheathing painted using a two component polyurethane paint Several such paints are commercially available. It was not considered vital to use polyurethane paints and any water-resistant paint giving a reasonably even and smooth surface would give the same result.

[0038] This surface was subdued to severe testing including twenty cycles of consecutive freezing and prolonged, 48 hours, exposure to 40 °C warm salt-water. The surface was equally subjected to 80 bar water jet cleaning. Neither of these conditions led to any visual separation of the copper-containing foil from the surface.

[0039] Then the surface was mounted under water on a boat in order to evaluate its properties under real conditions. After one full year of service no sign of release or separation was to be detected and the surface remained essentially free of fouling.

Example 2.

[0040] It was even more surprising to find that, using such copper containing foil as in example 1, even so called "sticking tape" (known commercially as Scotch, Tesa etc.) provided sufficiently strong bonding.

[0041] The surface to be protected was first prepared in the same way as in example 1 but using a glossy paint.

[0042] Normally boat and ship hulls are painted on their underwater parts using mat primer paints, which offers a better base for the subsequent application of antifouling paints. However, it was found that copper-containing sticking tape adhered just as well to glossy paint.

[0043] As the paint had cured, the surface of the hull to be studied was first clad with the double-sided tape (so called adhesive transfer tape available from the company 3M) making sure to cover the entire underwater surface and a band some decimetres above the waterline. The protective film facing the outside was left in place.

[0044] Then after successive removal of the protective film, the copper-containing-containing foil was pressed firmly, against the adhesive tape by the aid of a rubber roller. Care was taken not to enclose any air under the copper-containing-containing foil. Thus the work proceeded until the entire surface, to be studied, was covered. Although glossy paint was used in this example, the invention is in no way limited to the use such paint as also mat paint gives satisfactory results.

[0045] The fact of using a sub millimetre sheet, which was not heavy, made the work possible giving a most satisfactory result essentially without wrinkles. In fact, a ship or boat hull must be very smooth and even so as to exert the minimum of resistance when the ship makes way.

The boat was then launched.

[0046] The water exerts a hydrostatic pressure (depending on the depth beneath the water surface) on the hull. As the copper-containing-containing sheathing was so thin and the fact that its weight was only 0.88 kg per m2 the hydrostatic pressure actually counteracted the weight of the copper-containing sheathing so that in theory no further bonding would be required under static conditions, which explains why such a relatively unqualified adhesive turned out to have sufficient bonding strength. However, a boat or ship does not stay at rest and the water swirling by, when the hull makes headway, exerts a force on the sheathing. To avoid "peeling" off of the sheathing, it was applied in such a way as to ensure that all overlapping of the sheets was done "downstream" i.e. the surface was clad from stem to bow.

[0047] In one case, a band of such metal tape remained firmly attached to the boat hull after 17 full years!

[0048] It thus appears to be much less complicated than generally thought to adequately bond copper-containing-containing sheets to a boat or ship hull.

[0049] The copper-containing-containing sheet could be easily removed by heating the sheet by means of a hot air gun and a scraper.

Example 3.

[0050] As in example 1, the surface to be sheeted was first prepared by proper cleaning, sanding and painting with a polyurethane paint.

[0051] Separately, a copper-containing sheet, 100 microns thick and from the same supplier, had been washed and treated to ensure the removal of grease and loose oxides. After drying, the double-sided transfer tape was applied to the copper-containing sheet, leaving the protective outer film intact.

[0052] The protective film was then removed and the copper-containing sheet, with its transfer tape, was pressed against the surface of the boat hull by means of a rubber roller.

[0053] Also this procedure gave a most satisfactory result.

Example 4.

[0054] The surface to be protected was prepared in the same way as in example 1, 2 and 3. The surface was then coated with a heat sensitive adhesive tape, available from 3M Company. Such tapes perform like ordinary tapes but their bonding properties can be much improved on heating the substrate after the initial bonding. Thus the copper-containing sheet was applied in the same way as in example 1 and 2 but the surface was later heated using an electrically heated "iron" device so as to cure the bonding according to 3M's specifications.

[0055] This treatment resulted in an equally solid bonding. Subsequent attempts to remove the sheathing, with the aim of simulating a major overhaul, proved difficult, as the bonding was very firm indeed. New sheathing could therefore be made on top of the existing one.

Example 5.

[0056] A mould, normally used for the production of boat structures, was first clad with the thin copper foil on the part to be under water in the finished hull. Then, on top of the copper foil, this area was laminated using epoxy resin and a thick glass fibre weave, commercially readily available. The lamination then proceeded using resin and fibre glass in the usual manner until the part was finished. After release from the mould, the part of the structure, to be submerged, was thus shethed with the copper foil.

Claims

1. A method of durably and lastingly protect a surface in contact with water from biological fouling and at the same time protecting it from other effects associated with its contact with water characterised by the application onto the surface of a thin copper-containing sheet or foil, the softness of the copper-containing sheet or foil permitting a water-tight and close bonding to any surface, forming an essentially homogeneous surface composite, essentially free of cavities.

2. A method according to claim 1, characterised in that the thickness of said copper-containing sheet or foil is less than 0,2 mm, preferably between 10 and 100 µm.

3. A method according to any of the claims 1 and 2, characterised in that said thin copper-containing sheet is held in place by basically the hydraulic water-pressure exerted on any submerged surface and is applied to the surface by a suitable adhesive means able to exclude penetration or trickle of water between the surface to be protected and the copper-containing sheet or foil, thus maintaining the hydraulic pressure on the surface.

4. A method according to the preceding claim, characterised in that the said adhesive means is chosen amongst the adhesives having a high bonding power between the copper-containing sheet or foil and the surface to be treated.

5. A method according to any of the preceding claims, characterised in that the surface to be sheathed is rendered, prior to its sheathing, essentially even and smooth so that the copper-containing sheet or foil can be bonded closely and directly to the surface, thus excluding any cavities or channels permitting the water to trickle in between the sheets and the surface to be protected.

6. A method according to any of the preceding claims, characterised in that the copper-containing sheet or foil, as part of the bonding operation, prior to its attachment to the surface, is on one side coated with an adhesive able to be activated, thus forming a composite with the copper-containing sheet or foil, for subsequent sheathing of the surface to be protected.

7. A method according to the preceding claim, characterised in that the said adhesive is of the type "self-adhesive tape".

8. A method according to the claim 7, characterised in that the self adhesive tape is a two-sided adhesive tape.

9. A method according to any of the preceding claims, characterised in that said thin and soft copper-containing sheet or foil is applied to the surface by means of a mechanical device able to exert a pressure on the sheet or foil sufficient to ensure a close bonding essentially free of cavities.

10. A method according to the preceding claim, characterised in that the said mechanical device is a rubber roller.

11. A method according to any of the preceding claims, characterised in that the cooper-containing sheet or

foil having been bonding to the surface is further bonded to the surface by application of heat under pressure so as to enhance the close bonding.

12. A method according to any of the claims 1 and 2, characterised in that a surface is sheathed with the said cooper-containing sheet or foil by placing the sheet or foil in a mould, to be later included in a resin laminate with its cuprous side facing the side intended to be exposed to the water.

13. A method according to any of the preceding claims, characterised in that the sheathing is made in a manner ensuring that overlapping sheets or foils are joined without the outer layer facing the direction of the current thus reducing primarily the risk of peeling and secondly the strain on the bonding.

14. Application of the method of the preceding claims to the protection of ship's hulls.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 44 0252

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)
X	FR 2 256 072 A (ZONDEK KLAUS) 25 July 1975 (1975-07-25) * the whole document * ---	1-11,13, 14	B63B59/04
X	DE 129 753 C (JEBE PETER) 13 March 1902 (1902-03-13) * the whole document * ---	1,3,6,9, 14	
X	FR 2 628 701 A (ZIBOROFF PAUL) 22 September 1989 (1989-09-22) * the whole document * ---	1,4,13, 14	
X	GB 2 179 271 A (NICHIBAN KK) 4 March 1987 (1987-03-04) * page 2, line 22 - line 30 * ---	1,5	
A	US 3 154 460 A (GRANER WILLIAM) 27 October 1964 (1964-10-27) * column 3, line 18 - line 28; figure 1 * ---	1,12	
A	WO 82 02525 A (MARINE BIO GUARD SYSTEMS INC ;MITCHELL FREDERICK CHARLES (GB)) 5 August 1982 (1982-08-05) * the whole document * -----	1	TECHNICAL FIELDS SEARCHED (Int.Cl.7) B63B C09D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22 February 2000	Zaegel, B

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 44 0252

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-02-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2256072 A	25-07-1975	NONE	
DE 129753 C		NONE	
FR 2628701 A	22-09-1989	NONE	
GB 2179271 A	04-03-1987	JP 1054397 B	17-11-1989
		JP 1572596 C	25-07-1990
		JP 62041280 A	23-02-1987
		AU 593007 B	01-02-1990
		AU 6160686 A	26-02-1987
		CA 1272002 A	31-07-1990
		DE 3628150 A	26-02-1987
		DK 387686 A	20-02-1987
		FR 2586216 A	20-02-1987
		HK 100689 A	29-12-1989
		IT 1197098 B	25-11-1988
		KR 9209282 B	15-10-1992
		MX 167273 B	08-03-1993
		NL 8602093 A	16-03-1987
		SG 66289 G	26-01-1990
		US 4814227 A	21-03-1989
US 3154460 A	27-10-1964	NONE	
WO 8202525 A	05-08-1982	GB 2095169 A	29-09-1982
		AU 8002782 A	16-08-1982
		EP 0069746 A	19-01-1983

EPO FORM P0459

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