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(54) **Title:** VISCO-ELASTIC MEMORY FOAM WITH FUNCTIONS OF ANTI-BACTERIA, DEODORIZATION AND FAR INFRARED RAYS EMISSION

(57) **Abstract:** A memory foam with excellent antibacterial activity, deodorant property and far infrared ray radiation is disclosed. The memory foam is produced by mixing 75~98% by weight of polyurethane, 1~13% by weight of an inorganic porous material and 1~13% by weight of an inorganic antibacterial agent powder, and molding the mixture into the memory foam. The memory foam has an antibacterial activity and deodorant property, realized by inhibiting bacterial growth. In addition ,the memory foam has a far infrared ray radiation capable of promoting blood circulation and metabolism by radiating far infrared rays to the human body. Furthermore, the memory foam can be easily produced with improved hygiene and a simple production method, compared to conventional memory foams containing cottonwool therein . Accordingly, the memory foam can be used for household articles, articles for physical exercise, clothes, shock-absorbent cushions, pillows, etc.

VISCO-ELASTIC MEMORY FOAM WITH FUNTIONS OF ANTI-BACTERIA, DEODORIZATION AND FAR INFRARED RAYS EMISSION

Technical Field

The present invention relates to a memory foam with excellent antibacterial activity, deodorant property and far infrared ray radiation, and more particularly to a memory foam having an excellent antibacterial activity, deodorant property and far infrared ray radiation that can be produced by mixing polyurethane with a mineral and an antibacterial agent and molding the mixture into the memory foam. The memory foam can be used for bedclothes, articles for physical exercise, pillows, shock-absorbent cushions, etc.

Background Art

In general, urea-generating bacteria and *Staphylococcus aureus* which ingest bodily secretions including sweat, waste matters, etc., as nutrients cause various skin diseases on susceptible areas of the skin. These bacteria are very harmful to the human body. In addition, excretions from the bacteria involve in the catabolism, thereby generating ammonia gas. The generated ammonia gas leads to formation of an unpleasant odor as well as results in the embrittlement or discoloration of fibers and textiles. Accordingly, there is a need for a memory foam capable of imparting antibacterial activity to household articles such as pillows and cushions.

Recently, functions of far infrared rays in various products, e.g., electric heaters, driers, beds, and the like, are gaining worldwide recognition. When the far infrared rays penetrate deeply into the human body, they oscillate water molecules in the human body and further oscillate cell tissues. This oscillation of cell tissues results in temperature rise in the subcutaneous layer of the skin, expansion of blood vessels, promotion of blood circulation, cell activation, stimulation of enzyme formation, etc. Further, the far infrared rays are effective for promoting perspiration and metabolism, discharging waste matters in the body, and reducing pains. These beneficial effects in the human body are clearly supported by various scientific experiments. Accordingly, it is thought to be useful to impart the above-mentioned antibacterial activity, deodorant property and far infrared ray radiation to a memory foam.

From a material perspective, since conventional memory foams are produced by foam-molding polyurethane or simply inserting cottonwool therein, it is impossible to prevent malodor generation and bacteria proliferation due to the presence of sweat.

Disclosure of the Invention

Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide a memory foam which has an antibacterial activity and deodorant property, realized by inhibiting bacterial growth.

It is another object of the present invention to provide a memory foam containing a far infrared ray radiating material capable of promoting blood circulation and metabolism by radiating far infrared rays to the human body. At this time, the far infrared rays radiated from the material are obtained from ambient heat.

It is yet another object of the present invention to provide a method for producing a polyurethane foam which can sustain far infrared ray radiation, antibacterial activity and deodorant property over a long period of time and can be produced in a simpler manner. The memory foam thus produced has advantages in terms of improved hygiene and a simple production method, compared to conventional memory foams containing cottonwool therein.

To achieve these objects, there is provided a memory foam produced by mixing 75~98% by weight of polyurethane, 1~13% by weight of an inorganic porous material and 1~13% by weight of an inorganic antibacterial agent powder, and molding the mixture into the memory foam.

Hereinafter, the memory foam according to the present invention will be explained in detail.

In general, polyurethane foam used for medical beds, etc., is referred to as a memory foam, shape memory foam or slow recovery foam. Such polyurethane foam can be easily produced by melting polyurethane, followed by a molding process. This is considerably advantageous in the producing process, compared to conventional memory foams using cottonwool. The polyurethane foam takes a longer time to recover its original its shape than conventional sponge materials. In addition, the polyurethane foam responds to body temperature and pressure to remain its compressed shape at the contacted part. Furthermore, the polyurethane foam gently supports a user's neck and waist and distributes weight from the pressure points into various directions.

The polyurethane used in the present invention is a resin widely used in the art. When polyurethane is added in an amount of more than 75% by weight based on the total weight of the memory foam, it is difficult to mold into the memory foam. When polyurethane is added in an amount of less than 98% by weight, sufficient antibacterial activity and deodorant property are not expected.

The inorganic porous material which is present in an amount of 1~13% by weight refers to charcoal and/or any other porous mineral. The use of the inorganic porous material in the present invention is based on a microporous structure. The porous material adsorbs bad smells- and malodor-causing molecules.

Charcoal, preferably activated charcoal is made of oak. The charcoal used in the present invention preferably has an specific surface area of 100~500m^2/g and a particle diameter of 1~5μm.

Common activated charcoal has an internal surface area of 300 square meters per one gram of activated charcoal. On the other hand, activated carbon has a microporous structure which amounts to a total surface area of 3,500 square meters. The pores in the microporous structure enable the activated charcoal or activated carbon to adsorb a variety of microbes, bacteria and malodor-causing molecules. The activated charcoal consists of 80% carbon and other minerals (calcium (Ca), sodium (Na), iron (Fe), magnesium (Mg), phosphor (P), and the like.). As such, charcoal contains many minerals that a plant absorbs from soil. The minerals contained in the plant are further concentrated during the pyrolysis of the plant. In addition, the microporous structure of charcoal is already known to have dehumidifying ability, antiseptic effect, anion emitting effect, and the like. Accordingly, the memory foam according to the present invention is expected to exhibit these effects, in addition to antibacterial activity and deodorant property.

The memory foam according to the present invention can include various porous minerals as the inorganic porous material, instead of charcoal. The porous minerals used in the present invention may be natural or synthetic minerals. Since the porous minerals have a microporous structure like charcoal, they exhibit deodorant property. In addition, since the surface of the porous minerals bears positive charges, bacteria and microbes having negatively charged cell walls are adsorbed to the surface of the porous minerals. Accordingly, the porous minerals result in antibacterial activity and deodorant property. In particular, among the minerals, bioceramic is known to have various effects including far infrared ray radiation, antibacterial activity, deodorant property, electromagnetic wave shielding, ultraviolet ray shielding, adsorptivity, dehumidity, anion emission, and the like.

Examples of the porous minerals used in the present invention include dyscrasite, corundum, rutile, manganite, azurite, malachite, kernite, glauberite, monazite, tantalite, colemanite, brochantite, apatite, turquoise, phenakite, calcite, dolomite, galena, halite, fluorite, diamond, sphalerite, chalcocite, pyrrhotite, marcasite, polybasite, crysoberyl, ilmenite, brookite, columbite, euxenite, glauconite, samarskite, gibbsite, brucite, diaspore, boehmite, hydromagnesite, celadonite, riebeckite, arfvedsonite, anthophyllite, nepheline, anorthoclase, orthoclase, microcline, albite, cancrinite, marialite, dipyre, mizzonite, meionite, thomsonite, laumontite, mordenite, mellite, flagstaffite, phophyry, hornblende, zircon, muirite, jades and stones, shells, tourmaline, clinochlore, prochlorite, thuringite, kaolinite, antigorite, amesite, cronstedtite, halloysite, sanidine, heulandite, stilbite, phillipsite, acanthite, enargite, cryolite, hydrozincite, natron, borax, alunite, sepiolite, epsomite, uranophane, talc, pyrophyllite, paragonite, muscovite, margarite, phlogopite, biotite, lepidolite, zinnwaldite, stilpnomelane, beidellite, montmorillonite, montdorite, ilmenite, boracite, lazulite, carnotite, phenakite, willemite, forsterite, pyrope, grossular, andradite, almandine, silicates, andalusite, kyanite, mullite, topaz, staurolite, chloritoid, suanite, chondrite, humite, sphene, datolite, gadolinite, thortveitite, melilite, saponite, vermiculite, penninite, johannite, prochlorite (lepidolite), chamosite, chrysotile, palygorskite, clinoptilolite, hewellite, evenkite, amber, lawsonite, ilvaite, hemimorphite, clinozoisite, epidote, allanite, zoisite, pumpellyite, vesuvianite, benitoite, cordierite, tourmaline, dioptase, clinoenstatite, pigeonite, diopside, hedenbergite, pyroxene, spodumene, jadeite, aegirine, aegirine augite, enstatite, bronzite, hypersthene, tremolite, common hornblende, glaucophane, rhodonite, prehnite, tridymite, coesite, analcime, leucite, microcline feldspar, marialite, scolecite, hulsite, harmotome, chabazite, apophyllite, olivine, janggunite, magnesite, etc.

Among these porous minerals, phyllosilicate group (pyrophyllite: $Al_2Si_4O_{10}(OH)_2$)); muscovite group (paragonite: $NaAl_2(Al,Si_3)O_{10}(OH)_2$, muscovite: $KAl_2(AlSi_3)O_{10}(OH)_2$, glauconite: $(K,Na)(Al,Fe_3^{+}Mg)_2(Al,Si)_4O_{10}(OH)_2$, celadonite: $K(Mg,Fe)(Fe_3^{+},Al)Si_4O_{10}(OH)_2$, margarite: $CaAl_2(Al_2Si_2)O_{10}(OH)_2$, micaschist, lepidomelane: KFeAlSiO(OH,F)); biotite group (phlogopite:

$KMg_3(AlSi_3)O_{10}(F,OH)$, lepidolite: $K(Li, Al)_3(Si, Al)_4O_{10}(F,OH)_2$, zinnwaldite: $KLiFe^{+2}Al(Al,Si_3)O_{10}(F,OH)_2$, stilpnomelane: $K(Fe^{+2},Fe^{+3},Al)_{10}Si_{22}O_{30}(OH)_{12})$; montmorillonite group (beidellite: $(Na,Ca_2)0.03Al_2(Al,Si)_4O_{10}(OH)_2\cdot nH_2O$, montmorillonite: $(Na,Ca)0.33(Al,Mg)_2Si_4O_{10}(OH)_2\cdot nH_2O$, nontronite: $Na0.33Fe^{2+}{}_3(Al,Si)_4O_{10}(OH)_2\cdot nH_2O$, saponite: $(Ca/2,Na)0.33(Mg,Fe)_3(Si,Al)_4O_{10}(OH)_2\cdot 4H_2O$, vermiculite: $(Mg,Fe,Al)_3(Al,Si)_4O_{10}(OH)_2\cdot 4H_2O)$; chlorite group (penninite, clinochlore: $(Mg,Fe^{2+})_5Al(Si,Al)_4O_{10}(OH)_8$, prochlorite: $(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_8$, chamosite: $(Fe^{2+},Mg,Fe^{3+})_5Al(Si_3Al)O_{10}(OH,O)_8$, thuringite); and serpentine group (kaolinite: $Al_2Si_2O_5(OH)_4$, antigorite: $(Mg,Fe)_3Si_2O_5(OH)_4$, chrysotile: $Mg_3Si_2O_5(OH)_4$, amesite: $(Mg_2Al)(AlSi)O_5(OH)_4$, cronstedtite, halloysite: $Al_2Si_2O_5(OH)_4\cdot 2H_2O$, palygorskite: $(Mg,Al)_2Si_4O_{10}(OH)\cdot 4H_2O)$ are more preferable in terms of their relatively excellent antibacterial activity and deodorant property.

Further, members of tourmaline group and garnet group are effective in improving far infrared ray radiation. As one member of the tourmaline group can be exemplified dravite. Dravite is an aluminum-magnesium-silicate complex and typically has a composition of SiO_2: 80%, Al_2O_3: 5.16%, Fe_2O_3: 1.1%, TiO_2: 0.11%, CaO: 0.36%, MgO: 6.37%, K_2O: 4.2% and Na_2O: 0.39%.

As other members of the tourmaline group, there are tourmaline, schorl, elbaite, buergerite, feruvite, foitite, liddicoatite, olenite, povondraite, uvite, etc.

Specific examples of the garnet group include almandite and almandine, which are iron-aluminum-silicate complexes, and typically have a composition of SiO_2: 37%, Al_2O_3: 20%, Fe_2O_3: 32%, MnO_2: 2%, MgO: 8%, CaO: 2.5%, TiO_2: 2%.

These complexes help remove toxins existing in human body, particularly in the blood, and aid in attaining deep sleep mode.

In addition to almandite and almandine, other members of the garnet group include andradite, pyrope, rhodolite, grossular, spessartite, etc.

In accordance with the present invention, charcoal and/or the inorganic porous material are/is present in an amount of 1~13% by weight, based on the total weight of the memory foam. When the amount is less than 1% by weight, antibacterial activity and deodorant property of the memory foam are insufficient. When the amount exceeds 13%, miscibility with other components is unsatisfactory, which leads to low strength and moldability of the memory foam.

In accordance with the present invention, the memory foam according to the present invention further comprises at least one inorganic antibacterial agent selected from the group consisting of silver, calcium phosphate and zeolite in an amount of 1~13% by weight, based on the total weight of the memory foam.

In particular, silver is known to be effective in improving antibacterial activity and shielding electromagnetic waves. Silver used herein is added in the form of powder having a particle size of a few nanometers. When the amount of silver present in the memory foam is less than 1% by weight, electromagnetic wave shielding drops. When the amount exceeds 13% by weight, electromagnetic wave absorption is improved but the physical properties of the memory foam deteriorate. Like silver, zeolite and calcium phosphate in the form of powder having a particle size of a few nanometers are added in an amount of 1~13% by weight, respectively. When the amount is out of this range, antibacterial activity and physical properties of the memory foam are unsatisfactory.

The memory foam according to the present invention can further comprise an aromatic component for masking the odor of the polyurethane. The aromatic component is obtained by injecting a natural liquid fragrance into a microcapsule. The microcapsule can be made of conventional polymers so as to control the amount of the natural liquid fragrance released. Examples of the natural fragrance include lavender, pine fragrance and the like.

The amount of the aromatic component added to the memory foam is suitably within the range of 0.5~1.5% by weight based on the total weight of the memory foam. If the natural liquid fragrance is directly injected into the memory foam, the duration of the emitted fragrance is relatively short. On the contrary, when the natural liquid fragrance is encapsulated, the natural liquid fragrance can be sustainedly released.

The memory foam according to the present invention is produced by homogeneously mixing melted polyurethane resin with the inorganic porous material and inorganic antibacterial agent powder, and press molding the mixture into the memory foam. The press molding is carried out using a conventional process and apparatus well known in the art, but is not particularly limited thereto.

In an antibacterial test for *Staphylococcus aureus*, it was shown that a textile produced by hygienically treating with the memory foam had a reduction rate of over 99.9%. In addition, in a deodorization test, it was observed that the textile had a deodorization rate of over 97% (after 30 minutes). This observation suggests that the microporous structure of charcoal and/or porous minerals contained in the memory foam contribute to the deodorant property.

Furthermore, the memory foam according to the present invention absorbs ambient heat such as from a body's temperature and then emits far infrared rays.

Generally, the wavelength of infrared rays is within the range of 0.76~1000μm. Within this wavelength range, the wavelength of 4~16μm corresponds to far infrared rays. The far infrared rays are known to have function capable of giving comfort and warmth to humans. Since the wavelength of far infrared rays is equivalent to the oscillatory wavelength of water molecules, resonance absorption in the water molecule occurs, thereby increasing the oscillation of the water molecule. As a result, effect and massage effects are resulted. These effects have many beneficial influences on the human body, e.g., temperature rise in the subcutaneous layer of the skin, expansion of fine blood vessels, promotion of blood circulation, reinforcement of metabolism, removal of obstacles to aid blood circulation, and the like. In a test for far infrared ray radiation, the memory foam according to the present invention showed a radiation rate of more than 89% at a wavelength of 5~20μm at 37℃. In a thermal imaging test, the measured value in a untreated polyurethane foam was 23℃; whereas the measured value in the memory foam according to the present invention was 24.9℃. That is, the temperature of the memory foam according to the present invention was higher than the conventional memory foam by about 2℃.

In an anion-emitting test, the memory foam according to the present invention was determined to have an emission rate of 340 ions/cm^3. The anion emitted to the human body helps maintain a constant blood pressure and assists in respiration.

Best Mode for Carrying Out the Invention

Hereinafter, the present invention will be described in more detail with reference to the following examples. However, these examples are given for the purpose of illustration and not of limitation.

Example 1

First, 40g of jades (nephrite, emerald, jadeite, sapphire and ruby) and 60g of micas (muscovite, biotite and phlogopite) were pulverized to pass through a 325-mesh sieve. The pulverized mixture was calcinated at 800℃~1,200℃ to remove impurities, and was then finely pulverized to obtain a powder having a maximum particle diameter smaller than 1 micron. To the powder was added 30g of a mixture of silver, zeolite and calcium phosphate. The resulting mixture was added to 900g of polyester, melted, and press molded at 283± 1℃ to produce a memory foam.

Example 2

A memory foam was produced in the same manner as in Example 1, except that 100g of montmorillonites (beidellite, montmorillonite, nontronite, saponite and vermiculite) were used instead of jades and micas.

Example 3

A memory foam was produced in the same manner as in Example 1, except that 100g of serpentines (kaolinite, antigorite, chrysotile, amesite, cronstedtite, halloysite and palygorskite) were used instead of jades and micas.

Example 4

A cushion was produced in the same manner as in Example 1, except that 100g of a mixture of acanthite, polybasite, jamesonite, boulangerite and realgar was used instead of jades and micas.

Example 5

A cushion was produced in the same manner as in Example 1, except that 100g of a mixture of monazite, lazulite, carnotite, chloritoid and chondrodite was used instead of jades and micas.

Example 6

A pillow was produced in the same manner as in Example 1, except that 80g of jades and micas and 20g of tourmaline were used.

Example 7

A cushion was produced in the same manner as in Example 1, except that 80g of jades and micas and 20g of almandite were used.

Test results on the products produced in Examples 1~7 are shown in Table 1 below.

Table 1

Examples	Radiation rates of far infrared rays Maximum values (5-20μm)	Thermal imaging test (℃)	Reduction rates of bacteria	Deodoration efficiency
Example 1	89.3	24.9	99.9%	61%
Example 2	89.2	25.7	99.9%	80%
Example 3	89.2	27.4	99.9%	86%
Example 4	89.0	23.7	99.9%	88%
Example 5	90.2	26.3	99.9%	88%
Example 6	91.4	27.4	99.9%	96%
Example 7	90.2	27.1	99.9%	96%

· Test strain for antibacterial activity: *Staphylococcus aureus* ATCC 6538

· In the thermal imaging test, the measured value of untreated polyurethane foam was 23℃.

· Deodorization efficiency was measured after 30 minutes.

Industrial Applicability

As can be seen from the foregoing, the memory foam according to the present invention has excellent antibacterial activity and deodorant property, realized by inhibiting bacterial growth. In addition, the memory foam according to the present invention has a far infrared ray radiation capable of promoting blood circulation and metabolism by radiating far infrared rays to the human body. Furthermore, the memory foam according to the present invention can be easily produced with improved hygiene and a simple production method, compared to conventional memory foams containing cottonwool therein. Accordingly, the memory foam according to the present invention can be used for household articles, articles for physical exercise, clothes, shock-absorbent cushions, pillows, etc.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

Claims:

1. A memory foam produced by mixing 75~98% by weight of polyurethane, 1~13% by weight of charcoal and/or an inorganic porous material and 1~13% by weight of an inorganic antibacterial agent powder, and molding the mixture into the memory foam,

wherein the inorganic porous material is at least one porous mineral selected from the group consisting of dyscrasite, corundum, rutile, manganite, azurite, malachite, kernite, glauberite, monazite, tantalite, colemanite, brochantite, apatite, turquoise, phenakite, calcite, dolomite, galena, halite, fluorite, diamond, sphalerite, chalcocite, pyrrhotite, marcasite, polybasite, crysoberyl, ilmenite, brookite, columbite, euxenite, glauconite, samarskite, gibbsite, brucite, diaspore, boehmite, hydromagnesite, celadonite, riebeckite, arfvedsonite, anthophyllite, nepheline, anorthoclase, orthoclase, microcline, albite, cancrinite, marialite, dipyre, mizzonite, meionite, thomsonite, laumontite, mordenite, mellite, flagstaffite, phophyry, hornblende, zircon, muirite, jades and stones, shells, tourmaline, clinochlore, prochlorite, thuringite, kaolinite, antigorite, amesite, cronstedtite, halloysite, sanidine, heulandite, stilbite, phillipsite, acanthite, enargite, cryolite, hydrozincite, natron, borax, alunite, sepiolite, epsomite, uranophane, talc, pyrophyllite, paragonite, muscovite, margarite, phlogopite, biotite, lepidolite, zinnwaldite, stilpnomelane, beidellite, montmorillonite, montdorite, ilmenite, boracite, lazulite, carnotite, phenakite, willemite, forsterite, pyrope, grossular, andradite, almandine, silicates, andalusite, kyanite, mullite, topaz, staurolite, chloritoid, suanite, chondrite, humite, sphene, datolite, gadolinite, thortveitite, melilite, saponite, vermiculite, penninite, johannite, prochlorite (lepidolite), chamosite, chrysotile, palygorskite, clinoptilolite, hewellite, evenkite, amber, lawsonite, ilvaite, hemimorphite, clinozoisite, epidote, allanite, zoisite, pumpellyite, vesuvianite, benitoite, cordierite, tourmaline, dioptase, clinoenstatite, pigeonite, diopside, hedenbergite, pyroxene, spodumene, jadeite, aegirine, aegirine augite, enstatite, bronzite, hypersthene, tremolite, common hornblende, glaucophane, rhodonite, prehnite, tridymite, coesite, analcime, leucite, microcline feldspar, marialite, scolecite, hulsite, harmotome, chabazite, apophyllite, olivine, janggunite, magnesite, and

the inorganic antibacterial agent is selected from the group consisting of silver, zeolite and calcium phosphate.

2. The memory foam as set forth in claim 1, wherein the inorganic porous material is at least one mineral selected from the group consisting of phyllosilicate group (pyrophyllite); muscovite group (paragonite, muscovite, glauconite, celadonite, margarite, micaschist, lepidomelane); biotite group (phlogopite, lepidolite, zinnwaldite, stilpnomelane); montmorillonite group (beidellite, montmorillonite, nontronite, saponite, vermiculite); chlorite group (penninite, clinochlore, prochlorite, chamosite, thuringite); and serpentine group (kaolinite, antigorite, chrysotile, amesite, cronstedtite, halloysite, palygorskite).

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC7 B68G 1/00, C08G 9/32

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)
IPC7 B68G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Patents and applications for inventions since 1975, Korean Utility models and applications for inventions since 1975, Japanese Utility models and applications for inventions since 1975

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2001/0042271 A1 (EdiZONE, LC) 22 NOVEMBER 2001 See the whole document	1
A	JP 06-143306 A (ARACO CORP) 24 MAY1994 See the whole document	1
A	JP 01-294724 A (NAKAYASHI FINE CHEM KK) 28 NOVEMBER1989 See the whole document	1
A	WO 99/42528 A (MNEMOSCIENCE GMBH) 26 AUGUST 1999 See the whole document	1

☐ Further documents are listed in the continuation of Box C.　　☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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