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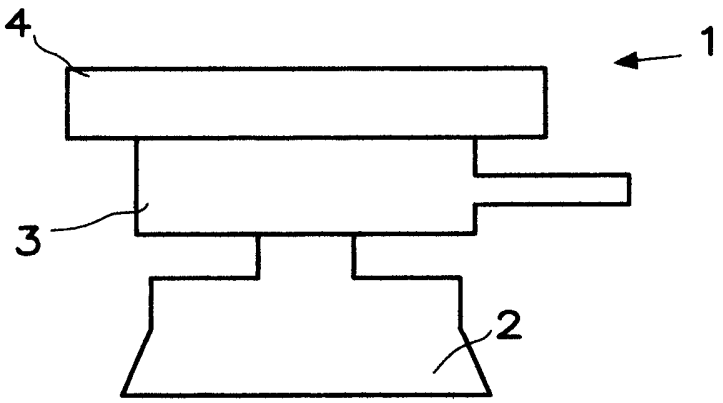
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(54) Title: GRIPPING DEVICE




(57) Abstract: A gripping device for handling at least one object, wherein the gripping device comprises an antimicrobial agent giving the surface of the gripping device an antimicrobial effect. The antimicrobial effect prevents bacterial growth on the surface of the gripping device. This ensures that the at least one object being handled by the gripping device is not contaminated by bacteria. The antimicrobial agent is either evenly distributed in the gripping device, arranged as a coating on the gripping device, or arranged as a modified surface on the gripping device.

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# Gripping device

## TECHNICAL FIELD

The present invention relates to a gripping device for handling at least one object. More particularly it relates to a gripping device for lifting or moving at least one object. A gripping device according to the invention is for example useful in areas, which require good sanitary conditions, such as in the food, the pharmaceutical, the biotechnology or the cosmetic industry.

## BACKGROUND ART

In certain industries there are great demands on hygiene. Those demands are usually regulated in legislation. Hygienic risks to the consumer of the product being processed have to be considered when designing machines and equipment for industries associated with hygienic risks. International standards are very general and applicable to all machines and associated equipment in applications where hygiene risks to the consumer of the product can occur, for example food, pharmaceuticals, biotechnology, and cosmetics.

A gripping device is used, for example in the food and the pharmaceutical industry, for lifting and moving objects. There are several different kinds of grippers used in the food and the pharmaceutical industry, both with contact and without contact to the object to be lifted. Examples of theses are vacuum grippers with suction cups, magnetic grippers, grippers with finger members and vacuum grippers without contact to the object to be lifted. The grippers are usually attached to an industrial robot, such as a pick and place robot, or above a conveyor belt in a production line.

A vacuum gripper usually comprises a housing with an attached suction cup for lifting and moving the object. The suction cup is connected to a vacuum source for creating a low pressure between the object to be lifted and the suction cup. The suction cup is usually made of a resilient material such as a polymer, for example polyurethane, silicone, chloroprene and nitrile-PVC.

Cleaning of parts that are in contact with the handled objects is carried out by washing the parts with detergents at predetermined intervals. Usually a complete stop in production is necessary for cleaning and disinfections operations.

In industries, such as the food and the pharmaceutical industry, there is a constant desire to improve the safety margins for the cleanliness of the parts that are in contact with, or in the vicinity of, the objects to be handled. There is also a demand to improve productivity and minimize the stops that are necessary for taking cleaning measures.

## SUMMARY OF THE INVENTION

The object of the invention is to provide a gripping device where the safety margins for keeping the gripper clean are improved.

This object of the invention is obtained by a gripping device according to the features in the characterizing part of the independent claim 1. Advantageous embodiments of the invention will be clear from the description below and in the dependent claims.

The object of the invention is achieved in that the gripping device comprises an antimicrobial agent. Preferably, at least the surface adapted to be in contact with the object to be handled comprises the antimicrobial agent.

An antimicrobial agent is a substance that kills or inhibits the growth of unwanted organisms, such as bacteria, yeast, fungi, algae, viruses and mould. The antimicrobial agent gives the gripping device an antimicrobial effect, which prevents the growth of unwanted organisms at the surface of the gripping device. This ensures that, for example, the food being handled by the gripper is not contaminated by microorganisms or biofilms.

Because the antimicrobial agent gives resistance to degradation and prevents bacterial growth it can lead to simplified washing and disinfecting measures and less detergent may be used, which saves the environment. Also the interval between cleaning may be extended or the cleaning may even be dispensed with.

By making the surface easier to clean, a more environmentally friendly detergent, than for grippers without an antimicrobial agent, may be used. Also, the safety margins when cleaning a gripper are improved.

Another advantage is that by extending the intervals for cleaning, the productivity is increased as usually a complete stop for production is necessary for cleaning and disinfection operations.

The antimicrobial agent is either distributed in the gripping device or a part thereof, arranged as a coating on the gripping device, or arranged as a modified surface on the gripping device.

According to an embodiment of the invention the antimicrobial agent comprises a metal in elemental form or in the form of a metal salt. For example, the antimicrobial agent is derived from an elemental metal or a metal compound selected from the group of silver metal, silver nitrate, silver sulfadiazine, silver oxide, and silver acetate. Preferably, the antimicrobial agent comprises metal ions. For example, the

metal ions are selected from the group of silver ions, copper ions and mercury ions. Such metal ions have been proven to have an antimicrobial effect. Silver ions are to prefer when the gripping device is to be used in the food industry.

According to an embodiment of the invention at least a part of the gripping device is made of a material including a portion of the antimicrobial agent. Preferably said portion of antimicrobial agent is between 0.1-10 wt%. Some antimicrobial agents are rather expensive. A portion of 0.1-10 wt% of antimicrobial agent provides the desired microbial effect of the gripping device and keeps the cost low for the microbial agent.

According to an embodiment of the invention, the antimicrobial agent is distributed in the material of the gripping device. This makes the manufacturing of the gripping device easy. However, only the antimicrobial agents that are in contact with the surface, or have the possibility to diffuse to the surface, have an antimicrobial effect on the surface.

According to an embodiment of the invention the gripping device is a vacuum gripper comprising a suction cup including a portion of the antimicrobial agent. For example the suction cup is made of a polymer comprising the antimicrobial agent. The antimicrobial agent is distributed in the polymer for a simple production of the suction cup.

According to an embodiment of the invention the gripping device is a magnetic gripper, wherein the gripper comprises a magnetic material comprising the antimicrobial agent. The antimicrobial agent is distributed in the magnetic material for a simple production of the gripper.

According to an embodiment of the invention the part of the gripping device, which is made of a material including a portion of the antimicrobial agent, is a coating on the gripping device. Preferably, the thickness of said coating is

in the interval of 0.1-150 µm. This embodiment is for example advantageous when an expensive antimicrobial agent is used, since less amount of antimicrobial agent is needed. The antimicrobial effect will be the same as for a gripping device having the antimicrobial agent distributed in the material of the gripping device, due to the fact that only the antimicrobial agents that are in contact with the surface, or have the possibility to diffuse to the surface, have an antimicrobial effect on the surface.

The coating is for example deposited on the gripper by one of the following methods; dipping, painting, spraying, printing, spin coating, electrolytic coating, electroless coating, Physical Vapor Deposition (PVD) or Chemical Vapor Deposition (CVD).

According to an embodiment of the invention the antimicrobial agent is arranged such that the metal ions are released at an essentially steady rate. This is advantageous since it provides an essentially steady concentration of antimicrobial agent at the surface of the gripper. For example the release of metal ions at an essentially steady rate is achieved by using an antimicrobial agent of a porous ceramic material comprising metal ions.

According to an embodiment of the invention the antimicrobial agent comprises an oxide derived from the group consisting of: titanium, zinc and tungsten. The oxide is, for example, titanium dioxide, zinc oxide or tungsten trioxide. The surface of a gripper comprising an oxide may easily be cleaned by exposing it to UV irradiation. Thereby highly reactive radicals, which are used in a photocatalytic reaction, are produced.

According to an alternative embodiment of the invention the antimicrobial agent comprises at least one halogen from the group consisting of: fluorine, chlorine, bromine and iodine.

According to a preferred embodiment, triclosane is used.

A gripper device according to an alternative embodiment of the invention comprises at least two finger members, where at least one of the finger members comprises the antimicrobial agent. The at least one finger member is either coated with the antimicrobial agent, or the antimicrobial agent is distributed in the material of the at least one finger member.

According to another embodiment of the invention the gripping device is adapted to be attached to an industrial robot. The robot is, for example, a pick-and-place or packaging robot. In pick and place operations with a robot the gripper tool is the only contact point of the robot with the objects to be handled. Consequently for robots in environments such as food and pharmaceuticals industry, where hygiene and cleanliness are of vital importance, it is essential to avoid microbial contamination by the gripper.

According to another embodiment of the invention, the surface of the gripping device is modified with an antimicrobial agent. A modified surface means that the outer layer of the gripper comprises the antimicrobial agent, while the inner part contains bulk material. For example the surface is modified with ion implantation. A modified surface has the advantages that there in no risk for it to flake of and lose material to the surrounding.

A gripping device according to the invention is particularly suitable for handling any of the following objects: food, pharmaceuticals or cosmetics.

A gripping device according to the invention is useful in the biotechnology industry.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be described in greater detail by description of embodiments with reference to the accompanying drawings, wherein

figure 1 schematically shows a vacuum gripper comprising a suction cup comprising an antimicrobial agent,

figure 2 schematically shows a gripper comprising two finger members having a coating comprising an antimicrobial agent, and

figure 3 shows a cross section through one of the fingers shown in figure 2 along a line A-A.

DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 shows a gripping device 1 according to an embodiment of the invention. The gripping device 1 comprises a suction cup 2 and is attached to a housing 3 connected to a vacuum source (not shown). The housing 3 is attached to a mounting plate 4 for attachment to a handling member, such as an industrial robot. The suction cup 2 is made of an elastic polymer and comprises an antimicrobial agent, for example a silver compound, evenly distributed in the polymer material. For example, the antimicrobial agent is one of the following silver compounds: silver nitrate, silver metal, silver sulfadiazine, silver oxide and silver acetate. The silver compounds are present in an amount of 0.1-10 wt%. During the use of the gripper the silver compound is released in a controlled way to the surface of the gripper and the surroundings of the gripper.

In another embodiment, the vacuum gripper comprises a suction cup made of an elastic polymer coated with an antimicrobial agent, such as a silver compound. The thickness of the coating is typically in the interval of 0.1-150 µm.

The antimicrobial agent may be added to a matrix material in order to achieve the antimicrobial effect. For example the agent is bound or buried in a ceramic or a polymer (resin) material. The agent is then subsequently released in a controlled fashion to its surroundings. If the agent cannot migrate/diffuse in the matrix is can instead be concentrated at the surface. For example a coating can be made of such a material.

In another embodiment, the gripper comprises an antimicrobial compound of an inert ceramic material comprising silver ions. Silver ions are released from the body at a slow and steady rate. Ambient moisture in the air causes low-level release that effectively maintains an antimicrobial surface on the gripper. When humidity increases and the environment become ideal for bacterial growth, more silver is released. The antimicrobial compound may be, for example, a commercial available antimicrobial compound such as AgION (trade mark).

Figure 2 show a gripping device 5 comprising two finger members 6, 7. The outer ends 8, 9 of the finger members are coated with a material including an antimicrobial agent. The gripping device is adapted to be attached to an industrial robot.

The coating is for example made of elastic polymer or durable paint comprising a portion of an antimicrobial agent in the interval of 0.1-10wt%. The antimicrobial agent is for example a metal in the form of elemental or in the form of a salt, a halogen or an oxide derived from the group consisting of: titanium, zinc and tungsten. Figure 3 shows an intersection through the finger member 6. The body 10 of the finger member 6 is provided with a coating 11 including an antimicrobial agent. The thickness of the coating is typically in the interval of 0.1-150 µm.

Since only certain preferred embodiments of the present invention have been described, many modifications and changes

will be apparent to those skilled in the art without departing from the scope of the invention, such as this is defined in the appended claims with support from the description and the drawing.

For example the antimicrobial coating may also be applied on other parts of the gripper not described above, i.e. parts in the vicinity of the object being handled, for example the housing holding the suction cups.

The antimicrobial agent can also be based on semiconductors (photocatalytic activity).

CLAIMS

1. A gripping device for handling at least one object, **characterized** in that the gripping device comprises an antimicrobial agent.

2. A gripping device according to claim 1, wherein the gripping device includes a surface adapted to be in contact with the object and said surface comprises said antimicrobial agent.

3. A gripping device according to claim 1 or 2, wherein the antimicrobial agent comprises a metal in elemental form or in the form of a metal salt.

4. A gripping device according to any of the preceding claims, wherein the antimicrobial agent comprises metal ions.

5. A gripping device according to claim 4, wherein said metal ions are selected from the group of silver ions, copper ions and mercury ions.

6. A gripping device according to any of the preceding claims, wherein the antimicrobial agent is derived from an elemental metal or a metal compound selected from the group of silver metal, silver nitrate, silver sulfadiazine, silver oxide, and silver acetate.

7. A gripping device according to any of the preceding claims, wherein at least a part of the gripping device is made of a material including a portion of said antimicrobial agent.

8. A gripping device according to claim 7, wherein said portion of antimicrobial agent is between 0.1-10wt%.

9. A gripping device according to claim 7 or 8, wherein the gripping device is a vacuum gripper and said part of the

gripping device is a suction cup including said portion of the antimicrobial agent.

10. A gripping device according to claim 8 or 9, wherein said part is made of a magnetic material.

11. A gripping device according to claim 8, wherein said part is a coating on the gripping device.

12. A gripping device according to claim 11, wherein the thickness of said coating is in the interval of 0.1-150 µm.

13. A gripping device according to claim 4, wherein the antimicrobial agent is arranged such that the metal ions are released at an essentially steady rate.

14. A gripping device according to claim 13, wherein the antimicrobial agent is of ceramic material comprising said metal ions.

15. A gripping device according to any of the preceding claims, wherein the antimicrobial agent comprises an oxide derived from the group consisting of: titanium, zinc and tungsten.

16. A gripping device according to any of the preceding claims, wherein the antimicrobial agent comprises at least one halogen from the group consisting of: fluorine, chlorine, bromine and iodine.

17. A gripping device according to claim 1, wherein the gripping device is a gripper comprising at least two finger members, where at least one of the finger members comprises the antimicrobial agent.

18. A gripping device according to any of the preceding claims, wherein the gripping device is adapted to be attached to an industrial robot.

19. A gripping device according to claim 18, wherein the robot is a pick-and-place or packaging robot.

20. Use of a gripping device according to any of claims 1-19 for handling any of the following objects: food, pharmaceuticals or cosmetics.

21. Use of a gripping device according to any of claims 1-19 in the biotechnology industry.

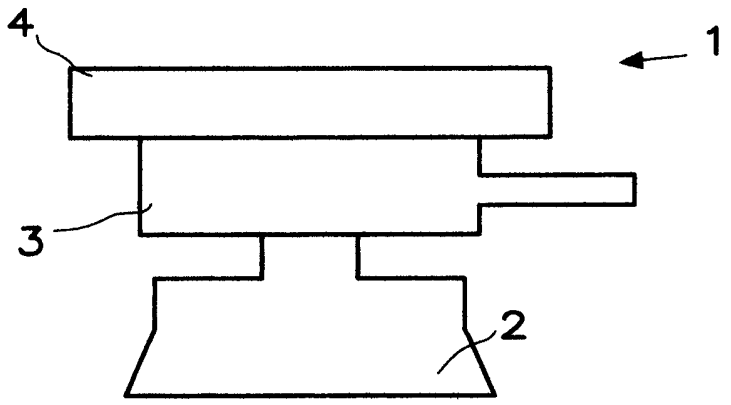



Fig.1

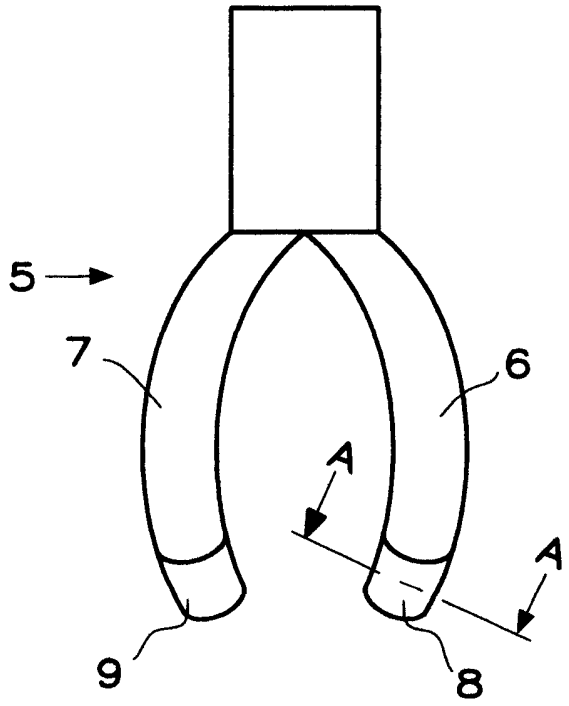



Fig.2

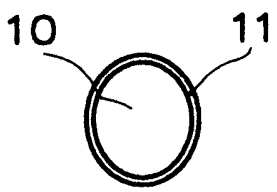



Fig.3

A–A

# INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/054324

A. CLASSIFICATION OF SUBJECT MATTER
A61L2/238 B65G17/32 B25J15/06 B25J15/08

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)
A61L B65G B25J

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)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | PATENT ABSTRACTS OF JAPAN<br>vol. 2002, no. 09,<br>4 September 2002 (2002-09-04)<br>& JP 2002 144268 A (MYOTOKU LTD),<br>21 May 2002 (2002-05-21)<br>abstract | 1-9,13,<br>18-21 |
| X | DE 103 05 142 A1 (RAHE, MARTIN)<br>19 August 2004 (2004-08-19) | 1-7,13 |
| Y | paragraphs '0007!, '0019!; claim 8;<br>figures | 11,12,<br>15,16 |
| X | GB 709 273 A (THOMAS HENRY SPICER)<br>19 May 1954 (1954-05-19)<br>page 2, line 73 - line 76 | 1-7,13,<br>17 |

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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 |
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| 16 November 2005 | 05/12/2005 |

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# INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/054324

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | EP 0 636 375 A (DEGUSSA-HUELS AKTIENGESELLSCHAFT) 1 February 1995 (1995-02-01) column 2, line 7 - line 43 | 10-12 |
| Y | US 2004/164571 A1 (PEDRAZZINI GIANANDREA) 26 August 2004 (2004-08-26) paragraphs '0001!, '0017! | 10 |
| Y | DE 102 31 459 A1 (NEUDECK, ANDREAS; BERNDT, ROLF-DIETRICH; AHLERS, HORST) 22 January 2004 (2004-01-22) paragraph '0005! | 15 |
| Y | DE 199 21 900 A1 (CREAVIS GESELLSCHAFT FUER TECHNOLOGIE UND INNOVATION MBH) 16 November 2000 (2000-11-16) column 2, line 59 - column 3, line 9 | 16 |
| A | DE 100 24 270 A1 (CREAVIS GESELLSCHAFT FUER TECHNOLOGIE UND INNOVATION MBH) 22 November 2001 (2001-11-22) paragraph '0038! | 14 |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP2005/054324

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| JP 2002144268 A | 21-05-2002 | NONE | |
| DE 10305142 A1 | 19-08-2004 | NONE | |
| GB 709273 A | 19-05-1954 | NONE | |
| EP 0636375 A | 01-02-1995 | DE 4324994 C1<br>JP 7051328 A | 23-02-1995<br>28-02-1995 |
| US 2004164571 A1 | 26-08-2004 | NONE | |
| DE 10231459 A1 | 22-01-2004 | NONE | |
| DE 19921900 A1 | 16-11-2000 | AU 3790100 A<br>CN 1361796 A<br>WO 0069933 A1<br>EP 1183289 A1<br>JP 2002544346 T<br>NO 20015530 A | 05-12-2000<br>31-07-2002<br>23-11-2000<br>06-03-2002<br>24-12-2002<br>07-01-2002 |
| DE 10024270 A1 | 22-11-2001 | AU 5632201 A<br>WO 0187998 A2 | 26-11-2001<br>22-11-2001 |