(12) **Oversettelse av europeisk patentskrift**

(11) **NO/EP 2468316 B1**

NORGE

(19) NO
(51) Int Cl.
A61L 27/54 (2006.01)
A61L 31/16 (2006.01)
B05C 1/06 (2006.01)
B05D 1/28 (2006.01)

Patentstyret

(21)	Oversettelse publisert	2017.01.23
(80)	Dato for Den Europeiske Patentmyndighets publisering av det meddelte patentet	2016.09.07
(86)	Europeisk søknadsnr	11009582.5
(86)	Europeisk innleveringsdag	2011.12.05
(87)	Den europeiske søknadens Publiseringsdato	2012.06.27
(30)	Prioritet	2010.12.23, DE, 102010055562
(84)	Utpekte stater	AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
(73)	Innehaver	Heraeus Medical GmbH, Philipp-Reis-Strasse 8/13, 61273 Wehrheim, DE-Tyskland
(72)	Oppfinner	Vogt, Sebastian, Dr., Gamstädter Weg 11, 99092 Erfurt, DE-Tyskland Büchner, Hubert, Dr., Mörickestrasse 13, 90491 Nürnberg, DE-Tyskland
(74)	Fullmektig	Zacco Norway AS, Postboks 2003 Vika, 0125 OSLO, Norge

(54) Benevnelse **Surface coating device**

(56) Anførte publikasjoner
WO-A1-2005/042045
WO-A2-2008/086794
US-A1- 2008 260 936
US-B1- 7 563 324

The invention relates to a device for coating a medical implant.

The coating of medical implants with pharmaceutical active ingredients has received increasing attention in recent years. A key requirement of coating methods is the antibiotic protection of the surface of implant materials. Another important requirement is the improvement of the surface compatibility of non-cementing medical implants for better growth of bone material.

The implantation of joint endoprostheses and also of osteosynthesis materials is always associated with a certain risk of microbial contamination. If microbial germs are able to settle on the implant surface, post-operative osteitis/osteomyelitis may occur. Osteitis/osteomyelitis is a serious complication for the patient and also entails considerable costs.

For decades, gentamicin-doped PMMA bone cement has been used with clinical success in cemented joint endoprostheses. The broad-spectrum antibiotic gentamicin, which is contained in the bone cement, protects the surface of the bone cement effectively against bacterial infections.

W02005/042045 A1 describes a method and a device for applying a defined quantity of a coating material to the surface of an implant by means of a pressure method. The coating is applied by means of a pressure roller.

US 7,563,324 B1 describes a device and a method for coating an implantable medical device, in particular a stent. The device includes a reservoir for the coating composition and an applicator for applying the coating composition. The coating composition is transferred from the reservoir to the applicator via a porous area.

WO 2008/086794 A2 relates to a method for coating catheter balloons with a defined quantity of a pharmacologically active substance, wherein the coating method uses a coating device which is provided with a volume measuring device for delivering a measurable quantity of a coating solution to the surface of the catheter balloon by means of a dispensing device.

US 2008/0260936 A1 describes methods for the selective coating of medical devices, such as expandable stents, wherein a coating is applied to the medical device and then distributed over the entire accessible surface.

In the case of non-cemented joint endoprostheses and osteosynthesis materials, a number of solutions have been proposed in order to also achieve local antibiotic protection of the implant surfaces.

Thus, for example, the use of antibiotic salts which are sparingly soluble in water has been described in several patents. By way of example, EP 0 623 349 A1, EP 1 470 829 A1, EP 1 374 923 A2, DE 101 42 465 A1 and DE 44 04 018 A1 are mentioned in this respect. These salts, which are sparingly soluble in water, dissolve with the release of the antibiotics contained therein through the action of body fluids. An advantage is the protracted release of active ingredient. However, the expensive preparation of these salts is a disadvantage.

Alternatively, it is also possible to use water-soluble antibiotic salts. The problem is to fix the antibiotic on the implant surface.

The majority of the coatings described so far are preferably intended for the manufacture of coated implants under industrial conditions. This means that the industrial coating of these implants may only be carried out with a few active ingredients that are relevant for large-scale application in order to be able to guarantee economical industrial production with corresponding high numbers of pieces.

In particular in the case of antibiotic coatings, however, in view of the increasingly problematic resistance situation and the increased occurrence of multiresistant microorganisms, such as MRSA and MRSE, antibiotics or antibiotic combinations adapted to the respective microorganisms are suitable for the coating of revision prostheses in the course of one-time or two-time septic joint prosthesis replacement in order to ensure an initial antibiotic protection of the implant surfaces.

It is disadvantageous here that the methods for coating the medical implants are relatively complex. A variable short-term application is not possible. Various coated medical implants have to be provided for different requirements in order to meet the needs of the different patients. This requires extensive storage and does not allow unusual mixtures for special cases.

The object of the invention is to overcome the disadvantages of the prior art. In particular, it is intended to provide a simple and easy-to-use device with which a surface of a medical implant, such as a prosthesis, may be coated without disturbing the course

of an operation (OP). As many different medical implants as possible should be able to be coated using the same device. The device is also intended to be variable in use, so that it may be adapted to the medical necessities, in particular to a medicament suitable for the patient. The cleanliness offered in operating theaters should also be taken into account.

The object of the invention is also to develop as simple a coating device as possible and a coating method which is as simple as possible for use by the operating personnel during surgery involving a minimum of time for coating the various implants with pharmaceutical preparations which may be produced by any manufacturer. In addition, it should be possible to coat implants of any manufacturers with little effort using any liquid pharmaceutical preparation under OP conditions. Also, the device itself should not release plastic particles, metal particles or other particles which are not, or only partially, biodegradable. A further object is that the device should be particularly suitable for coating non-cemented joint endoprostheses and osteosynthesis materials. In addition, as simple as possible a coating method should be developed.

The object of the invention is achieved by the fact that the device comprises a container which comprises a liquid, wherein the liquid comprises at least a pharmaceutically active substance, wherein the device comprises an elastic head for applying the liquid to a surface to be coated, wherein the liquid is fed via least one channel that is connected to the interior of the container so that, when the surface to be coated is passed over or rolled over, the elastic head is used to wet the surface to be coated.

According to the invention, a pharmaceutically active substance is to be understood as meaning pharmaceutically active agents and agents which act pharmacologically, as well as those which support a pharmacological action or else support the body's self-healing powers in some way. Examples are antibiotics, organic antiseptics, copper salts, copper oxide, gallium salts, strontium salts, lithium salts, silver salts, silver oxide, bisphosphonates, growth factors, steroid hormones, nonsteroidal hormones, haemostyptics, antiphlogistics, plasmids, cosmids, linear DNA and mixtures thereof.

According to the invention, a liquid is also to be understood as a viscous liquid. The width or the cross-sections of the channel(s) may be adapted to the viscosity of the liquid.

The object of the invention is also to develop a coating device which is as simple as possible and which may be used by surgical staff during surgery involving a minimum of time to coat a wide variety of implants, which may be produced by any manufacturer, with pharmaceutical preparations. In addition, it should be possible to coat implants of any manufacturers under OP conditions with little effort using any liquid pharmaceutical preparations. In addition, the device itself should not release plastic particles, metal particles or other particles which are not, or only partially, biodegradable. A further object is that the device is to be particularly suitable for coating non-cemented joint endoprostheses and osteosynthesis materials. In addition, a coating process which is as simple as possible should be developed.

The object of the invention is achieved by the fact that the device comprises a container which contains a liquid which at least comprises a pharmaceutically active substance, wherein the device comprises an elastic head for applying the liquid onto a surface to be coated, which has at least one channel that is connected to the interior of the container. The surface to be coated with the elastic head is preferably wetted with the liquid during contact, in particular in the case of passing over or rolling over, of the surface to be coated, wherein the floor and/or the wall of the container comprise(s) at least one elastic pierceable membrane.

According to the invention, a pharmaceutically active substance is to be understood as meaning pharmaceutically active agents and agents which act pharmacologically, as well as those which support a pharmacological action or else support the body's self-healing powers in some way. Examples are antibiotics, organic antiseptics, copper salts, colloidal salts, copper oxide, gallium salts, strontium salts, lithium salts, silver salts, silver oxide, bisphosphonates, growth factors, steroid hormones, nonsteroidal hormones, haemostyptics, antiphlogistics, plasmids, cosmids, linear DNA and mixtures thereof.

According to the invention, a liquid is also to be understood as a viscous liquid. The width or the cross-sections of the channel(s) may be adapted to the viscosity of the liquid.

According to a particularly advantageous embodiment of the invention, the container may have elastic walls, so that, upon manual pressure on the elastic container walls, the liquid flows through the at least one channel to the surface of the elastic head. This makes it possible to control the quantity of the emerging liquid by manual pressure.

Methods according to the invention may also be characterized in that the elastic head is a rotationally symmetrical roller, which is mounted to rotate about its axis of symmetry at one end of the container.

A further embodiment of the method according to the invention may provide that the elastic head is a sphere which is mounted to rotate about an axis at one end of the container. The rotatability of the elastic head has the particular advantage that the liquid may be applied to the medical implant substantially without sliding friction. This avoids the abrasion of the elastic head and thus any disturbing particles on the medical implant. On the other hand, the transfer of the liquid onto the medical implant is particularly well controlled by this approach. In this case, provision may be made for the sphere to be mounted to rotate freely at one end of the container.

Furthermore, provision may be made for at least one channel to be formed between the container wall and the elastic head. This is particularly advantageous in the context of a rotatably mounted elastic head, since the rotation of the elastic head transports the liquid from the container to the surface of the device from where it may then be transferred to the surface of the medical implant.

It may also be provided that an antibiotic or antibiotic mixture suitable for the treatment situation may be filled into the container in the liquid. By means of this measure, the specific treatment situation of the respective patient may be taken into account.

According to a particularly preferred embodiment of the invention it may be provided that the pharmaceutically active substance includes antibiotics and/or organic antiseptics, so that the coating to be produced contains a pharmaceutically effective dose.

It may also be provided that the elastic head comprises a porous elastic sponge. The porous elastic sponge may be used according to the invention to apply the liquid in a uniform film on the medical implant.

A further embodiment of the invention proposes that the elastic head is arranged to be linearly displaceable in the container. In particular, it may be provided that the elastic head may be pressed into the container. As a result, the liquid is forced outwards from the interior of the container when the elastic head is pressed onto a surface.

It may also be provided that a channel is formed in the elastic head, preferably by pores of a sponge.

Furthermore, it is possible to provide that the elastic head has an inelastic plug which closes off the container on one side and which at least comprises a channel and/or at least forms a channel between the plug and the container, wherein the plug is preferably arranged to be linearly displaceable in the container. This ensures the stability of the device.

According to a further embodiment of the invention, it is provided that the elastic head has a rough surface, preferably with a roughness of 0.5 µm to 100 µm, particularly preferably 1 µm to 10 µm, most preferably 2 µm. This supports, in particular in the case of a rotatably mounted elastic head, the stable conveying of the liquid to the surface of the device and thus to the medical implant.

For this purpose, it may also be provided that the elastic head is hydrophilic and the liquid is an aqueous solution.

In order to meet particular hygienic requirements, provision may be made for the elastic head to close the container to the outside, apart from the connection, by means of the at least one channel.

In order to ensure simple applicability and fillability of the container, it may be provided that the floor and/or at least one wall of the container at least partially comprises an elastic pierceable membrane, wherein the membrane is preferably formed from a bio-compatible elastomer and/or may be covered and/or sealed by a cover.

It may also be provided that the device comprises a bearing for the elastic head, which is connected to the container or is integrally formed with the container.

Particularly advantageous embodiments of the invention provide that the elastic head has a modulus of elasticity of less than 2000 MPa, preferably of less than 500 MPa, particularly preferably between 1 and 100 MPa. In the case of these moduli of elasticity, flat application of the liquid is also possible in the case of uneven surfaces of the medical implant to be coated when the device according to the invention is operated by hand.

It may also be provided that at least one channel, preferably all channels, has/have a cross-section of less than 500 µm, preferably a cross-section of less than 200 µm.

Furthermore, it may be provided that at least one channel is a gap with a width of less than 500 µm, preferably with a width of less than 200 µm, wherein preferably all channels are such gaps. A particularly suitable liquid film is applied for the medical purpose in these channel cross-sections or channel widths.

According to the invention, it may also be provided that the elastic head and/or the container comprise(s) a biocompatible material, preferably at least the surface of the elastic head consists of a biocompatible elastomer or elastomer mixture.

It may also be provided that the elastic head and/or the container is/are made of a biocompatible material.

A particularly easy-to-handle embodiment of the device according to the invention results when the volume enclosed by the container and the elastic head is between 0.5 ml and 1000 ml, preferably between 1 ml and 100 ml.

It may also be provided that the container contains sterile air or a sterile gas.

It may also be provided that at least one open-pore porous layer is arranged between the elastic head and the container, preferably inside the device. The open-pore porous layer is intended to ensure that there is always enough liquid in the region of the elastic head.

A further embodiment of the invention provides that the liquid comprises an aqueous gentamicin sulfate solution, preferably comprising stabilizers, wherein particularly an aqueous gentamicin sulfate solution having a gentamicin sulfate content of 0.5 to 88 wt.-% is preferred.

It may be provided that the liquid is a gentamicin sulfate solution with a gentamicin sulfate content of 10 to 88 wt.-%, particularly preferably a gentamicin sulfate solution with a gentamicin sulfate content of 80 wt.-%.

According to a method for coating a medical implant with a device according to the invention, a medical implant is provided and the elastic head of the device is brought into contact with the surface of the medical implant to be coated, and is preferably passed over or rolled over the surface of the medical implant to be coated, so that the liquid is transferred as a film from the elastic head to the surface of the medical implant.

In this case, it is provided that the container of the device is filled with the liquid by filling with a liquid, preferably by injecting the liquid through the membrane. By means of this measure, the specific treatment situation of the respective patient may be taken into account.

In this case, provision may again be made for a lid to be removed before the container is filled with the liquid and/or a lid is fixed, preferably over a puncture point, after the container has been filled with the liquid. The use of a lid is intended to prevent inadvertent opening or piercing of the container wall, enabling the container, once the container wall or the floor of the container has been pierced or opened, to again be sealed so that no contamination may enter the container, while the contents of the device may not reach the container environment, i.e. may not contaminate the operating room.

The procedures are performed before the medical implants are inserted. The procedures thus take place "ex vivo".

Furthermore, provision may be made that at least 50% of the surface of the medical implant, preferably at least 80%, most preferably at least 90% of the surface of the medical implant, is coated.

It may also be provided that the method is repeated until a complete coating of the surface of the medical implant to be coated is achieved. Particularly in connection with a coloring of the liquid and checking the completeness of the coating with the aid of the coloring, wherein this is advantageous according to the invention in order to produce a sufficiently coated medical implant.

According to the invention, the device may be pre-filled with a solution or suspension comprising the at least one pharmaceutically active substance, so that the operating personnel may use it immediately.

Alternatively, it is possible to equip a non-filled device directly in the operating theater by injecting an active substance solution or active compound suspension containing one or more pharmaceutical active ingredients. Thus, in the case of the antibiotic coating, it is possible to make an appropriate selection of an antibiotic or an antibiotic combination according to an existing resistance situation, and thus to produce an antibiogram coating.

It is also possible, prior to the operation, to fill non-filled devices in the respective hospital pharmacy with suitable active ingredient solutions or active agent suspensions so that the coating may be performed without a time delay during the operation.

Examples of useful pharmaceutical agents are antibiotics, organic antiseptics, copper salts, copper oxide, gallium salts, strontium salts, lithium salts, silver salts, silver oxide, bisphosphonates, growth factors, steroid hormones, nonsteroidal hormones, haemostyptics, antiphlogistics, plasmids, cosmids, linear DNA and mixtures thereof.

The use of other aminoglycoside antibiotic solutions, such as aqueous solutions of tobramycin sulfate, amikacine sulfate, netilmicin sulfate and sisomycin sulfate, are also within the scope of the invention. It is also possible to use aqueous solutions of vancomycin, dalbavancine, and ramoplanin, daptomycin, moxifloxacin, clindamycin and/or uncomycin. Also within the scope of the invention is the use of combinations of solutions of different antibiotics. Examples include the double combination of gentamicin sulfate with vancomycin hydrochloride, the double combination of daptomycin with gentamicin sulfate and the double combination of gentamicin sulfate with clindamycin, and the triple combination of gentamicin sulfate with vancomycin hydrochloride and clindamycin hydrochloride. Furthermore, it is also possible to use antiseptic solutions instead of antibiotic solutions. Solutions of chlorhexidine digluconate, octenidine dihydrochloride and polyhexanide are examples.

Also within the scope of the invention is the use of solutions of antibiotics and antiseptics which contain organic solvents or combinations of organic solvents or well as combinations of organic solvents and water, as the solvent.

It is thus possible, for example, to use antibiotic salts which are slightly soluble in water, such as laurates, myristates, palmitates and stearates. In addition, antibiotics or antibiotic salts in the form of aqueous suspensions that are slightly soluble in water may also be used.

According to the invention, it is also provided that the device is provided as a medicament or as a medical product.

A combination of the device according to the invention with a medical implant could also be provided. This combination is formed from the device and the implant, wherein this combination has a minimum life duration of 0.1 second. The combination is formed during the coating method.

The invention is based on the surprising finding that a liquid with which a medical implant is to be coated may also be applied shortly before its application by contacting, preferably by spreading over, the medical implant with a device according to the invention, in which the liquid is stored. The simple method and the device for this ensure applicability even in the operating room. The liquid to be applied, which contains the pharmaceutically active substance, is conveyed to an elastic head of the device through a channel or, better, through several channels. According to the invention, the elastic head ensures that the shape of the head at least slightly matches the outer contours of the object to be coated. Above all, this discovery, surprisingly found, allows easy handling of the device according to the invention.

A particularly interesting aspect of the invention, in particular from the point of view of hygiene, is based on the additional inventive idea of designing the elastic head as a rotating roller or as a sphere that is freely rotatable in all directions. If sufficient roughness and/or sufficient wettability with the liquid is provided on the surface of the roller or sphere, the rotating elastic head conveys the liquid from the interior of the apparatus to the surface to be coated. Without rubbing over the surface of the medical implant to be coated, the liquid film is then applied in the manner of a deodorant roller. The elasticity of the rotatably mounted elastic head should be so dimensioned that the deformation does not propagate to the bearing of the elastic head in the container, or to such a small extent that the rotatability of the elastic head in the device is affected as

little as possible. The container may comprise an elastic region in the region of the bearing.

For an initial antibiotic protection, sufficient antibiotic or antibiotic concentrations may be present on the implant surfaces for a period of 24 to 72 hours. Therefore, a sufficient temporary, local, antibiotic protection of the medical implant may be achieved even with the local introduction of simple water-soluble antibiotics into a fluid.

Instead of coating the medical implant well in advance during manufacture, it may also be coated immediately prior to insertion. As a result, relatively short-lived coatings may also be used. In addition, even a still liquid layer may be used, which opens up new fields of application and makes new active ingredients accessible.

A device according to the invention is so designed that no spray may contaminate the operating area, and that bristles, or other hair or bristles or other components may also be avoided.

Exemplary embodiments of the invention are explained below with reference to two schematically illustrated figures, without, however, limiting the invention.

Fig. 1 shows a schematic cross-sectional view of a device according to the invention, and

Fig. 2 shows a schematic cross-sectional view of a second device according to the invention.

Fig. 1 shows a schematic cross-sectional view of a device 1 according to the invention. The device 1 comprises a container 4 in the form of a pot which is open at the top. The side walls of the container 4 are cylindrical and of uniform thickness.

Inside the container 4 is an aqueous liquid 6. which contains a pharmaceutically active substance. The liquid 6 is, for example, an aqueous solution containing antibiotics with which a medical implant (not shown) is to be coated.

In the opening of the container 4, an elastic head 8 in the form of a sponge 8 is arranged on a plug 10. The plug 10 is inserted in the opening of the container 4 and closes it on all sides. A plurality of channels 12 is arranged in the plug 10, through which the liquid 6 is guided from the interior of the container 4 to the porous sponge 8. The sponge 8 is hydrophilic and thus suitable for absorbing the liquid 6. Thus the sponge 8 may suck up the liquid 6 through the channels 12.

The plug 10 and the inner walls of the container 4 may consist of a hydrophobic material or may be coated with a hydrophobic material. The plug 10 may be displaced in the opening of the container 4, and is thus linearly movable in the opening of the container and is guided by the inner walls of the container 4.

A method according to the invention may be carried out with the device 1 shown. For this purpose, the device 1 is coated with the elastic head 8 facing downwards over a surface of a medical implant to be coated. By the pressure exerted on the sponge 8, the liquid 6 contained in the sponge 8 is pressed out and transferred to the surface of the medical implant as a flowing film. The liquid 6 is pressed simultaneously from the interior of the container 4 into the sponge 8 by the manually applied pressure to ensure liquid supply to the surface of the elastic head 8. The liquid film dries quickly on the surface of the medical implant and leaves a layer of a pharmaceutically active substance, for example an antibiotic or an antibiotic mixture. The coated medical implant is then ready for surgery, i.e. ready for insertion.

The composition of the liquid 6 may be determined and produced shortly before the operation by adding suitable pharmaceutically active substances with a syringe through the walls and/or the floor of the container 4. Alternatively, the container 4 may also be simply filled before use with a suitable liquid 8 which is filled through the opening of the container 4 before the plug 10 is inserted into the opening. For this purpose, the container 4 and the plug 10 along with the elastic head 8 may be previously stored in a sterile package, which may also be filled with a sterile gas. The container 4 itself may also be filled with such a sterile gas.

The coating device 1 is made of polypropylene, has a height of approximately 20 cm and a diameter of 8 cm. The plug 10 also consists of polypropylene and is press-fitted into the upper region of the interior of the container 4. The container 4 may, in addition, be sealed by an aluminum composite film (not shown) which closes the opening of the container 4 before application.

Fig. 2 shows a schematic cross-sectional view of a second device 21 according to the invention which is suitable for a method according to the invention. The device 21 comprises a container 24 with a pierceable, elastic membrane 25 on the underside, which completely closes the container 24 on the underside. Inside the container 24 is a

liquid 26 containing a pharmaceutically active substance with which the medical implant is coated when the solvent of the liquid in which the pharmaceutically active substance is dissolved, is vaporized through the membrane 25. The membrane 25 may be pierced with syringes to fill the container 24 with the liquid 26, or the liquid 26 with the pharmaceutically active substance contained in the container 24.

On the upper side of the container 24, a circumferential lip 27 of an elastic material is arranged on the container walls. The top of the container 24 is closed by a sphere 28 as the elastic head 28 of the device 21. The sphere 28 is made of an elastic biocompatible polymer and has a surface roughness of 10 µm. There is a gap 32 between the sphere 28, the walls of the container 24 and the lip 27, which serves as a channel 32 for the liquid 26 inside the container 24.

The sphere 28 is held in the container 24 by the lip 27 and by a ball bearing 34. As a result, the sphere 28 is freely movable, i.e. rotatable in all directions. The ball bearing 34 is not necessary for the embodiment of the invention; instead, the sphere 28 may also be simply slidably mounted on a liquid film of the liquid 26 in a holder at the upper end of the container 24.

When the device 21 with the sphere 28 is rolled over a medical implant (not shown) with the sphere 28 facing downwards, it feeds the liquid on its rough surface from the interior of the device 21 through the gap 32 to the outer surface of the device 21. When the sphere 28 is pressed into the ball bearing 34 by the pressure exerted by the weight of the device 21 and, if appropriate, by the user of the device 21, the gap 32 has a width of approximately 50 µm. The gap may also be adapted to suit the consistency of the liquid 26 and/or the roughness of the sphere 28. The more viscous the liquid 26 is, the wider the gap 32 selected.

If a ball bearing 34 is not provided, instead of the gap 32, channels may be arranged as flat grooves in the bearing of the container, which have a width of approximately 1 to 10 mm and a depth of 50 to 200 µm. The liquid 26 may then be conveyed out of the device 21 in these channels. For the embodiment according to the invention according to Fig. 2, the particular and inventive aspect is to be seen in that the liquid 26 contains a pharmaceutically active substance with which a medical implant is to be coated, while, at the same time, the sphere 28 forms the elastic head 28 of the

device 21, The liquid 26 is conveyed out of the interior of the device 21 by the rotation of the sphere 28, and, because of the elasticity of the sphere 28, the liquid 26 is applied evenly on the uneven contours of the medical implant.

According to the invention, conventional Zweymüller hip prostheses may be briefly covered with the liquid-filled devices 1, 21. The Zweymüller hip prostheses then have a film of liquid 6, 26 on the shaft surface. After the fluid film has dried, the Zweymüller hip prostheses then have a white coating on the shaft surface in which the pharmaceutically active substance is present. The hip prostheses are ready for use during surgery.

After coating with the liquid 6, 26, the still moist medical implant may also be coated with a powder. The powder contains a second pharmaceutically active substance, preferably a bone growth promoting substance, such as calcium phosphate. The powder adheres well to the surface of the medical implant through the liquid film. This results in a liquid-powder coating on the surface of the medical implant to be coated.

Examples of the preparation of liquids for a method according to the invention and a further example for a device according to the invention are described below.

16.0 g of gentamicin sulfate (Fujian Fukang Ltd.) are mixed with 4.0 ml of pyrogen-free sterile water at room temperature. After 24 hours of stirring at room temperature with a magnetic stirrer, an oily-viscous yellowish solution has formed. A coating solution with gentamicin sulfate as a liquid for coating a medical implant results.

Preparation of a coating solution with the double combination of gentamicin sulfate and clindamycin hydrochloride:

12.0 g of gentamicin sulfate (Fujian Fukang Ltd.), 4.0 g of clindamycin hydrochloride (Sigma-Aldrich) are mixed with 4.0 ml of pyrogen-free sterile water at room temperature. After 24 hours of stirring at room temperature with a magnetic stirrer, an oily viscous yellowish solution has formed.

Preparation of a coating solution with the triple combination of gentamicin sulfate, clindamycin hydrochloride and vancomycin hydrochloride

4.0 g of gentamicin sulfate (Fujian Fukang Ltd), 4.0 g of clindamycin hydrochloride (Sigma-Aldrich) and 4.0 g of vancomycin hydrochloride (Sigma-Aldrich)

are mixed with 8.0 ml of pyrogen-free sterile water at room temperature. After stirring for 24 hours at room temperature with a magnetic stirrer, a viscous yellowish solution has formed.

Preparation of a coating solution with the double combination of gentamicin sulfate and clindamycin hydrochloride:

3.0 g of gentamicin sulfate (Fujian Fukang Ltd.), 1.0 g of clindamycin hydrochloride (Sigma-Aldrich) are mixed with 1.0 ml of pyrogen-free sterile water at room temperature. After stirring at room temperature for 24 hours with a magnetic stirrer, an oily viscous yellowish solution has formed.

Preparation of a coating solution with the triple combination of gentamicin sulfate, clindamycin hydrochloride and vancomycin hydrochloride:

2.0 g of gentamicin sulfate (Fujian Fukang Ltd.), 1.0 g of clindamycin hydrochloride (Sigma-Aldrich) and 1.0 g of vancomycin hydrochloride (Sigma-Aldrich) are mixed with 1.0 ml of pyrogen-free sterile water at room temperature. After stirring for 24 hours at room temperature with a magnetic stirrer, a viscous yellowish solution has formed.

The coating solutions of examples 2-4 are each coated using conventional 10 ml plastic syringes and then, after placing a cannula through the floor plate, are injected into the container of a device according to the invention.

The devices thus filled are rolled over conventional Zweimüller hip prostheses. A viscous film is formed on the implant surfaces.

The features of the invention disclosed in the foregoing description, as well as the claims, figures and embodiments, may be used both individually and in any combination for the implementation of the invention in its various embodiments.

List of reference numerals

1, 21	Device
4, 24	Container
6, 26	Liquid
8	Elastic head/sponge
10	Plug
12, 32	Channel/gap
25	Membrane
28	Elastic head/sphere
34	Ball bearing

Patentkrav

1. Innretning (1, 21) til overtrekking av et medisinsk implantat, der innretningen (1, 21) omfatter en beholder (4, 24) som inneholder en væske (6, 26), der væsken (6, 26) omfatter minst en farmasøytisk aktiv substans, der innretningen (1, 21) omfatter et elastisk hode (8, 28) for påføring av væsken (6, 26) på en overflate som skal overtrekkes, som via en kanal (12, 32) er forbundet med beholderens (4, 24) indre, slik at når det elastiske hodet (8, 28) strykes eller rulles over overflaten som skal overtrekkes, fukter væsken (6, 26) overflaten som skal overtrekkes, **karakterisert ved at**
bunnen og/eller minst én vegg til beholderen (4, 24) omfatter minst områdevis en elastisk, perforerbar membran (25).

2. Innretning (1, 21) ifølge krav 1, **karakterisert ved at** membranen (25) er dannet av en biokompatibel elastomer.

3. Innretning (1, 21) ifølge krav 1 eller 2, **karakterisert ved at** membranen (25) kan dekkes til eller tettes ved hjelp av et lokk.

4. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** beholderen (4, 24) har elastiske vegger, slik at ved manuelt trykk på de elastiske beholderveggene strømmer væsken (6, 26) gjennom den minst ene kanalen (12, 32) mot det elastiske hodets (8, 28) overflate.

5. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** det elastiske hodet (8, 28) er en rotasjonssymmetrisk vals (28) som er opplagret roterbart rundt sin symmetriakse ved en ende av beholderen (4, 24).

6. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** det elastiske hodet (8, 28) er en kule (28) som er opplagret roterbart rundt minst én akse ved en ende av beholderen (4, 24).

7. Innretning (1, 21) ifølge et av kravene 5 eller 6, **karakterisert ved at** minst én kanal (12, 32) er dannet mellom beholderveggen og det elastiske hodet (8, 28).

8. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at**

det elastiske hodet (8, 28) omfatter en porøs, elastisk svamp (8).

9. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** det elastiske hodet (8, 28) er anordnet lineært forskyvbart i beholderen (4, 24).

10. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** minst én kanal (12, 32) er utformet i det elastiske hodet (8, 28), fortrinnsvis ved porer til en svamp (8).

11. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** det på det elastiske hodet (8, 28) er anordnet en uelastisk propp (10) som avslutter beholderen (4, 24) på en side, og som omfatter minst én kanal (12, 32) og/eller danner minst én kanal (12, 32) mellom propp (10) og beholder (4, 24), der proppen (10) fortrinnsvis er anordnet lineært forskyvbart i beholderen (4, 24).

12. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** det elastiske hodet (8, 28) har en ru overflate, fortrinnsvis en ruhet på 0,5 µm til 100 µm, spesielt foretrukket på 1 µm til 10 µm, helt spesielt foretrukket på 2 µm.

13. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** det elastiske hodet (8, 28) er hydrofilt og væsken (6, 26) er en vandig løsning.

14. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** det elastiske hodet (8, 28) avslutter beholderen (4, 24) mot utsiden med unntak av forbindelsen gjennom den minst ene kanalen (12, 32).

15. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** innretningen (1, 21) omfatter en opplagring (34) for det elastiske hodet (8, 28), som er forbundet med beholderen (4, 24) eller er utformet i ett stykke med beholderen (4, 24).

16. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** det elastiske hodet (8, 28) har en elastisitetsmodul på mindre enn 2000 MPa, foretrukket mindre enn 500 MPa, spesielt foretrukket mellom 1 og 100 MPa.

17. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** minst én kanal (12, 32), foretrukket alle kanalene (12, 32), har et tverrsnitt på under 500 µm, fortrinnsvis med et tverrsnitt på under 200 µm.

18. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** minst én kanal (12, 32) er en spalte (32) med en bredde på under 500 µm, fortrinnsvis med en bredde på under 200 µm, foretrukket er alle kanalene (12, 32) slike spalter (32).

19. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** det elastiske hodet (8, 28) og/eller beholderen (4, 24) omfatter et biokompatibelt materiale eller er fremstilt fra et biokompatibelt materiale, fortrinnsvis består minst det elastiske hodets (8, 28) overflate av en biokompatibel elastomer eller elastomerblanding.

20. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** volumet innesluttet av beholderen (4, 24) og det elastiske hodet (8, 28) er på mellom 0,5 ml og 1000 ml, fortrinnsvis mellom 1 ml og 100 ml.

21. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** beholderen (4, 24) inneholder steril luft eller en steril gass.

22. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** minst ett porøst lag med åpne porer er anordnet mellom det elastiske hodet (8, 28) og beholderen (4, 24), fortrinnsvis i innretningens (1, 21) indre.

23. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at** væsken (6, 26) omfatter en vandig gentamicinsulfatløsning, fortrinnsvis omfattende stabilisatorer, der spesielt en vandig gentamicinsulfatløsning med et gentamicinsulfatinnhold på 0,5 til 88 vektprosent er foretrukket.

24. Innretning (1, 21) ifølge krav 23, **karakterisert ved at** væsken (6, 26) er en gentamicinsulfatløsning med et gentamicinsulfatinnhold på 10 til 88 vektprosent, spesielt foretrukket en gentamicinsulfatløsning med et gentamicinsulfatinnhold på 80 vektprosent.

25. Innretning (1, 21) ifølge et av de foregående kravene, **karakterisert ved at**

kanalene (12, 32) er utformet som mellomrom til fibre, der fibrene danner det elastiske hodet (8, 28).

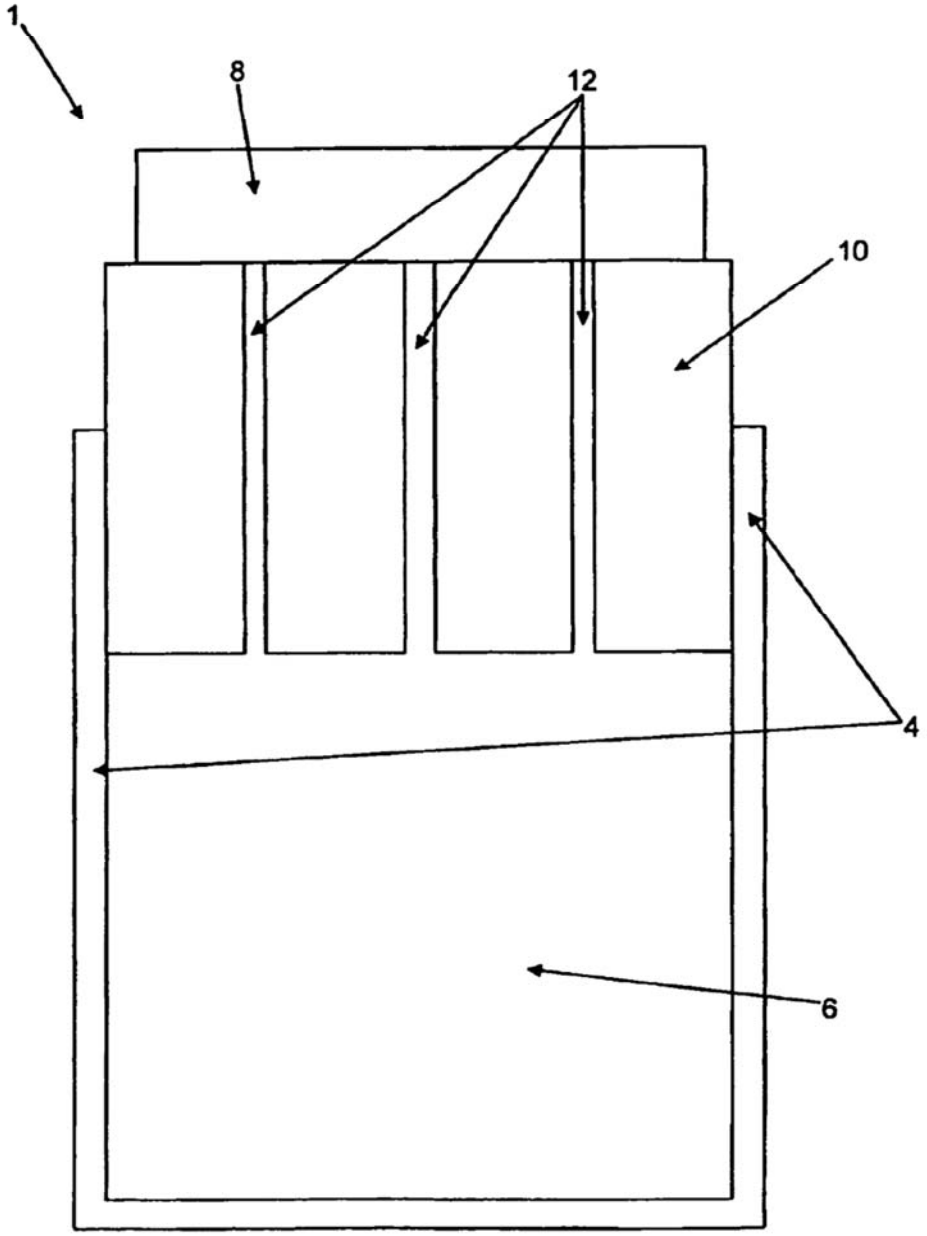

Figure 1

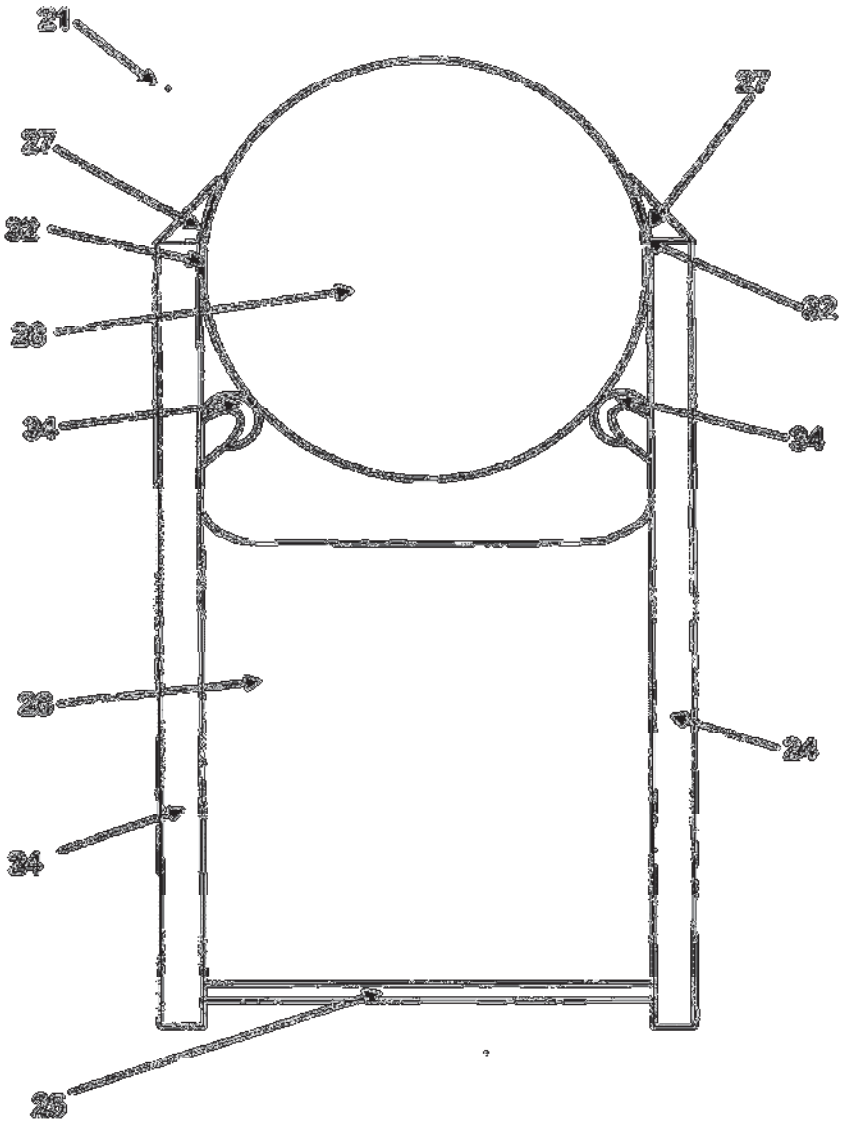

Figure 2