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CA 2878783 C 2017/05/23

(11)(21) 2 878 783

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2013/07/25
(87) Date publication PCT/PCT Publication Date: 2014/02/06
(45) Date de délivrance/Issue Date: 2017/05/23
(85) Entrée phase nationale/National Entry: 2015/01/09
(86) N° demande PCT/PCT Application No.: IB 2013/001626
(87) N° publication PCT/PCT Publication No.: 2014/020401
(30) Priorité/Priority: 2012/07/30 (IT VI2012A000188)

(51) Cl.Int./Int.Cl. *B01F 13/08* (2006.01), *B01F 15/00* (2006.01), *B01F 15/06* (2006.01)

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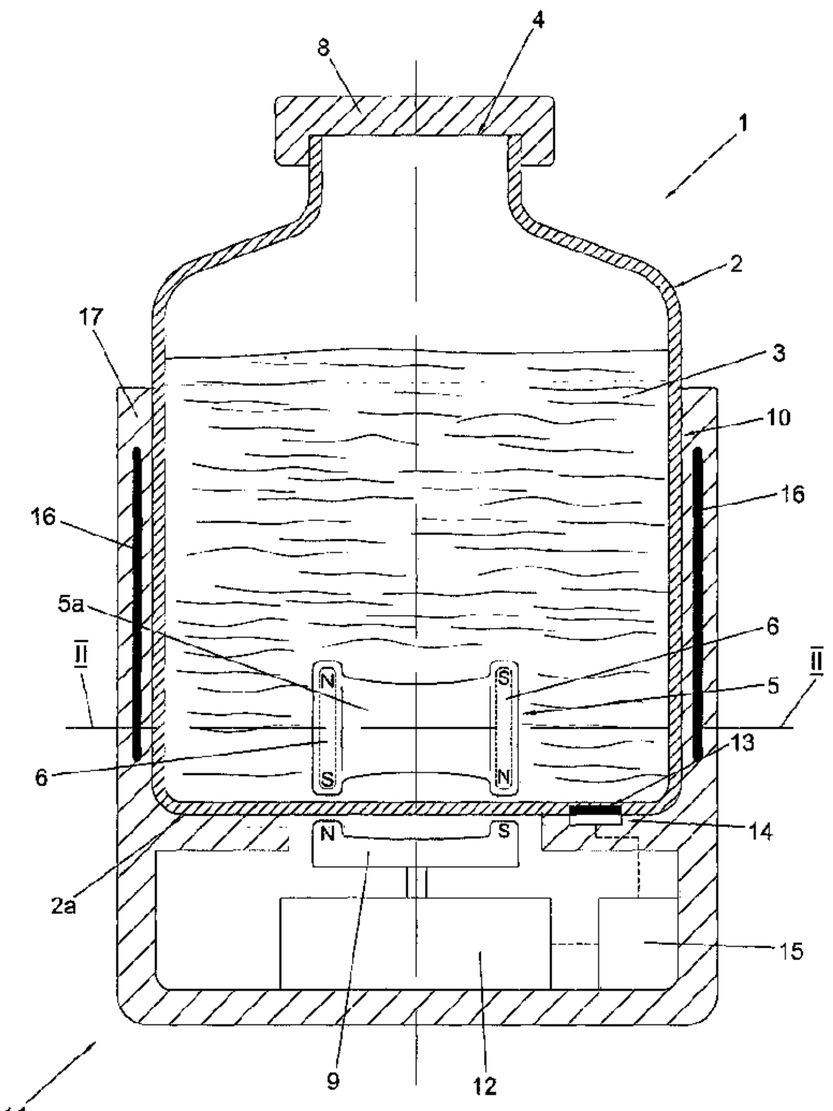
(54) Titre : ENSEMBLE DE RESINE DE STEREOLITHOGRAPHIE, DISPOSITIF DE MELANGE CONCU POUR ETRE UTILISE AVEC LEDIT ENSEMBLE, SYSTEME DE STEREOLITHOGRAPHIE ET PROCEDE POUR MELANGER UNE RESINE DE STEREOLITHOGRAPHIE CONTENUE DANS LEDIT ENSEMBLE

(54) Title: PACKAGE OF STEREOLITHOGRAPHY RESIN, MIXING DEVICE SUITED TO BE USED WITH SAID PACKAGE AND METHOD FOR MIXING A STEREOLITHOGRAPHY RESIN CONTAINED IN SAID PACKAGE



(57) Abrégé/Abstract:
The invention is a package (1) for stereolithography comprising a container (2) filled with stereolithography resin (3), provided with an access opening (4), and a mixer element (5) arranged in a removable manner in the container (2) and provided with at least one magnet (6).

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
6 February 2014 (06.02.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/020401 A1

(51) International Patent Classification:
B01F 13/08 (2006.01) *B01F 15/06* (2006.01)
B01F 15/00 (2006.01)

(21) International Application Number:
PCT/IB2013/001626

(22) International Filing Date:
25 July 2013 (25.07.2013)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
VI2012A000188 30 July 2012 (30.07.2012) IT

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) **Title**: PACKAGE OF STEREOLITHOGRAPHY RESIN, MIXING DEVICE SUITED TO BE USED WITH SAID PACKAGE, STEREOLITHOGRAPHY SYSTEM AND METHOD FOR MIXING A STEREOLITHOGRAPHY RESIN CONTAINED IN SAID PACKAGE

(57) **Abstract**: The invention is a package (1) for stereolithography comprising a container (2) filled with stereolithography resin (3), provided with an access opening (4), and a mixer element (5) arranged in a removable manner in the container (2) and provided with at least one magnet (6).

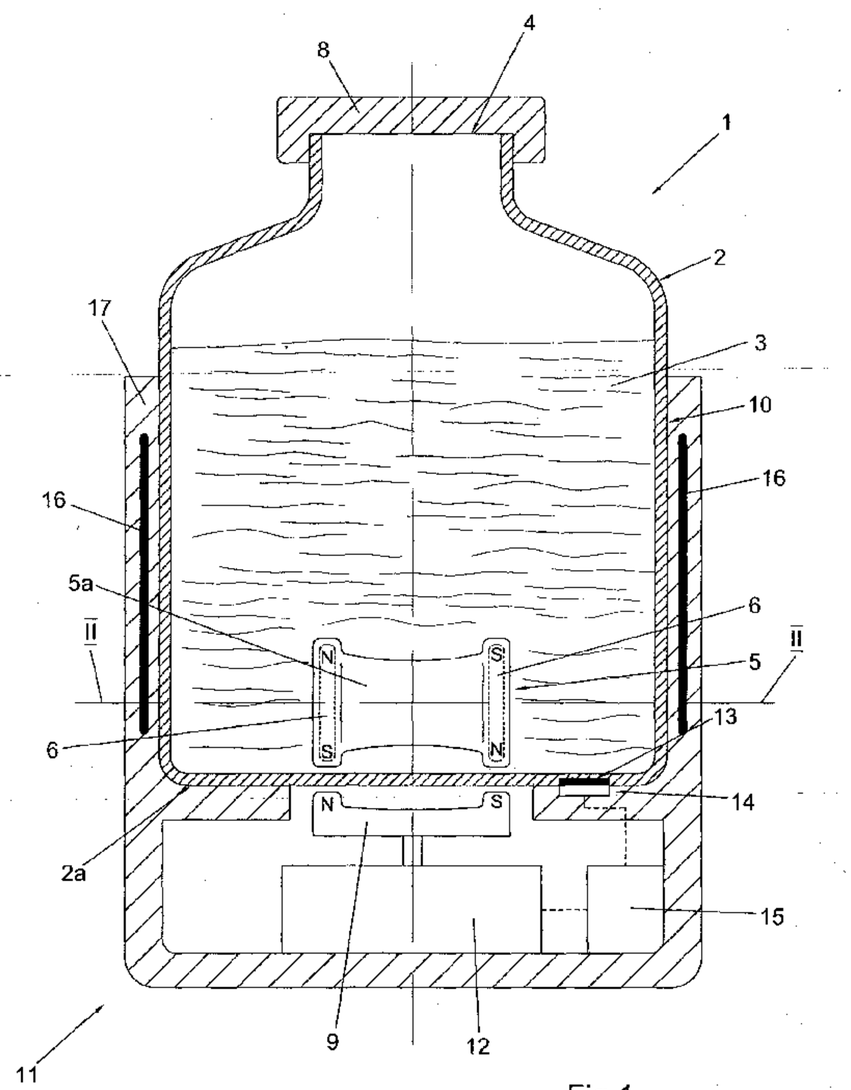

Fig.1

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PACKAGE OF STEREOLITHOGRAPHY RESIN, MIXING DEVICE SUITED TO BE USED WITH SAID PACKAGE AND METHOD FOR MIXING A STEREOLITHOGRAPHY RESIN CONTAINED IN SAID PACKAGE.

BACKGROUND OF THE INVENTION

The present invention concerns a package of stereolithography resin, suited to be used to feed a stereolithography machine.

The present invention also concerns a mixing device suited to be used with said package. The present invention also concerns a method for mixing the stereolithography resin contained in said package.

As is known, a stereolithography machine is a device that allows a three-dimensional object to be produced by superimposing a plurality of layers on top of one another, said layers being obtained through the solidification of a suitable stereolithography resin.

In particular, the term “stereolithography resin” means a liquid or pasty material suited to solidify when exposed to a predefined radiation, in particular a luminous radiation.

The stereolithography resin is available on the market packaged in containers that are provided with a closing cap.

When necessary, the container is opened and the resin contained therein is poured into a tank of the stereolithography machine in order to solidify it.

Many stereolithography resins are mixtures made up of several components having different specific weights and including, for example, epoxy resins, ceramic particles in suspension and the like.

In said mixtures, also called “hybrid resins”, the heavier components tend to sediment during the periods of inactivity, for example during the time elapsing from when the resin is packaged in the container to when it is actually used in the machine.

Therefore, before using a resin of the type mentioned above it is necessary to mix it, in such a way as to restore its homogeneity.

According to the known art, the resin contained in the container is mixed manually, for example using a stick.

Obviously, this manual operation poses the drawback that it is uncomfortable and that the operator needs a certain amount of time to carry it out.

A further drawback posed by the manual mixing operation lies in that it is very subjective and, therefore, it does not allow repeatable results to be obtained.

In particular, manual mixing cannot be optimised for each specific type of resin contained in the container.

Furthermore, the manual mixing operation has a further drawback that the operator may accidentally come into contact with the resin, which often has a certain degree of toxicity.

The manual mixing operation also has the drawback that it requires that the container be opened, with the consequence that the resin is exposed to the atmospheric agents, in particular to the air of the external environment, which may cause it to deteriorate.

SUMMARY OF THE INVENTION

The present invention intends to overcome all the drawbacks of the known art outlined above.

In particular, it is a first feature of an embodiment of the present invention to provide a package of stereolithography resin that makes it easier to mix the resin contained therein.

It is also the a feature of an embodiment of the invention to allow a mixing operation that is repeatable and independent of the operator to be carried out.

It is a further feature of an embodiment of the invention to avoid the exposure of the resin to the atmospheric agents during the mixing operation.

In accordance with one embodiment of the present invention, there is provided a stereolithography system comprising: a stereolithography machine; a stereolithography resin package, comprising a container, filled with a stereolithography resin and provided with an access opening. The stereolithography resin package further comprises: a mixer

element, arranged in a removable manner in the container and provided with at least one magnet; a data storing device belonging to the container, containing information on the type and quantity of the stereolithography resin. The data storing device is associated with connection means suited to transmit the information to an external device. The stereolithography system further comprises: a duct for connecting the container to the stereolithography machine, suited to withdraw the stereolithography resin from the container; a mixing device provided with: a seat suited to accommodate the container; an external magnet associated with motorisation means suited to set the external magnet moving; reading means suited to acquire the information contained in the data storing device of the container, operatively associated with a logic control unit and configured so as to control the motorisation means based on the information.

Another embodiment of the present invention provides a method for mixing a stereolithography resin, comprising the steps of: preparing a stereolithography resin package by filling a container provided with an access opening with the stereolithography resin; wherein said stereolithography resin package further comprises: a mixer element arranged in a removable manner in the container and provided with at least one magnet; a data storing device belonging to the container, containing information on the type and quantity of the stereolithography resin, associated with connection means suited to transmit the information to an external device; and wherein the method further comprises the following steps: arranging an external magnet outside the container, facing a bottom of the container; acquiring the information from the data storing device; controlling motorization means through a logic control unit for setting the external magnet moving based on the information so as to drive the mixer element.

Advantageously, the fact that the resin is easier to mix lightens the operator's tasks.

Further advantageously, the repeatability of the mixing operation ensures that the resin is mixed effectively before being used.

Furthermore, advantageously, the invention makes it possible to prevent the operator from coming into contact with the stereolithography resin, thus reducing the risks related to the toxicity of the latter.

Still advantageously, the possibility to protect the resin from the atmospheric agents during the mixing operation makes it possible to preserve the resin itself, increasing its duration.

Still advantageously, the invention makes it possible to carry out the mixing operation taking into account the type and quantity of the resin contained in the container, in such a way as to obtain optimal mixing results in the different possible situations.

BRIEF DESCRIPTION OF THE DRAWINGS

The said features and advantages, together with others which will be highlighted below, are illustrated in the description of a preferred embodiment of the invention which is provided by way of non-limiting example with reference to the attached drawings, wherein:

Figure 1 shows a side sectional view of a package of stereolithography resin according to the invention positioned on a mixing device;

Figure 2 shows a cross section of Figure 1 carried out along plane II-II;

Figure 3 shows a cross section of a variant embodiment of the package of Figure 1 carried out along a plane analogous to that of Figure 2.

DETAILED DESCRIPTION

The invention is described with reference to a stereolithography system comprising a stereolithography machine, not illustrated herein but known per se, of the type suited to produce a three-dimensional object.

In particular, the stereolithography machine produces the three-dimensional object through the selective solidification of a stereolithography resin in successive superimposed layers.

The stereolithography resin is supplied in a package, indicated as a whole by **1** in Figure 1, which comprises a container **2** filled with said stereolithography resin **3**.

Preferably, the stereolithography resin **3** is a resin of the so-called "hybrid" type, meaning a mixture of several components having different specific weights including, for example, epoxy resins, ceramic particles in suspension and the like.

Said container **2** is provided with an access opening **4** from which it is possible to withdraw the stereolithography resin **3**.

Furthermore, the package **1** comprises a mixer element **5** arranged in a removable manner in said container **2**.

The mixer element **5** is also provided with one or more magnets **6**, represented with a broken line in Figure 1.

Advantageously, said magnets **6** react to a magnetic force produced by a magnet **9** arranged outside the container **2**.

In particular, the external magnet **9** induces the magnets **6** of the mixer element **5** to be oriented with the respective north pole **N** and south pole **S** in opposition with respect to the corresponding poles **N**, **S** of the external magnet **9**.

Therefore, the movement of the external magnet **9** causes an analogous movement of the mixer element **5**.

Obviously, the movement of the mixer element **5** mixes the stereolithography resin **3** contained in the container **2**.

It can be understood that the possibility to move the mixer element **5** from the outside of the container **2** makes it possible to mix the stereolithography resin **3** with no need to open the container **2**, thus preserving the resin contained in the container by avoiding exposure to the atmospheric agents.

Furthermore, advantageously, said package **1** is particularly simple to make, as it does not require any connection device to connect the mixer element **5** to the container **2**.

In fact, the position and the movement of the mixer element **5** are determined by the position and the movement of the external magnet **9**.

Therefore, the package **1** can be obtained by simply inserting the mixer element **5** in the container **2** together with the stereolithography resin **3**.

Preferably but not necessarily, the movement of the external magnet **9** is a rotation around the geometrical axis of the container **2**.

Advantageously, and as will be explained below, said rotation can be obtained by connecting the external magnet **9** to particularly simple motorisation means **12** such as, for example, an electric motor.

Obviously, according to variant embodiments of the invention the mixer element **5** may perform a movement different from rotation, for example a translation movement, a planetary movement or any other movement of the known type.

Preferably, the mixer element **5** comprises two magnets **6**, arranged in such a way that each pole **N**, **S** of a magnet **6** faces a corresponding pole **N**, **S** of the other magnet **6**.

In particular, as shown in Figure 1, each one of the poles **N**, **S** of a magnet **6** faces the pole with opposite sign of the other magnet **6**.

In this way, each one of the two poles **N**, **S** of the external magnet **9** attracts the pole with opposite sign of a corresponding magnet **6** of the mixer element **5** and repels the other pole of the same magnet **6**.

Therefore, the two magnets **6** of the mixer element **5** are forced to assume a position that is coplanar with the external magnet **9**.

In particular, when the external magnet **9** is rotated according to a plane parallel to the bottom **2a** of the container **2**, the mixer element **5** rotates while at the same time remaining perpendicular to the bottom **2a**, with the advantage of increasing the efficiency of the mixer element.

Still advantageously, with the two magnets **6** arranged opposing each other as described above, the mixer element **5** has such a configuration that it can assume any one of two equivalent positions, one rotated by 180° with respect to the other.

Still advantageously, the opposing arrangement of the two magnets **6** makes it possible to use a single external magnet **9** to move them.

According to a variant embodiment of the invention, not illustrated herein, the two magnets **6** of the mixer element **5** may be arranged with the respective poles **N**, **S** with the same sign mutually facing each other.

In this case, the movement of the mixer element **5** is obtained by means of two external magnets, arranged, too, with the respective poles **N**, **S** with the same sign facing each other, in such a way as to attract the corresponding poles with opposite sign of the magnets **6** of the mixer element.

It can be understood that, also in this variant embodiment, the mixer element **5** assumes an operating configuration that is coplanar with respect to the external magnets.

In any case, the mixer element **5** preferably comprises a laminar body **5a** that extends between the two magnets **6**.

Advantageously, the laminar body **5a** carries out the mixing action following the rotation of the mixer element **5**.

Obviously, variant embodiments of the invention may comprise a mixer element with a single magnet, or with more than two magnets.

In these variant embodiments, the laminar body **5a** is configured, with respect to the magnets, in such a way that in the operating position it develops mainly on the plane that is perpendicular to the rotation axis of the mixer element **5**.

With regard to the container **2**, it is preferably a bottle, which can advantageously be supplied separately from the stereolithography machine.

Preferably, said bottle has a flat bottom **2a** that, advantageously, improves the mixing action, as it eliminates the presence of concave portions at the level of the corners of the container **2**, which can be hard to reach by the mixing action.

Still advantageously, the flat bottom **2a** favours the proximity of the mixer element **5** to the external magnet **9**.

It can be understood that said proximity increases the attraction between the magnets **6** of the mixer element **5** and the external magnet **9**, thus facilitating the driven movement of the mixer element **5**.

The bottle has a preferably circular cross section, as shown in Figure 2.

According to a variant embodiment of the invention, shown in Figure 3, the cross section of the bottle is delimited by a mixtilinear profile.

Said mixtilinear profile makes it possible to precisely fit the bottle in a seat **10** whose shape matches the shape of the container.

Said configuration of the seat **10** advantageously prevents any rotation of the bottle around its axis following the rotational movement transmitted to the mixer element **5**.

Preferably, the cross section is generally triangular in shape, which advantageously facilitates the storage of the bottle.

Obviously, in variant embodiments of the invention the shape of the bottle can be other than triangular, more generally polygonal.

Preferably, the bottle is supplied with the access opening **4** sealed by a cap **8**.

Said cap **8** advantageously makes it possible to preserve the contents of the container **2**, avoiding any deterioration due to its contact with external agents.

Obviously, variant embodiments of the invention may comprise a container **2** configured so that it can be used directly as a tank for the stereolithography machine, for example with a transparent bottom.

Preferably, the internal surface of the container **2** defines a concave area **7**, as in the embodiment shown in Figure 3, that extends according to a direction orthogonal to the plane of the access opening **4** to the bottom **2a** of the container **2**.

Said concave area **7** is suited to house a dispensing pipe arranged in the container **2**, through which the resin **3** is withdrawn in order to convey it to the stereolithography machine.

Advantageously, said concave area **7** can accommodate the dispensing pipe, thus preventing the latter from interfering with the rotation of the mixer element **5**.

Obviously, if the container **2** has a polygonal shape as described above, each one of the vertices of the polygon defines a corresponding concave area **7**.

According to a variant embodiment of the invention, not illustrated herein, the mixer element **5** is provided with a through hole in which said dispensing pipe is revolvingly inserted.

Advantageously, said arrangement of the dispensing pipe makes it possible to place its end at the level of the centre of the container **2**, from where the resin **3** can be withdrawn more efficiently.

In this case, the dispensing pipe is preferably made of a flexible material, in order to ensure that the mixer element **5** has a certain freedom of movement.

According to the invention, the container **2** comprises also a data storing device **13** containing information on the type and quantity of stereolithography resin **3** contained in the container **2**.

The data storing device **13** is associated with connection means suited to transmit information on the stereolithography resin **3** to an external device, for example to the stereolithography machine or to an automatic mixing device **11** of the type shown in Figure 1.

Advantageously, the presence of said data storing device **13** allows the external device to carry out the processing based on the contents of the container **2**.

Preferably but not necessarily, the data storing device **13** is an electronic device, for example a transponder of the RFID type (radio-frequency identification), an integrated circuit (microchip) or a similar device.

According to variant embodiments of the invention, the data storing device **13** can be a magnetic band or any other support, provided that it is suited to store said information.

Regarding the connection means, they preferably comprise electromagnetic means, such as an antenna or a magnetic field, particularly suited to be used in the case where the data storing device **13** is respectively a RFID or a magnetic band.

In variant embodiments of the invention, the transmission means may comprise electric means like, for example, a connector, which is particularly suited to be used with an integrated circuit.

In further variant embodiments of the invention, the transmission means may comprise any means, provided that they are suited to transmit the information from the data storing device **13** to the user device.

As already mentioned, the mixing operation can be performed by an automatic mixing device **11** comprising a seat **10** suited to accommodate the container **2** and comprising also the external magnet **9** and the corresponding motorisation means **12** that sets it rotating.

In particular, the mixing device **11** is configured so that, when the container **2** is associated with the seat **10**, the external magnet **9** is in proximity to the container **2** itself and preferably faces its bottom **2a**.

Obviously, in variant embodiments of the invention, the external magnet **9** can be arranged in a different position and can be moved in another way, different from that described above.

Preferably, the mixing device **11** comprises reading means **14**, for example an antenna, a magnetic reader, a connector suited to be associated with the container **2**, or any other means, provided that it is suited to acquire the information contained in the data storing device **13**.

Preferably, said acquisition takes place when the container **2** is associated with the seat **10** and the reading means **14** are configured accordingly.

The mixer device **11** is configured so that it can mix the stereolithography resin **3** based on said information, for example through a logic control unit **15** that controls the motorisation means **12** of the external magnet **9**, in particular the rotation speed and the mixing time.

Preferably, the mixing device **11** comprises also heating elements **16** configured so as to establish a thermal contact with the container **2** when the latter is arranged in the seat **10**. Preferably, said heating elements **16** are positioned within the walls **17** that delimit the seat **10**.

Advantageously, the heating elements **16** are capable of heating the stereolithography resin **3** contained in the container **2** to a predetermined temperature, in such a way as to favour the mixing of the resin **3** and/or its successive use in a stereolithography process. Preferably, also the heating elements **16** are controlled by the logic control unit **15** based on the information contained in the data storing device **13**, so as to maintain the resin **3** at the optimal temperature during the mixing operation.

According to a variant embodiment of the invention, the mixing device **11** belongs to the stereolithography machine, with the advantage of simplifying the processing cycle.

The above clearly shows that the invention achieves all the set objects.

In particular, the presence of a magnetic mixer element situated inside the container makes it possible to carry out the mixing operation with no need to open the container itself and thus with no need to expose the resin to the atmospheric agents.

Furthermore, the magnetic operation can be obtained through an automatic mixing device, avoiding the intervention of the operator and thus making the mixing operation simpler and repeatable.

In particular, said mixing device can be configured so that the mixing operation is performed according to the type and quantity of the material contained in the container, thus allowing a more reliable mixing process to be implemented.

The embodiments of the present invention for which an exclusive property or privilege is claimed are defined as follows:

1) A stereolithography system comprising:
a stereolithography machine;
a package comprising a container filled with a stereolithography resin and provided with an access opening;

wherein said package further comprises: a mixer element, removably arranged in said container and provided with at least one magnet; a data storing device belonging to said container, containing information on a type and quantity of said stereolithography resin, said data storing device associated with connection means to transmit said information to an external device;
and wherein said stereolithography system further comprises:

a duct for connecting said container to said stereolithography machine, said duct adapted for withdrawal of said stereolithography resin from said container;

a mixing device provided with:

a seat suited to accommodate said container;

an external magnet associated with motorisation means to move said external magnet;

reading means to read the information contained in said data storing device of said container, said reading means operatively associated with a logic control unit configured so as to control said motorisation means based on said information.

2) The stereolithography system according to claim 1, further comprising heating means to establish a thermal contact with said container when said container is arranged in said seat.

3) The stereolithography system according to claim 2, wherein said logic control unit controls said heating means based on the information contained in said data storing device.

4) The stereolithography system according to any one of claims 1 to 3, wherein said mixer element comprises at least two of said magnets, arranged so that each pole (N, S) of one of said magnets faces a corresponding pole (N, S) of the other magnet.

5) The stereolithography system according to claim 4, wherein each pole (N, S) of one of said magnets faces the pole (N, S) with opposite sign of the other magnet.

6) The stereolithography system according to claim 4 or 5, wherein said mixer element comprises a laminar body that extends between said two magnets.

7) The stereolithography system according to any one of claims 1 to 6, wherein said mixer element is released from said container.

8) The stereolithography system according to any one of claims 1 to 7, wherein said container is a bottle and said access opening is sealed by a cap.

9) The stereolithography system according to claim 8, wherein said bottle has a cross section which is externally delimited by a mixtilinear profile.

10) The stereolithography system according to any one of claims 1 to 9, wherein said mixing device is configured so that, when said container is associated with said seat, said external magnet is close to said container and faces a bottom of said container.

11) The stereolithography system according to any one of claims 1 to 10, wherein said mixing device is part of said stereolithography machine.

12) A method for mixing a stereolithography resin comprising the steps of:

preparing a package by filling a container provided with an access opening with said stereolithography resin; wherein said package further comprises: a mixer element removably arranged in said container and provided with at least one magnet; a data storing device belonging to said container, containing information on a type and quantity of said stereolithography resin, said data storing device associated with connection means to transmit said information to an external device;

arranging an external magnet outside said container, facing a bottom of said container;

reading said information from said data storing device;

controlling motorization means through a logic control unit for moving said external magnet based on said information so as to drive said mixer element.

13) The method according to claim 12, wherein said movement of said external magnet is a rotation.

14) The method according to claim 12 or 13, further comprising the step of heating said stereolithography resin.

15) The method according to any one of claims 10 to 12, further comprising the step of:

controlling a speed of said external magnet based on said information.

16) The method according to any one of claims 12 to 15, further comprising the step of controlling the rotation time of said external magnet based on said information.

17) The method according to claim 14, further comprising the step of controlling the temperature used in said step of heating said stereolithography resin based on said information.

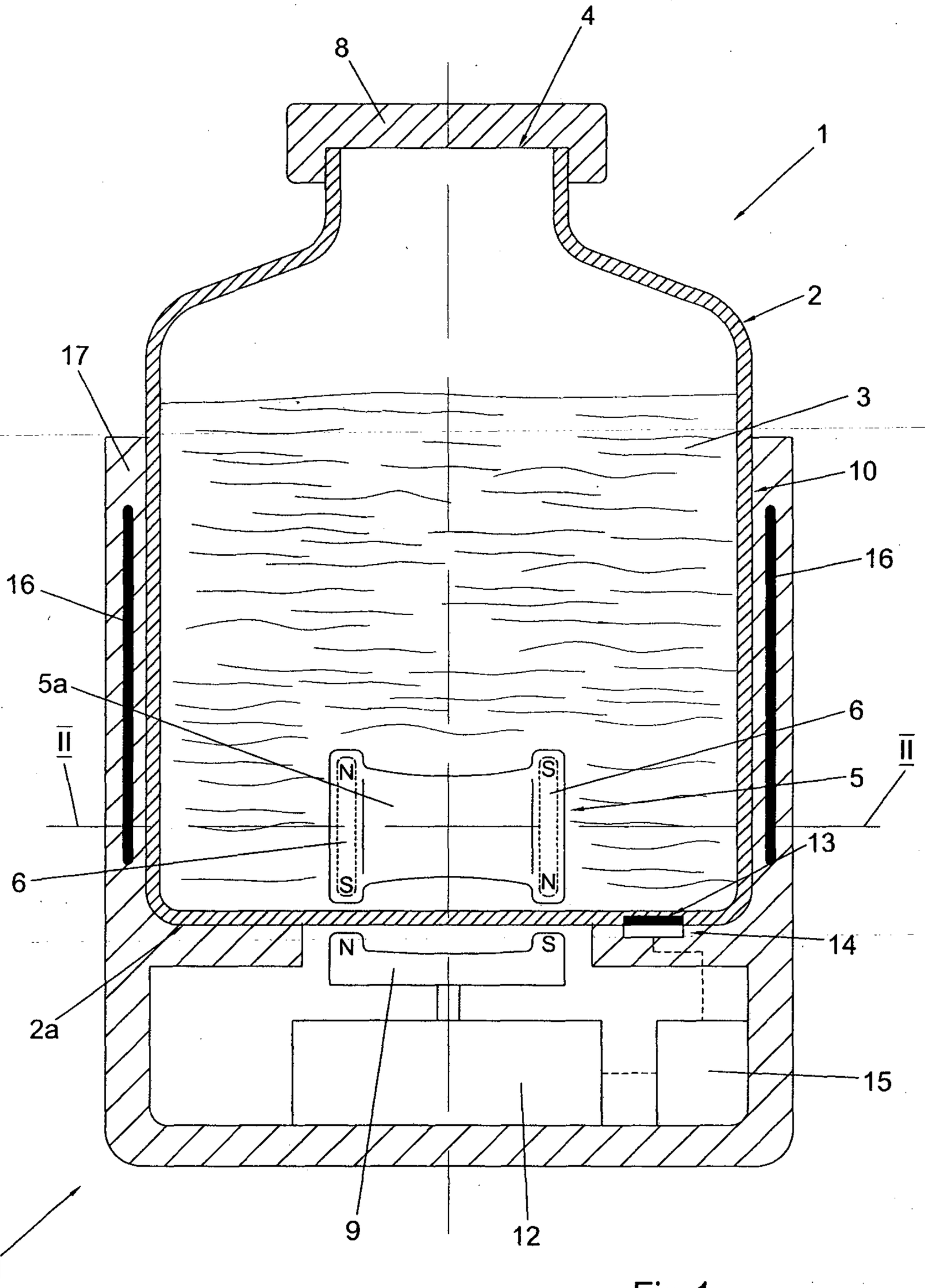


Fig.1

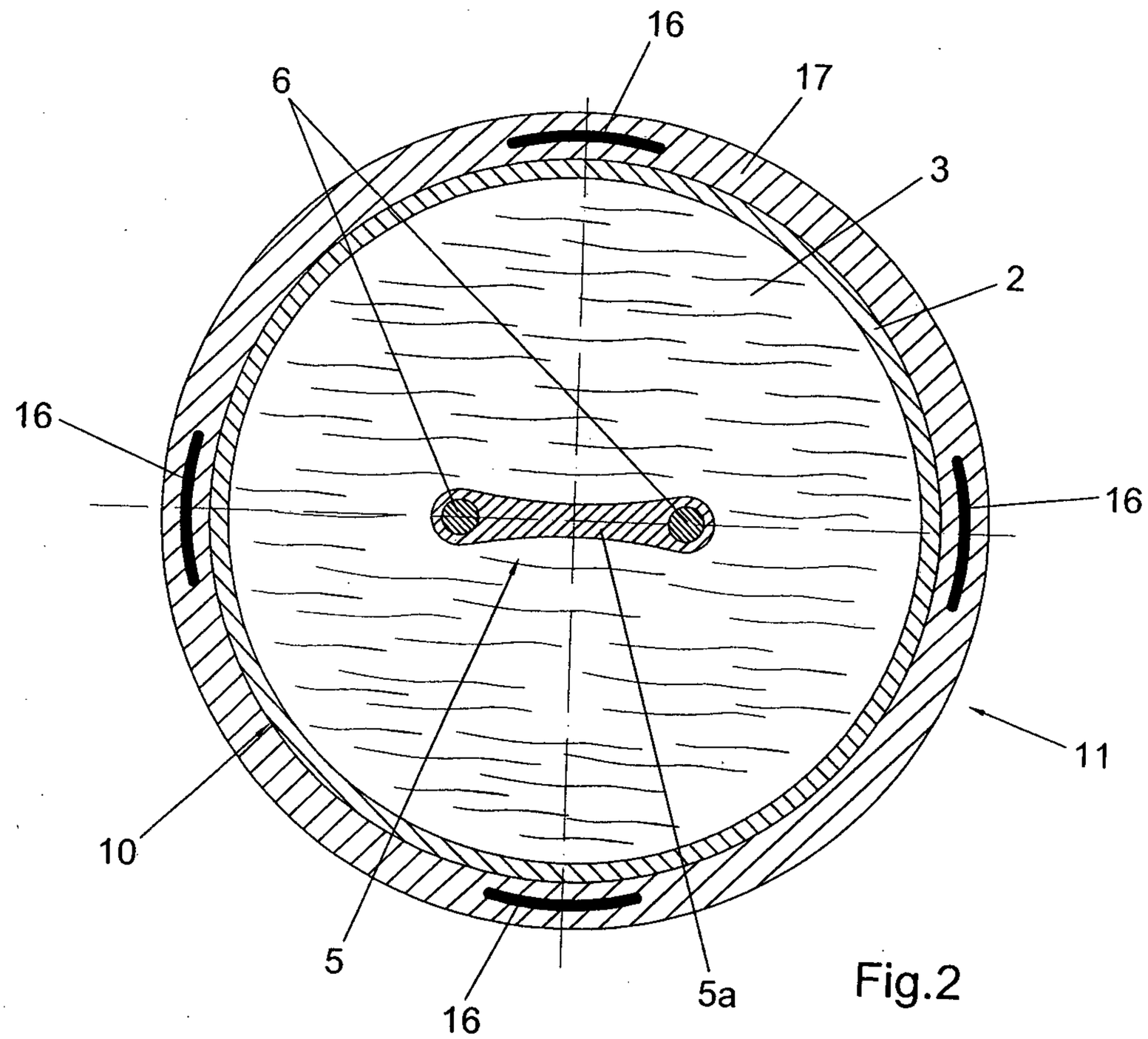


Fig.2

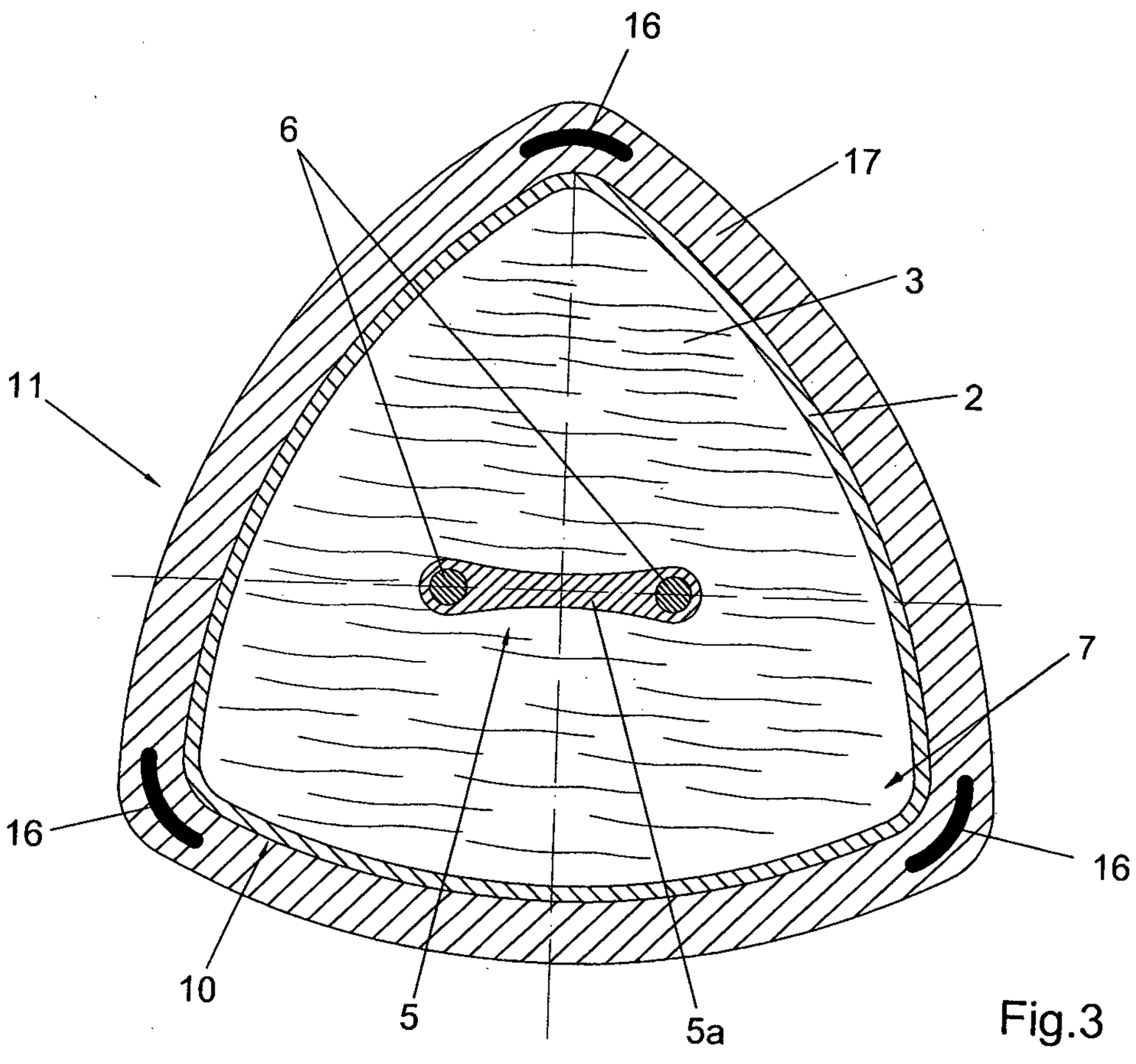
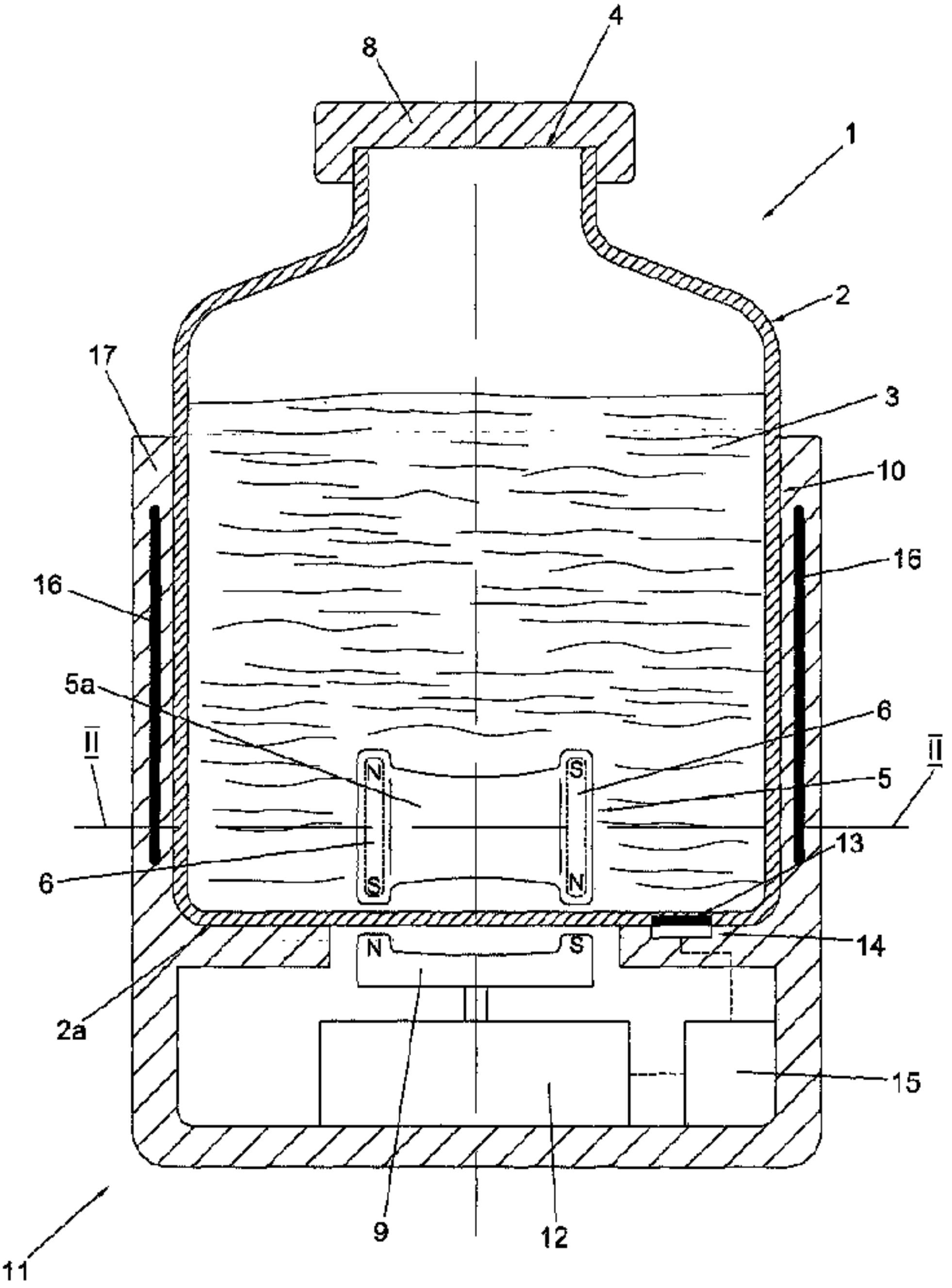


Fig.3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