IMPROVED CARTRIDGE FOR A STEREOLITHOGRAPHY MACHINE, STEREOLITHOGRAPHY MACHINE SUITED TO HOUSE SAID IMPROVED CARTRIDGE AND METHOD FOR USING SAID IMPROVED CARTRIDGE.

DESCRIPTION

The present invention concerns an interchangeable cartridge for a stereolithography machine.

As is known, the stereolithography technique makes it possible to produce a three-dimensional object through the superimposition of a plurality of layers of a liquid or pasty base material that is solidified through exposure to predefined radiation, generally light radiation.

A stereolithography machine of the known type comprises a container suited to contain the base material and provided with a bottom that is transparent to the predefined radiation.

The machine comprises also emitter means suited to emit said predefined radiation and arranged under the container, which selectively solidify the layer of base material that is adjacent to the bottom of the container.

The solidified layers are supported by a modelling platform, powered so that it moves in the vertical direction in order to allow the last solidified layer to be arranged adjacent to said layer of base material before its solidification.

According to an embodiment described in the Italian patent application VI2012A000183, the container belongs to a removable device, which in technical jargon is called “cartridge”, comprising also a reservoir suited to contain the base material and associated with the container in a non-removable way, so as to form a single body with it.

When necessary, the base material is made flow out of the reservoir and into the container, through valve means that connect the two elements.

Said cartridge offers several advantages, among which the advantage of allowing the automatic top-up of the container in the moment when and to the extent to which this is required, as well as the advantage of avoiding the need to clean the stereolithography machine, as the reservoir and the base material feeding system are incorporated in the cartridge and therefore the base material does not contaminate any component of the machine.

Overall, said cartridge considerably simplifies the use of the stereolithography machine, making it suited to be used even by an unskilled operator like, for example, an operator working in the goldsmithery or dentistry sector.

It is the object of the present invention to provide an improved cartridge that, compared to the cartridge described above and belonging to the known art, is particularly simple to produce.

It is another object of the present invention to provide a cartridge that can be connected to a stereolithography machine in a simple and rapid manner.

It is also the object of the invention to provide a stereolithography machine that is suited to operate with said cartridge.

It is another, yet not the least object of the invention to provide a method for using the cartridge itself.

Said objects are achieved by a cartridge carried out according to the main claim.

Said objects are also achieved by a stereolithography machine according to claim 8 and by a method for using the cartridge according to claim 23.

Variant embodiments of the invention are illustrated in the corresponding dependent claims.

Advantageously, the simple construction structure of the cartridge of the invention makes it particularly economical to manufacture and suitable for mass production.

Still advantageously, the simple connection of the cartridge to the stereolithography machine further simplifies the use of the machine itself, to the advantage of its possible diffusion.

Said objects and advantages, together with others that will be mentioned below, will be evident in the description of a preferred embodiment of the invention that is provided by way of example without limitation with reference to the attached drawings, wherein:

- Figure 1 shows a schematic axonometric view of the cartridge that is the subject of the invention;
- Figure 2 shows a schematic axonometric view of a part of the stereolithography machine of the invention;
- Figure 3 shows an axonometric view of the part illustrated in Figure 2 in a different operating configuration;
- Figure 4 shows a sectional view of the part illustrated in Figure 2, according to a plane of symmetry;
- Figure 5 shows a side view of the cartridge illustrated in Figure 1 associated with the part illustrated in Figure 2;

- Figure 6 shows an axonometric view of the cartridge of Figure 1 associated with the part illustrated in Figure 2, in an operating configuration different from the one shown in Figure 5;
- Figure 7 shows the cartridge of Figure 1 and the part of Figure 2 associated together as in Figure 6, in a sectional view according to a plane of symmetry;
- Figure 8 shows an enlarged detail of Figure 7.

The cartridge for a stereolithography machine that is the subject of the invention, shown in Figure 1 and therein indicated as a whole by **1**, comprises a container **2** provided with an access opening **3** and with a transparent bottom **4** facing and opposite to said access opening **3**.

The access opening **3** is intended to allow the access of the modelling platform of a stereolithography machine of the type described in the introductory part and not illustrated in the figures, but known per se, into the container **2**.

The transparent bottom **4** allows predefined radiation to pass therethrough, said predefined radiation being capable of selectively solidifying a pre-selected liquid or pasty base material contained therein.

Preferably but not necessarily, the base material is a light hardening resin or a photopolymer and the predefined radiation is light, for example a light beam.

The cartridge **1** comprises also a reservoir **5** suited to contain said base material and forming a single body with the container **2**.

The cartridge **1** also comprises valve means **6** that connect the reservoir **5** to the container **2** in such a way as to allow the passage of the base material from the reservoir **5** to the container **2**.

According to the invention, the valve means **6** are configured in such a way that they open when the difference between the pressure present in the reservoir **5** and the pressure present in the container **2** is at least equal to a predefined value and close spontaneously when said pressure difference is lower than said predefined value.

The reservoir **5** furthermore comprises tight connection means **7** suited to connect the reservoir **5** to an external air feeding device.

The valve means **6** and the connection means **7** described above make it possible to control the outflow of the base material by simply operating the air feeding device in such a way as to increase the pressure present in the reservoir **5**, stopping said outflow by stopping the air feeding device.

Preferably, the valve means **6** comprise a first membrane **9** provided with a hole **10** that is normally closed and is configured so that it opens elastically as a result of the effect of said pressure difference exceeding the predefined value.

Advantageously, said first membrane **9** represents a particularly economical way to produce the valve means **6** and therefore makes it possible to limit the cost of the cartridge **1**.

Preferably, the valve means **6** are distributed on different points of the wall **36** that delimits the container **2** perimetrically and comprise corresponding first membranes **9** of the type described above.

Preferably, the connection means **7** comprise a second membrane **11** belonging to the wall of the reservoir **5**, suited to be perforated by a needle-shaped element while at the same time maintaining its tightness when the needle-shaped element is arranged so that it passes through the second membrane **11**.

Advantageously, said second membrane **11** makes it possible to connect the reservoir **5** to the air feeding device **8** in a simple and rapid manner, as described in greater detail below.

Preferably, the reservoir **5** is provided with an annular wall **36** that corresponds to the perimeter wall of the container **2**.

Advantageously, the fact that the reservoir **5** delimits the container **2** perimetrically allows the valve means **6** to be distributed along the entire perimeter of the container **2** itself, in such a way as to guarantee the uniform and rapid outflow of the base material towards the container **2**.

Preferably, said annular wall **36** comprises two mutually facing sections **37** with semi-circular profile.

Advantageously, the presence of said semi-circular sections **37** makes it possible to avoid the presence of sharp corners in the wall of the container **2**, in such a way as to favour the rapid distribution of the base material in the container **2** itself.

Preferably and as shown in Figure 7, the reservoir **5** is internally delimited by an inclined wall **12** that forms an angle larger than 90° and smaller than 180° with respect to the transparent bottom **4**.

The valve means **6** are arranged at the level of said inclined wall **12**, in particular of its edge nearest to the container **2**.

In this way, to advantage, the inclined wall **12** makes it easier to convey the base material towards the valve means **6**.

The configuration just described above offers the further advantage that the valve means **6** are always submerged by the base material, which prevents the air that is introduced in the reservoir **5** to increase pressure therein from obstructing the valve means **6** themselves and affecting the regular operation of the cartridge **1**.

Regarding the transparent bottom **4**, this is preferably delimited perimetrically by an outer edge **4a**, housed in a cavity **5a** belonging to the reservoir **5** in such a way that it is contained within the overall dimensions of the reservoir **5**.

This advantageously makes it possible to limit the overall dimensions of the cartridge **1**.

In variant embodiments of the cartridge, the transparent bottom **4** is integral with the reservoir **5**.

The cartridge **1** is preferably provided with a cap, not shown in the drawings, which can be removably inserted in the access opening **3** in such a way as to close it.

Advantageously, the presence of said cap makes it possible to preserve any base material that may have been left in the container **2** during the periods of inactivity of the cartridge **1**, in particular when the latter is temporarily removed.

As already mentioned above, said cartridge **1** is suited to be associated with a stereolithography machine of which the drawings show just a part, corresponding to the area of the machine that is coupled with the cartridge **1**.

In particular, the stereolithography machine comprises a supporting structure that, as shown in Figure 2, supports a housing **14** configured in such a way as to removably accommodate the cartridge **1** in a stable operating position.

The stereolithography machine furthermore comprises emitter means, not illustrated in the drawings but known per se, configured so as to emit said predefined radiation, associated with an optical unit in order to convey the radiation towards said housing **14**.

Said emitter means may comprise, for example, a laser emitter, a projector or any other analogous means of known type.

The stereolithography machine comprises also a modelling plate, not represented in the drawings but known per se, suited to support the three-dimensional object during its production.

Said modelling plate is arranged in such a way that it faces the transparent bottom **4** of the cartridge **1** when the latter is in operating position and is associated with power means for its movement with respect to the housing **14**, so that it can be moved near to and away from the transparent bottom **4** of the cartridge **1**.

According to the invention, the machine comprises an air feeding device **8** provided with a feed duct **15** suited to be tightly connected to the connection means **7** of the cartridge **1** when the latter is arranged in the housing **14**.

In particular, the air feeding device **8** is suited to be operated in such a way as to increase the pressure present in the reservoir **5** when it is necessary to cause the base material to flow towards the container **2** and to decrease it when it is necessary to stop said flow.

Preferably, the feed duct **15** is configured so that it can be removably connected to the connection means **7**, in such a way as to allow the cartridge **1** to be easily removed from the machine.

Preferably, the feed duct **15** comprises a needle-shaped end **16**, visible in Figure 3, suited to be arranged through the second membrane **11** when the cartridge **1** is arranged in said operating position.

Advantageously, the needle-shaped end **16** ensures the simple and rapid connection of the air feeding device **8** to the reservoir **5** of the cartridge **1**.

In fact, as shown in Figures 7 and 8, when the cartridge **1** is arranged in operating position, the second membrane **11** of the cartridge **1** is perforated by the needle-shaped end **16** with no need for the operator to take care to activate any valve or sealing element, as tightness is already ensured by the second membrane **11**, as described above.

Regarding the housing **14** for the cartridge **1**, visible in particular in Figure 3, it preferably comprises stop means **17** configured to maintain the cartridge **1** in operating position, which can be released in order to free the cartridge **1** from the housing **14**.

Advantageously, said stop means **17** facilitate the connection of the cartridge **1** to the stereolithography machine, as well as its removal therefrom.

In particular, the housing **14** comprises a supporting base **18** that defines a supporting surface **19** suited to support the cartridge **1** on the side corresponding to the transparent bottom **4**.

Preferably but not necessarily, the supporting surface **19** comprises a

transparent sheet **13** arranged in such a way that it faces the transparent bottom **4** when the cartridge **1** is in operating position.

Advantageously, said transparent sheet **13** protects the underlying area of the stereolithography machine from dust and any base material that may contaminate it, the radiation emitter and the corresponding optical unit being arranged in said underlying area of the stereolithography machine.

Preferably, the transparent bottom **4** has the same geometry as the transparent sheet **13**, that is, they are preferably but not necessarily plane, so that the two components are arranged in mutual contact when the cartridge **1** is arranged in operating position.

Advantageously, this avoids the formation of intermediate spaces that would shift the focus of the light beam with respect to the desired position, reducing the processing precision of the stereolithography machine.

The transparent sheet **13** is preferably flat and the curvature of the transparent bottom **4** is directed towards the outside of the cartridge **1**.

Furthermore, the transparent sheet **13** is more rigid than the transparent bottom **4** of the cartridge **1**.

For example, the transparent sheet **13** can be made of glass and the transparent bottom **4** can be made of a plastic material, for example methacrylate.

The different degrees of rigidity and the different curvatures described above are such that when the cartridge **1** is arranged in a stable position and pressed against the supporting base **18**, the transparent bottom **4** of the cartridge **1** becomes deformed in such a way as to adhere perfectly to the transparent sheet **13**.

According to a variant embodiment of the invention, the transparent sheet **13** is curved and the transparent bottom **4** has a curvature that is different from that of the transparent sheet **13** and such as to obtain the same compression effect described above.

Preferably and as shown in Figure 3, said supporting surface **19** is delimited by a containment edge **20** that projects from the supporting surface **19** and is suited to come into contact with the cartridge **1** in such a way as to prevent it from sliding on the supporting surface **19**.

The stop means **17** preferably comprise a cover **21** suited to face the supporting surface **19** in such a way as to come into contact with the cartridge

1 on the opposite side with respect to the supporting surface **19**, as shown in Figure 7.

Advantageously, the cover **21** maintains the cartridge **1** pressed against the supporting base **18**, increasing the stability of the cartridge **1** itself during the operation of the stereolithography machine.

The cover **21** is provided with an opening **21a** configured in such a way that it can be arranged so that it faces the access opening **3** of the cartridge **1** when the latter is in operating position and the cover **21** is in contact with the cartridge **1** itself.

Obviously, in variant embodiments of the machine said cover **21** can be replaced by equivalent elements capable of preventing the cartridge **1** from being lifted from the supporting base **18**.

Preferably, the cover **21** is provided with elastic elements **38** configured so that they can be compressed when they come into contact with the cartridge **1**, in such a way as to compensate for any defects of the cartridge **1** and in any case ensure contact with the latter.

Preferably, the cover **21** is provided with a first edge **22** revolvingly associated with the supporting base **18** and a second edge **23** opposite the first one and connected to the supporting base **18** through releasable snap-fitting means **24**.

Preferably and as shown in Figure 4, said first edge **22** is provided with tabs **33** removably inserted in corresponding openings **34** belonging to the supporting base **18**, in such a way as to allow both the rotation of the cover **21** with respect to the supporting base **18** and its removal from the supporting base **18**.

Advantageously, the possibility to remove the cover **21** allows the operator to easily access the supporting base **18** for periodical cleaning, if necessary.

Preferably, the containment edge **20** of the housing **14** comprises a manoeuvring wall **25** provided with a first end **26** and with a second end **27** that mutually oppose each other, the first end **26** being revolvingly associated with the supporting base **18** in such a way as to define for the manoeuvring wall **25** a stop position and a release position relating to the cartridge **1**.

In the stop position shown in Figures 6 and 7, the second end **27** is arranged against the cover **21** when this is arranged in contact with the cartridge **1**, so as to prevent the rotation of the cover **21** and avoid the accidental release of the cartridge **1** from the supporting base **18**.

In the release position, shown in Figures 2 and 4, the second end **27** is

arranged in such a way as to allow the rotation of the cover **21** in such a direction as to move it away from the supporting base **18**, thus allowing the cartridge **1** to be lifted from the housing **14**.

For this purpose, the cartridge **1** is preferably provided with an edge **39** projecting towards the outside of the housing **14**, suited to make it easier for the user to hold and lift the cartridge **1**.

Preferably, the second end **27** of the manoeuvring wall **25** is provided with a chute-like surface **27a** on which the second edge **23** of the cover **21** can freely slide during the rotation of the cover **21** towards the supporting base **18**.

During the rotation of the cover **21** in the direction just described above, it slides on said chute-like surface **27a** making the manoeuvring wall **25** rotate towards the release position.

When the cover **21** has reached the position of contact with the cartridge **1**, it is released from the chute-like surface surface, thus allowing the manoeuvring wall **25** to be arranged in the stop position.

For this purpose, the manoeuvring wall **25** is preferably associated with first elastic means **30**, shown in Figure 4, suited to force the movement of the manoeuvring wall **25** itself from the release position towards the stop position.

Regarding the second end **27** of the manoeuvring wall **25**, it is preferably provided with a stop surface **28** suited to limit said rotation of the cover **21** and, consequently, its opening with respect to the supporting base **18**.

Preferably, there are second elastic means **35** suited to force the rotation of the cover **21** in the direction in which it opens with respect to the supporting base **18**.

Advantageously, said second elastic means **35** facilitate the opening of the cover **21** and the release of the cartridge **1** from the housing **14**, since it is sufficient for the operator to move the manoeuvring wall **25** to the release position in order to automatically cause the cover **21** to be lifted.

Preferably, the stop surface **28** is shaped in such a way as to define a concave portion **29** facing the second edge **23** of the cover **21**, wherein said second edge in turn is configured to be arranged inside said concave portion **29** in such a way as to limit the rotation of the manoeuvring wall **25**, as can be observed in Figure 4.

Advantageously, said stop surface **28** makes it possible to prevent the cover **21** from being completely separated from the supporting base **18**, thus

avoiding also the accidental removal of the cover **21** itself.

It is evident that the cover **21** can in any way be removed by keeping it pressed and at the same time rotating the manoeuvring wall **25** until its stop surface **28** is positioned in such a way as to prevent it from interfering with the trajectory of the cover **21**.

Preferably, the manoeuvring wall **25** comprises a through opening **31** suited to slidingly house the cartridge **1**.

Advantageously, said through opening **31** facilitates the insertion of the cartridge **1** in the housing **14**.

Preferably and as can be observed in Figure 2, the through opening **31** comprises an edge **32** that is raised with respect to the supporting surface **19** and is suited to maintain the cartridge **1** inclined with respect to the supporting surface **19** during the sliding movement of the cartridge **1** towards the housing **14**, as shown by way of example in Figure 5.

In this way, the transparent bottom **4** of the cartridge **1** remains lifted from the transparent sheet **13** until the cartridge **1** has completely occupied the housing **14**, with the advantage of protecting the transparent bottom **4** and the transparent sheet **13** from scratches.

Preferably, the housing **14** is removably associated with the supporting structure through moving means, not represented herein but known per se, which define for the housing **14** a direction of movement that is parallel to the plane defined by the access opening **3**.

Said moving means make it possible to move the cartridge **1** with respect to the modelling plate during the production of the object, in such a way as to periodically modify the area of the transparent bottom **4** of the cartridge **1** and of the transparent sheet **13** exposed to radiation, with the advantage of making them last longer.

Furthermore, the feed duct **15** that connects the cartridge **1** to the air feeding device **8** is deformable, so as to allow air to be introduced in the reservoir **5** in any position occupied by the housing **14** during its movement.

Preferably, the modelling plate of the stereolithography machine has a circular profile, in particular with the radius only slightly smaller than the radius of the two semi-circular sections **37** of the access opening **3** of the cartridge **1**.

It can be understood that said circular modelling plate allows the widest movement of the cartridge **1** in the manner described above, with the

advantage of allowing the entire surface of the transparent bottom **4** and of the transparent sheet **13** to be used.

In practice, in order to insert the cartridge **1** in the housing **14**, the operator places the manoeuvring wall **25** in the release position, so as to lift the cover **21**, as shown in Figure 2.

The cartridge **1** can thus be arranged in the through opening **31** of the manoeuvring wall **25**, oriented so that the second membrane **11** faces the needle-shaped end **16** of the stereolithography machine.

The cartridge **1** is made slide while it is in contact with the raised edge **32** of the through opening **31**, as shown in Figure 5, until it is completely inserted in the housing **14**, as shown in Figure 4.

During said movement, the needle-shaped end **16** of the feed duct **15** perforates the second membrane **11** of the cartridge **1** and becomes positioned so that it passes through it.

Successively, the cover **21** can be lowered until the manoeuvring wall **25** snaps in the stop position, as shown in Figures 6 and 7.

At this point, the machine is ready for use.

When necessary, during the production of the three-dimensional object, the air feeding device **8** is operated in such a way as to generate a difference between the pressure present in the reservoir **5** and the pressure present in the container **2** that is sufficient to cause the valve means **6** to open, so as to have the base material contained in the reservoir **5** flow towards the container **2**.

When the base material has reached a sufficient level in the container **2**, the air feeding device **8** is operated in such a way as to reduce said pressure difference, causing the valve means **6** to close spontaneously and the flow to stop.

Preferably, the air feeding device **8** as described above is operated by the logic unit of the machine, which also serves for controlling the emitter means, the modelling plate and the moving means of the housing **14**.

According to the above, it can be understood that the cartridge and the machine described above achieve all the objects of the invention.

In particular, the cartridge can be produced with no need to use complex components, thus simplifying its production.

In particular, the only movable components are the first membranes and the

second membrane, which however are inexpensive components easily available on the market.

Furthermore, the fact that the reservoir is connected to the air feeding device by simply positioning the cartridge in the housing, with no need to operate any valve, makes the manoeuvre simple and rapid.

CLAIMS

1) Cartridge (1) for a stereolithography machine, comprising:

- a container (2) delimited by a wall and provided with an access opening (3) and with a transparent bottom (4) opposite said access opening (3);
- a reservoir (5) unremovably associated with said container (2) and suited to contain a liquid or pasty base material;
- valve means (6) connecting said reservoir (5) to said container (2) for the passage of said base material;

characterized in that said valve means (6) are configured to open when the difference between the pressure present in said reservoir (5) and the pressure present in said container (2) is at least equal to a predefined value and to spontaneously close when said pressure difference is lower than said predefined value, said reservoir (5) comprising tight connection means (7) for connection to an external air feeding device (8).

2) Cartridge (1) according to claim 1, **characterized in that** said valve means (6) comprise a first membrane (9) provided with a hole (10) that is normally closed and configured to open elastically due to the effect of said pressure difference at least equal to said predefined value.

3) Cartridge (1) according to claim 1 or 2, **characterized in that** said connection means (7) comprise a second membrane (11) belonging to the wall of said reservoir (5) and suited to be perforated by a needle-shaped element while at the same time maintaining its tightness when said needle-shaped element is arranged so that it passes through said second membrane (11).

4) Cartridge (1) according to any of the claims from 1 to 3, **characterized in that** said reservoir (5) is provided with an annular wall (36) that delimits said container (2) perimetrically.

5) Cartridge (1) according to claim 4, **characterized in that** said annular wall (36) comprises two mutually facing sections (37) with semi-circular profile.

6) Cartridge (1) according to claim 4 or 5, **characterized in that** said transparent bottom (4) is perimetrically delimited by an outer edge (4a), said outer edge (4a) being housed in a cavity (5a) belonging to said reservoir (5) in such a way as to remain within the overall dimensions of said reservoir (5).

7) Cartridge (1) according to any of the claims from 1 to 6, **characterized in that** said reservoir (5) is internally delimited by an inclined wall (12) that forms, together with said transparent bottom (4), an angle that is larger than

90° and smaller than 180°, said valve means (6) being arranged at the level of the edge of said inclined wall (12) that is nearest to said container (2).

8) Stereolithography machine comprising a supporting structure and a housing (14) associated with said supporting structure, configured to removably house in a stable operating position a cartridge (1) according to any of the claims from 1 to 6, **characterized in that** it comprises an air feeding device (8) provided with a feed duct (15) suited to be tightly connected to said connection means (7) of said cartridge (1) when said cartridge (1) is arranged in said housing (14), said air feeding device (8) being suited to be operated in such a way as to modify the pressure present in said reservoir (5).

9) Stereolithography machine according to claim 8, **characterized in that** said cartridge (1) is in accordance with claim 3, said feed duct (15) comprising a needle-shaped end (16) suited to be arranged through said second membrane (11) when said cartridge (1) is arranged in said operating position.

10) Stereolithography machine according to claim 8 or 9, **characterized in that** said housing (14) comprises stop means (17) configured to maintain said cartridge (1) in said operating position, said stop means (17) being suited to be released in such a way as to disconnect said cartridge (1) from said housing (14).

11) Stereolithography machine according to claim 10, **characterized in that** said housing (14) comprises a supporting base (18) suited to support said cartridge (1) on the side corresponding to said transparent bottom (4), said supporting base (18) defining a supporting surface (19) delimited by a containment edge (20) projecting from said supporting surface (19) and suited to be arranged in contact with said cartridge (1) so as to prevent the sliding movement of said cartridge (1) on said supporting surface (19), said stop means (17) comprising a cover (21) suited to face said supporting surface (19) so that it can be arranged in contact with said cartridge (1) on the opposite side with respect to said supporting surface (19).

12) Stereolithography machine according to claim 11, **characterized in that** said cover (21) has a first edge (22) revolvingly associated with said supporting base (18), snap-fitting means (24) being provided in order to releasably connect to said supporting base (18) a second edge (23) of said cover (21) opposite said first edge (22).

13) Stereolithography machine according to claim 12, **characterized in**

that said containment edge (20) comprises a manoeuvring wall (25) provided with a first end (26) and with a second end (27) mutually opposing each other, said first end (26) being revolvingly associated with said supporting base (18) in such a way as to define for said manoeuvring wall (25):

- a stop position, in which said second end (27) is arranged against said cover (21) when said cover (21) is arranged in contact with said cartridge (1), in such a way as to prevent the rotation of said cover (21); and
- a release position, in which said second end (27) is arranged in such a way as to allow the rotation of said cover (21) in the direction corresponding to the opening of said cover (21) with respect to said supporting base (18).

14) Stereolithography machine according to claim 13, **characterized in that** said second end (27) is provided with a stop surface (28) suited to limit said rotation of said cover (21).

15) Stereolithography machine according to claim 14, **characterized in that** said stop surface (28) defines a concave portion (29) facing said second edge (23) of said cover (21), said second edge (23) being configured so as to be arranged inside said concave portion (29) in such a way as to limit the rotation of said manoeuvring wall (25).

16) Stereolithography machine according to any of claims from 13 to 15, **characterized in that** it comprises first elastic means (30) suited to force the return of said manoeuvring wall (25) from said release position towards said stop position.

17) Stereolithography machine according to any of claims from 13 to 16, **characterized in that** said manoeuvring wall (25) comprises a through opening (31) suited to slidingly house said cartridge (1).

18) Stereolithography machine according to claim 17, **characterized in that** said through opening (31) comprises an edge (32) that is raised with respect to said supporting surface (19) and suited to maintain said cartridge (1) inclined with respect to said supporting surface (19) in such a way that said transparent bottom (4) remains lifted from said supporting surface (19).

19) Stereolithography machine according to any of claims from 12 to 18, **characterized in that** said first edge (22) of said cover (21) is provided with at least one tab (33) removably inserted in a corresponding opening (34) belonging to said supporting base (18), said at least one tab (33) and said opening (34) being configured in such a way as to allow the rotation of said

cover (21) with respect to said supporting base (18) and the removal of said cover (21) from said supporting base (18).

20) Stereolithography machine according to any of claims from 12 to 19, **characterized in that** it comprises second elastic means (35) suited to force the rotation of said cover (21) in the opening direction with respect to said supporting base (18).

21) Stereolithography machine according to any of claims from 8 to 20, **characterized in that** said housing (14) is removably associated with said supporting structure according to a direction of movement that is parallel to the plane defined by said access opening (3), said feed duct (15) being deformable.

22) Stereolithography machine according to any of claims from 8 to 21, **characterized in that** said feed duct (15) is configured in such a way that it can be removably connected to said connection means (7).

23) Method for using a cartridge (1) according to claim 3, **characterized in that** it comprises the following operations:

- preparing a stereolithography machine comprising a feed duct (15) operatively connected to an air feeding device (8) and provided with a needle-shaped end (16) suited to perforate said second membrane (11) of said cartridge (1);
- inserting said needle-shaped end (16) through said second membrane (11);
- operating said air feeding device (8) in such a way as to generate a difference higher than said predefined value between the pressure present in said reservoir (5) and the pressure present in said container (2).

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DESCRIPTION

The present invention concerns an interchangeable cartridge for a stereolithography machine.

As is known, the stereolithography technique makes it possible to produce a three-dimensional object through the superimposition of a plurality of layers of a liquid or pasty base material that is solidified through exposure to predefined radiation, generally light radiation.

A stereolithography machine of the known type comprises a container suited to contain the base material and provided with a bottom that is transparent to the predefined radiation.

The machine comprises also emitter means suited to emit said predefined radiation and arranged under the container, which selectively solidify the layer of base material that is adjacent to the bottom of the container.

The solidified layers are supported by a modelling platform, powered so that it moves in the vertical direction in order to allow the last solidified layer to be arranged adjacent to said layer of base material before its solidification.

According to an embodiment described in the Italian patent application VI2012A000183, the container belongs to a removable device, which in technical jargon is called “cartridge”, comprising also a reservoir suited to contain the base material and associated with the container in a non-removable way, so as to form a single body with it.

Further known embodiments are shown in documents US 5,503,793 and DE 4102261.

When necessary, the base material is made flow out of the reservoir and into the container, through valve means that connect the two elements.

Said cartridge offers several advantages, among which the advantage of allowing the automatic top-up of the container in the moment when and to the extent to which this is required, as well as the advantage of avoiding the need to clean the stereolithography machine, as the reservoir and the base material feeding system are incorporated in the cartridge and therefore the base material does not contaminate any component of the machine.

Overall, said cartridge considerably simplifies the use of the stereolithography

machine, making it suited to be used even by an unskilled operator like, for example, an operator working in the goldsmithery or dentistry sector.

It is the object of the present invention to provide an improved cartridge that, compared to the cartridge described above and belonging to the known art, is particularly simple to produce.

It is another object of the present invention to provide a cartridge that can be connected to a stereolithography machine in a simple and rapid manner.

It is also the object of the invention to provide a stereolithography machine that is suited to operate with said cartridge.

It is another, yet not the least object of the invention to provide a method for using the cartridge itself.

Said objects are achieved by a cartridge carried out according to the main claim.

Said objects are also achieved by a stereolithography machine according to claim 8 and by a method for using the cartridge according to claim 23.

Variant embodiments of the invention are illustrated in the corresponding dependent claims.

Advantageously, the simple construction structure of the cartridge of the invention makes it particularly economical to manufacture and suitable for mass production.

Still advantageously, the simple connection of the cartridge to the stereolithography machine further simplifies the use of the machine itself, to the advantage of its possible diffusion.

Said objects and advantages, together with others that will be mentioned below, will be evident in the description of a preferred embodiment of the invention that is provided by way of example without limitation with reference to the attached drawings, wherein:

Figure 1 shows a schematic axonometric view of the cartridge that is the subject of the invention;

Figure 2 shows a schematic axonometric view of a part of the stereolithography machine of the invention;

Figure 3 shows an axonometric view of the part illustrated in Figure 2 in a different operating configuration;

Figure 4 shows a sectional view of the part illustrated in Figure 2, according to a plane of symmetry;

Figure 5 shows a side view of the cartridge illustrated in Figure 1 associated with the part illustrated in Figure 2;

Figure 6 shows an axonometric view of the cartridge of Figure 1 associated with the part illustrated in Figure 2, in an operating configuration different from the one shown in Figure 5;

Figure 7 shows the cartridge of Figure 1 and the part of Figure 2 associated together as in Figure 6, in a sectional view according to a plane of symmetry;

Figure 8 shows an enlarged detail of Figure 7.

The cartridge for a stereolithography machine that is the subject of the invention, shown in Figure 1 and therein indicated as a whole by **1**, comprises a container **2** provided with an access opening **3** and with a transparent bottom **4** facing and opposite to said access opening **3**.

The access opening **3** is intended to allow the access of the modelling platform of a stereolithography machine of the type described in the introductory part and not illustrated in the figures, but known per se, into the container **2**.

The transparent bottom **4** allows predefined radiation to pass therethrough, said predefined radiation being capable of selectively solidifying a pre-selected liquid or pasty base material contained therein.

Preferably but not necessarily, the base material is a light hardening resin or a photopolymer and the predefined radiation is light, for example a light beam.

The cartridge **1** comprises also a reservoir **5** suited to contain said base material and forming a single body with the container **2**.

The cartridge **1** also comprises valve means **6** that connect the reservoir **5** to the container **2** in such a way as to allow the passage of the base material from the reservoir **5** to the container **2**.

According to the invention, the valve means **6** are configured in such a way that they open when the difference between the pressure present in the reservoir **5** and the pressure present in the container **2** is at least equal to a predefined value and close spontaneously when said pressure difference is lower than said predefined value.

The reservoir **5** furthermore comprises tight connection means **7** suited to connect the reservoir **5** to an external air feeding device.

The valve means **6** and the connection means **7** described above make it possible to control the outflow of the base material by simply operating the

air feeding device in such a way as to increase the pressure present in the reservoir **5**, stopping said outflow by stopping the air feeding device.

Preferably, the valve means **6** comprise a first membrane **9** provided with a hole **10** that is normally closed and is configured so that it opens elastically as a result of the effect of said pressure difference exceeding the predefined value.

Advantageously, said first membrane **9** represents a particularly economical way to produce the valve means **6** and therefore makes it possible to limit the cost of the cartridge **1**.

Preferably, the valve means **6** are distributed on different points of the wall **36** that delimits the container **2** perimetrically and comprise corresponding first membranes **9** of the type described above.

Preferably, the connection means **7** comprise a second membrane **11** belonging to the wall of the reservoir **5**, suited to be perforated by a needle-shaped element while at the same time maintaining its tightness when the needle-shaped element is arranged so that it passes through the second membrane **11**.

Advantageously, said second membrane **11** makes it possible to connect the reservoir **5** to the air feeding device **8** in a simple and rapid manner, as described in greater detail below.

Preferably, the reservoir **5** is provided with an annular wall **36** that corresponds to the perimeter wall of the container **2**.

Advantageously, the fact that the reservoir **5** delimits the container **2** perimetrically allows the valve means **6** to be distributed along the entire perimeter of the container **2** itself, in such a way as to guarantee the uniform and rapid outflow of the base material towards the container **2**.

Preferably, said annular wall **36** comprises two mutually facing sections **37** with semi-circular profile.

Advantageously, the presence of said semi-circular sections **37** makes it possible to avoid the presence of sharp corners in the wall of the container **2**, in such a way as to favour the rapid distribution of the base material in the container **2** itself.

Preferably and as shown in Figure 7, the reservoir **5** is internally delimited by an inclined wall **12** that forms an angle larger than 90° and smaller than 180° with respect to the transparent bottom **4**.

The valve means **6** are arranged at the level of said inclined wall **12**, in particular of its edge nearest to the container **2**.

In this way, to advantage, the inclined wall **12** makes it easier to convey the base material towards the valve means **6**.

The configuration just described above offers the further advantage that the valve means **6** are always submerged by the base material, which prevents the air that is introduced in the reservoir **5** to increase pressure therein from obstructing the valve means **6** themselves and affecting the regular operation of the cartridge **1**.

Regarding the transparent bottom **4**, this is preferably delimited perimetrically by an outer edge **4a**, housed in a cavity **5a** belonging to the reservoir **5** in such a way that it is contained within the overall dimensions of the reservoir **5**.

This advantageously makes it possible to limit the overall dimensions of the cartridge **1**.

In variant embodiments of the cartridge, the transparent bottom **4** is integral with the reservoir **5**.

The cartridge **1** is preferably provided with a cap, not shown in the drawings, which can be removably inserted in the access opening **3** in such a way as to close it.

Advantageously, the presence of said cap makes it possible to preserve any base material that may have been left in the container **2** during the periods of inactivity of the cartridge **1**, in particular when the latter is temporarily removed.

As already mentioned above, said cartridge **1** is suited to be associated with a stereolithography machine of which the drawings show just a part, corresponding to the area of the machine that is coupled with the cartridge **1**.

In particular, the stereolithography machine comprises a supporting structure that, as shown in Figure 2, supports a housing **14** configured in such a way as to removably accommodate the cartridge **1** in a stable operating position.

The stereolithography machine furthermore comprises emitter means, not illustrated in the drawings but known per se, configured so as to emit said predefined radiation, associated with an optical unit in order to convey the radiation towards said housing **14**.

Said emitter means may comprise, for example, a laser emitter, a projector or any other analogous means of known type.

The stereolithography machine comprises also a modelling plate, not

represented in the drawings but known per se, suited to support the three-dimensional object during its production.

Said modelling plate is arranged in such a way that it faces the transparent bottom **4** of the cartridge **1** when the latter is in operating position and is associated with power means for its movement with respect to the housing **14**, so that it can be moved near to and away from the transparent bottom **4** of the cartridge **1**.

According to the invention, the machine comprises an air feeding device **8** provided with a feed duct **15** suited to be tightly connected to the connection means **7** of the cartridge **1** when the latter is arranged in the housing **14**.

In particular, the air feeding device **8** is suited to be operated in such a way as to increase the pressure present in the reservoir **5** when it is necessary to cause the base material to flow towards the container **2** and to decrease it when it is necessary to stop said flow.

Preferably, the feed duct **15** is configured so that it can be removably connected to the connection means **7**, in such a way as to allow the cartridge **1** to be easily removed from the machine.

Preferably, the feed duct **15** comprises a needle-shaped end **16**, visible in Figure 3, suited to be arranged through the second membrane **11** when the cartridge **1** is arranged in said operating position.

Advantageously, the needle-shaped end **16** ensures the simple and rapid connection of the air feeding device **8** to the reservoir **5** of the cartridge **1**.

In fact, as shown in Figures 7 and 8, when the cartridge **1** is arranged in operating position, the second membrane **11** of the cartridge **1** is perforated by the needle-shaped end **16** with no need for the operator to take care to activate any valve or sealing element, as tightness is already ensured by the second membrane **11**, as described above.

Regarding the housing **14** for the cartridge **1**, visible in particular in Figure 3, it preferably comprises stop means **17** configured to maintain the cartridge **1** in operating position, which can be released in order to free the cartridge **1** from the housing **14**.

Advantageously, said stop means **17** facilitate the connection of the cartridge **1** to the stereolithography machine, as well as its removal therefrom.

In particular, the housing **14** comprises a supporting base **18** that defines a supporting surface **19** suited to support the cartridge **1** on the side

corresponding to the transparent bottom **4**.

Preferably but not necessarily, the supporting surface **19** comprises a transparent sheet **13** arranged in such a way that it faces the transparent bottom **4** when the cartridge **1** is in operating position.

Advantageously, said transparent sheet **13** protects the underlying area of the stereolithography machine from dust and any base material that may contaminate it, the radiation emitter and the corresponding optical unit being arranged in said underlying area of the stereolithography machine.

Preferably, the transparent bottom **4** has the same geometry as the transparent sheet **13**, that is, they are preferably but not necessarily plane, so that the two components are arranged in mutual contact when the cartridge **1** is arranged in operating position.

Advantageously, this avoids the formation of intermediate spaces that would shift the focus of the light beam with respect to the desired position, reducing the processing precision of the stereolithography machine.

The transparent sheet **13** is preferably flat and the curvature of the transparent bottom **4** is directed towards the outside of the cartridge **1**.

Furthermore, the transparent sheet **13** is more rigid than the transparent bottom **4** of the cartridge **1**.

For example, the transparent sheet **13** can be made of glass and the transparent bottom **4** can be made of a plastic material, for example methacrylate.

The different degrees of rigidity and the different curvatures described above are such that when the cartridge **1** is arranged in a stable position and pressed against the supporting base **18**, the transparent bottom **4** of the cartridge **1** becomes deformed in such a way as to adhere perfectly to the transparent sheet **13**.

According to a variant embodiment of the invention, the transparent sheet **13** is curved and the transparent bottom **4** has a curvature that is different from that of the transparent sheet **13** and such as to obtain the same compression effect described above.

Preferably and as shown in Figure 3, said supporting surface **19** is delimited by a containment edge **20** that projects from the supporting surface **19** and is suited to come into contact with the cartridge **1** in such a way as to prevent it from sliding on the supporting surface **19**.

The stop means **17** preferably comprise a cover **21** suited to face the supporting surface **19** in such a way as to come into contact with the cartridge **1** on the opposite side with respect to the supporting surface **19**, as shown in Figure 7.

Advantageously, the cover **21** maintains the cartridge **1** pressed against the supporting base **18**, increasing the stability of the cartridge **1** itself during the operation of the stereolithography machine.

The cover **21** is provided with an opening **21a** configured in such a way that it can be arranged so that it faces the access opening **3** of the cartridge **1** when the latter is in operating position and the cover **21** is in contact with the cartridge **1** itself.

Obviously, in variant embodiments of the machine said cover **21** can be replaced by equivalent elements capable of preventing the cartridge **1** from being lifted from the supporting base **18**.

Preferably, the cover **21** is provided with elastic elements **38** configured so that they can be compressed when they come into contact with the cartridge **1**, in such a way as to compensate for any defects of the cartridge **1** and in any case ensure contact with the latter.

Preferably, the cover **21** is provided with a first edge **22** revolvingly associated with the supporting base **18** and a second edge **23** opposite the first one and connected to the supporting base **18** through releasable snap-fitting means **24**.

Preferably and as shown in Figure 4, said first edge **22** is provided with tabs **33** removably inserted in corresponding openings **34** belonging to the supporting base **18**, in such a way as to allow both the rotation of the cover **21** with respect to the supporting base **18** and its removal from the supporting base **18**.

Advantageously, the possibility to remove the cover **21** allows the operator to easily access the supporting base **18** for periodical cleaning, if necessary.

Preferably, the containment edge **20** of the housing **14** comprises a manoeuvring wall **25** provided with a first end **26** and with a second end **27** that mutually oppose each other, the first end **26** being revolvingly associated with the supporting base **18** in such a way as to define for the manoeuvring wall **25** a stop position and a release position relating to the cartridge **1**.

In the stop position shown in Figures 6 and 7, the second end **27** is arranged against the cover **21** when this is arranged in contact with the cartridge **1**, so as to prevent the rotation of the cover **21** and avoid the accidental release

of the cartridge **1** from the supporting base **18**.

In the release position, shown in Figures 2 and 4, the second end **27** is arranged in such a way as to allow the rotation of the cover **21** in such a direction as to move it away from the supporting base **18**, thus allowing the cartridge **1** to be lifted from the housing **14**.

For this purpose, the cartridge **1** is preferably provided with an edge **39** projecting towards the outside of the housing **14**, suited to make it easier for the user to hold and lift the cartridge **1**.

Preferably, the second end **27** of the manoeuvring wall **25** is provided with a chute-like surface **27a** on which the second edge **23** of the cover **21** can freely slide during the rotation of the cover **21** towards the supporting base **18**.

During the rotation of the cover **21** in the direction just described above, it slides on said chute-like surface **27a** making the manoeuvring wall **25** rotate towards the release position.

When the cover **21** has reached the position of contact with the cartridge **1**, it is released from the chute-like surface surface, thus allowing the manoeuvring wall **25** to be arranged in the stop position.

For this purpose, the manoeuvring wall **25** is preferably associated with first elastic means **30**, shown in Figure 4, suited to force the movement of the manoeuvring wall **25** itself from the release position towards the stop position.

Regarding the second end **27** of the manoeuvring wall **25**, it is preferably provided with a stop surface **28** suited to limit said rotation of the cover **21** and, consequently, its opening with respect to the supporting base **18**.

Preferably, there are second elastic means **35** suited to force the rotation of the cover **21** in the direction in which it opens with respect to the supporting base **18**.

Advantageously, said second elastic means **35** facilitate the opening of the cover **21** and the release of the cartridge **1** from the housing **14**, since it is sufficient for the operator to move the manoeuvring wall **25** to the release position in order to automatically cause the cover **21** to be lifted.

Preferably, the stop surface **28** is shaped in such a way as to define a concave portion **29** facing the second edge **23** of the cover **21**, wherein said second edge in turn is configured to be arranged inside said concave portion **29** in such a way as to limit the rotation of the manoeuvring wall **25**, as can be observed in Figure 4.

Advantageously, said stop surface **28** makes it possible to prevent the cover **21** from being completely separated from the supporting base **18**, thus avoiding also the accidental removal of the cover **21** itself.

It is evident that the cover **21** can in any way be removed by keeping it pressed and at the same time rotating the manoeuvring wall **25** until its stop surface **28** is positioned in such a way as to prevent it from interfering with the trajectory of the cover **21**.

Preferably, the manoeuvring wall **25** comprises a through opening **31** suited to slidingly house the cartridge **1**.

Advantageously, said through opening **31** facilitates the insertion of the cartridge **1** in the housing **14**.

Preferably and as can be observed in Figure 2, the through opening **31** comprises an edge **32** that is raised with respect to the supporting surface **19** and is suited to maintain the cartridge **1** inclined with respect to the supporting surface **19** during the sliding movement of the cartridge **1** towards the housing **14**, as shown by way of example in Figure 5.

In this way, the transparent bottom **4** of the cartridge **1** remains lifted from the transparent sheet **13** until the cartridge **1** has completely occupied the housing **14**, with the advantage of protecting the transparent bottom **4** and the transparent sheet **13** from scratches.

Preferably, the housing **14** is removably associated with the supporting structure through moving means, not represented herein but known per se, which define for the housing **14** a direction of movement that is parallel to the plane defined by the access opening **3**.

Said moving means make it possible to move the cartridge **1** with respect to the modelling plate during the production of the object, in such a way as to periodically modify the area of the transparent bottom **4** of the cartridge **1** and of the transparent sheet **13** exposed to radiation, with the advantage of making them last longer.

Furthermore, the feed duct **15** that connects the cartridge **1** to the air feeding device **8** is deformable, so as to allow air to be introduced in the reservoir **5** in any position occupied by the housing **14** during its movement.

Preferably, the modelling plate of the stereolithography machine has a circular profile, in particular with the radius only slightly smaller than the radius of the two semi-circular sections **37** of the access opening **3** of the cartridge **1**.

It can be understood that said circular modelling plate allows the widest movement of the cartridge **1** in the manner described above, with the advantage of allowing the entire surface of the transparent bottom **4** and of the transparent sheet **13** to be used.

In practice, in order to insert the cartridge **1** in the housing **14**, the operator places the manoeuvring wall **25** in the release position, so as to lift the cover **21**, as shown in Figure 2.

The cartridge **1** can thus be arranged in the through opening **31** of the manoeuvring wall **25**, oriented so that the second membrane **11** faces the needle-shaped end **16** of the stereolithography machine.

The cartridge **1** is made slide while it is in contact with the raised edge **32** of the through opening **31**, as shown in Figure 5, until it is completely inserted in the housing **14**, as shown in Figure 4.

During said movement, the needle-shaped end **16** of the feed duct **15** perforates the second membrane **11** of the cartridge **1** and becomes positioned so that it passes through it.

Successively, the cover **21** can be lowered until the manoeuvring wall **25** snaps in the stop position, as shown in Figures 6 and 7.

At this point, the machine is ready for use.

When necessary, during the production of the three-dimensional object, the air feeding device **8** is operated in such a way as to generate a difference between the pressure present in the reservoir **5** and the pressure present in the container **2** that is sufficient to cause the valve means **6** to open, so as to have the base material contained in the reservoir **5** flow towards the container **2**.

When the base material has reached a sufficient level in the container **2**, the air feeding device **8** is operated in such a way as to reduce said pressure difference, causing the valve means **6** to close spontaneously and the flow to stop.

Preferably, the air feeding device **8** as described above is operated by the logic unit of the machine, which also serves for controlling the emitter means, the modelling plate and the moving means of the housing **14**.

According to the above, it can be understood that the cartridge and the machine described above achieve all the objects of the invention.

In particular, the cartridge can be produced with no need to use complex

components, thus simplifying its production.

In particular, the only movable components are the first membranes and the second membrane, which however are inexpensive components easily available on the market.

Furthermore, the fact that the reservoir is connected to the air feeding device by simply positioning the cartridge in the housing, with no need to operate any valve, makes the manoeuvre simple and rapid.

CLAIMS

1) Cartridge (1) for a stereolithography machine, comprising:

- a container (2) delimited by a wall and provided with an access opening (3) and with a transparent bottom (4) opposite said access opening (3);
- a reservoir (5) suited to contain a liquid or pasty base material;
- valve means (6) connecting said reservoir (5) to said container (2) for the passage of said base material;

characterized in that said valve means (6) are configured to open when the difference between the pressure present in said reservoir (5) and the pressure present in said container (2) is at least equal to a predefined value and to spontaneously close when said pressure difference is lower than said predefined value, said reservoir (5) being unremovably associated with said container (2) and comprising tight connection means (7) for connection to an external air feeding device (8).

2) Cartridge (1) according to claim 1, **characterized in that** said valve means (6) comprise a first membrane (9) provided with a hole (10) that is normally closed and configured to open elastically due to the effect of said pressure difference at least equal to said predefined value.

3) Cartridge (1) according to claim 1 or 2, **characterized in that** said connection means (7) comprise a second membrane (11) belonging to the wall of said reservoir (5) and suited to be perforated by a needle-shaped element while at the same time maintaining its tightness when said needle-shaped element is arranged so that it passes through said second membrane (11).

4) Cartridge (1) according to any of the claims from 1 to 3, **characterized in that** said reservoir (5) is provided with an annular wall (36) that delimits said container (2) perimetrically.

5) Cartridge (1) according to claim 4, **characterized in that** said annular wall (36) comprises two mutually facing sections (37) with semi-circular profile.

6) Cartridge (1) according to claim 4 or 5, **characterized in that** said transparent bottom (4) is perimetrically delimited by an outer edge (4a), said outer edge (4a) being housed in a cavity (5a) belonging to said reservoir (5) in such a way as to remain within the overall dimensions of said reservoir (5).

7) Cartridge (1) according to any of the claims from 1 to 6, **characterized in that** said reservoir (5) is internally delimited by an inclined wall (12) that forms, together with said transparent bottom (4), an angle that is larger than

90° and smaller than 180°, said valve means (6) being arranged at the level of the edge of said inclined wall (12) that is nearest to said container (2).

8) Stereolithography machine comprising a supporting structure and a housing (14) associated with said supporting structure, configured to removably house in a stable operating position a cartridge (1) according to any of the claims from 1 to 6, **characterized in that** it comprises an air feeding device (8) provided with a feed duct (15) suited to be tightly connected to said connection means (7) of said cartridge (1) when said cartridge (1) is arranged in said housing (14), said air feeding device (8) being suited to be operated in such a way as to modify the pressure present in said reservoir (5).

9) Stereolithography machine according to claim 8, **characterized in that** said cartridge (1) is in accordance with claim 3, said feed duct (15) comprising a needle-shaped end (16) suited to be arranged through said second membrane (11) when said cartridge (1) is arranged in said operating position.

10) Stereolithography machine according to claim 8 or 9, **characterized in that** said housing (14) comprises stop means (17) configured to maintain said cartridge (1) in said operating position, said stop means (17) being suited to be released in such a way as to disconnect said cartridge (1) from said housing (14).

11) Stereolithography machine according to claim 10, **characterized in that** said housing (14) comprises a supporting base (18) suited to support said cartridge (1) on the side corresponding to said transparent bottom (4), said supporting base (18) defining a supporting surface (19) delimited by a containment edge (20) projecting from said supporting surface (19) and suited to be arranged in contact with said cartridge (1) so as to prevent the sliding movement of said cartridge (1) on said supporting surface (19), said stop means (17) comprising a cover (21) suited to face said supporting surface (19) so that it can be arranged in contact with said cartridge (1) on the opposite side with respect to said supporting surface (19).

12) Stereolithography machine according to claim 11, **characterized in that** said cover (21) has a first edge (22) revolvingly associated with said supporting base (18), snap-fitting means (24) being provided in order to releasably connect to said supporting base (18) a second edge (23) of said cover (21) opposite said first edge (22).

13) Stereolithography machine according to claim 12, **characterized in**

that said containment edge (20) comprises a manoeuvring wall (25) provided with a first end (26) and with a second end (27) mutually opposing each other, said first end (26) being revolvingly associated with said supporting base (18) in such a way as to define for said manoeuvring wall (25):

- a stop position, in which said second end (27) is arranged against said cover (21) when said cover (21) is arranged in contact with said cartridge (1), in such a way as to prevent the rotation of said cover (21); and
- a release position, in which said second end (27) is arranged in such a way as to allow the rotation of said cover (21) in the direction corresponding to the opening of said cover (21) with respect to said supporting base (18).

14) Stereolithography machine according to claim 13, **characterized in that** said second end (27) is provided with a stop surface (28) suited to limit said rotation of said cover (21).

15) Stereolithography machine according to claim 14, **characterized in that** said stop surface (28) defines a concave portion (29) facing said second edge (23) of said cover (21), said second edge (23) being configured so as to be arranged inside said concave portion (29) in such a way as to limit the rotation of said manoeuvring wall (25).

16) Stereolithography machine according to any of claims from 13 to 15, **characterized in that** it comprises first elastic means (30) suited to force the return of said manoeuvring wall (25) from said release position towards said stop position.

17) Stereolithography machine according to any of claims from 13 to 16, **characterized in that** said manoeuvring wall (25) comprises a through opening (31) suited to slidingly house said cartridge (1).

18) Stereolithography machine according to claim 17, **characterized in that** said through opening (31) comprises an edge (32) that is raised with respect to said supporting surface (19) and suited to maintain said cartridge (1) inclined with respect to said supporting surface (19) in such a way that said transparent bottom (4) remains lifted from said supporting surface (19).

19) Stereolithography machine according to any of claims from 12 to 18, **characterized in that** said first edge (22) of said cover (21) is provided with at least one tab (33) removably inserted in a corresponding opening (34) belonging to said supporting base (18), said at least one tab (33) and said opening (34) being configured in such a way as to allow the rotation of said

cover (21) with respect to said supporting base (18) and the removal of said cover (21) from said supporting base (18).

20) Stereolithography machine according to any of claims from 12 to 19, **characterized in that** it comprises second elastic means (35) suited to force the rotation of said cover (21) in the opening direction with respect to said supporting base (18).

21) Stereolithography machine according to any of claims from 8 to 20, **characterized in that** said housing (14) is removably associated with said supporting structure according to a direction of movement that is parallel to the plane defined by said access opening (3), said feed duct (15) being deformable.

22) Stereolithography machine according to any of claims from 8 to 21, **characterized in that** said feed duct (15) is configured in such a way that it can be removably connected to said connection means (7).

23) Method for using a cartridge (1) according to claim 3, **characterized in that** it comprises the following operations:

- preparing a stereolithography machine comprising a feed duct (15) operatively connected to an air feeding device (8) and provided with a needle-shaped end (16) suited to perforate said second membrane (11) of said cartridge (1);
- inserting said needle-shaped end (16) through said second membrane (11);
- operating said air feeding device (8) in such a way as to generate a difference higher than said predefined value between the pressure present in said reservoir (5) and the pressure present in said container (2).