



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
15.10.2014 Bulletin 2014/42

(51) Int Cl.:
G03G 15/34 (2006.01) G03G 15/00 (2006.01)
G03C 1/76 (2006.01)

(21) Application number: **14163913.8**

(22) Date of filing: **08.04.2014**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(72) Inventors:
• **Cassinelli, Erasmo**
I-22070 Montano Lucino (Como) (IT)
• **Lodi, Paolo**
I-41123 Modena (IT)

(30) Priority: **12.04.2013 IT RM20130221**

(74) Representative: **Carangelo, Pierluigi et al**
Jacobacci & Partners S.p.A.
Via delle Quattro Fontane, 15
00184 Roma (IT)

(71) Applicant: **Tintoria Emiliana Srl**
41122 Modena (IT)

(54) **Light impression apparatus and method for providing at least one graphic motif on a textile fabric**

(57) There are described a light impression apparatus and method (1) for providing at least one graphic motif (2A) on a textile fabric (3) to which a photosensitive substance is applied. The light impression apparatus (1) comprises an irradiation chamber (5) provided with a first and a second light source (14A, 14B) suitable for emitting respective light radiations. Moreover, such apparatus comprises at least one support apparatus (10) to support at least one filter sheet (18A) which is suitable for filtering the light radiation emitted by at least one of the first or second light sources (14A, 14B). In particular, the support apparatus (10) comprises a lower support portion (16A) and an upper support portion (16B) which are respectively provided with a first and a second irradiation window (17A, 17B) and which are suitable for respectively supporting a first and a second filter sheet (18A, 18B) of said at least one filter sheet, the upper support portion (16B) being coupled or suitable for coupling to the lower support portion (16A). The support apparatus (10) is suitable for assuming a loading/unloading configuration wherein the upper and lower support portions (16A, 16B) are arranged in such a way as to allow arranging/removing the textile fabric (3) between/from the lower and upper support portions (16A, 16B). Moreover, the support apparatus (10) is suitable to assume an irradiation configuration wherein the support apparatus (10) is disposed in the irradiation chamber (5) and wherein the first and second support portions (16A, 16B) are disposed mutually facing and have the first and second irradiation window (17A, 17B) which are interposed between the first and the second light source (14A, 14B).

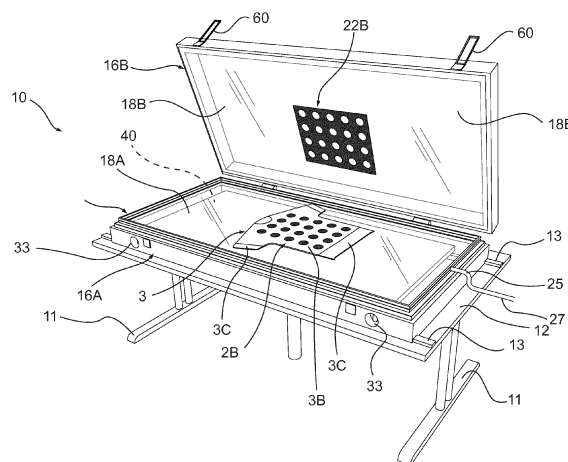


FIG. 4

Description

[0001] The present invention relates to the technical field of apparatus and methods for providing a graphic motif on a textile fabric, such as an item of clothing, a piece of fabric or the like. More in particular, the present description relates to a light impression apparatus for providing at least one graphic motif on a textile fabric as defined in the preamble of claim 1.

[0002] Several methods are known for creating a graphic motif on a textile fabric. Among such methods, in particular, a method practised as a hobby/craft is known which allows the creation in a relatively simple manner of prints of essentially "photographic" type on a textile fabric. In practice, this method involves an initial step of impregnating the textile fabric with a photosensitive dye. Thereafter, the fabric is exposed to sunlight interposing a filter sheet between the solar radiation and the textile fabric that normally consists of a photographic negative suitable for filtering the solar radiation. This photographic negative is provided on a respective portion with a negative graphic motif that corresponds to the negative of a graphic motif to be provided on the textile fabric. When the solar radiation, passing through the portion of the photographic negative on which the negative graphic motif is provided, reaches the surface of the textile fabric on which the photosensitive dye is applied, such a dye is photo-oxidized so as to be converted into an insoluble pigment. Thereafter, the textile fabric is washed in order to remove the part of photosensitive dye that has not been photo-oxidized as much as possible from the textile fabric. In this way, the positive graphic motif of the negative graphic motif provided on the photographic negative remains imprinted on the fabric.

[0003] The hobby/craft method described above conveniently allows a graphic motif to be made relatively easily on a textile fabric which is characterized by high definition and a wide variety of shades and hue gradations.

[0004] On the other hand, a drawback of the above hobby/craft method is related to the fact that such a method cannot be directly implemented in the industry. In fact, this method will generally involve considerable variability and possible defects of the final result which, although tolerable in view of a hobby/craft production, does not allow meeting the strict tolerances in relation to quality, uniformity, stability and repeatability of the final results that are required for a production on an industrial scale. In the case of the hobby/craft method discussed above, the above variability of the final result is in particular due to several factors such as:

- the fact that photosensitive dyes are in general relatively more complex to manage compared to other known dyes, as they tend to photo-oxidize whenever they are exposed to light resulting in undesirable effects on the fabric even after the light impression method has been completed;

- the fact that the intensity and inclination of the solar radiation are strongly variable in an uncontrolled way;
- the fact that undesired light spreading is possible between the photographic negative and the textile fabric due to the imperfect and non-uniform adhesion between the textile fabric and the photographic negative.

Note also that the above hobby/craft method does not allow achieving with sufficient accuracy, particularly in the junction zone between two opposite faces of the fabric, a graphic motif which extends on one face of the fabric and which continues on the opposite face of the fabric (for example a graphic motif with parallel lines that must be aligned almost perfectly with one another on two opposite faces of the textile fabric). In fact, in order to reproduce such a graphic motif on two opposite faces of the fabric by the hobby/craft method it is necessary in practice to perform the method described twice. More in particular, it is necessary to perform the method a first time on one face of the fabric, flip the fabric and repeat the method a second time on the opposite face of the fabric. On the other hand, in this case it is almost impossible to place the photographic negative in exactly the same position relative to the face of the fabric the first and the second time that the method is performed. This is also because of the flexibility and elasticity of the fabric and the formation of creases of the fabric.

[0005] An object of the present description is to provide a light impression apparatus for providing at least one graphic motif on a textile fabric to which a photosensitive substance is applied which is able to obviate or at least partly reduce the drawbacks discussed above with reference to the prior art.

[0006] In particular, an object of the present invention is to provide a light impression apparatus of the aforesaid type which allows implementing the hobby/craft method discussed above with reference to the prior art at an industrial level.

[0007] Such an object is achieved by a light impression apparatus as defined and characterised in the annexed claim 1 in the most general form thereof and in the dependent claims in some particular embodiments.

[0008] The object of the present invention is also a light impression method as defined in the annexed claim 11 in the most general form thereof and in the dependent claims in some particular embodiments.

[0009] The invention will be better understood from the following detailed description of embodiments thereof, made by way of an example and therefore in no way limiting with reference to the accompanying drawings, in which:

- Fig. 1 is a perspective view of a light impression apparatus according to a currently preferred embodiment;
- Fig. 2 is a plan side elevation view of a group of

components of the light impression apparatus in Fig. 1;

- Fig. 3 is an exploded perspective view which shows some components of the group in Fig. 2;
- Fig. 4 is a perspective view which shows the group in Fig. 2 shown in a different configuration and further elements operatively associatable with such a group;
- Fig. 5 is a schematic side sectional view of a part of the light impression apparatus in Fig. 1, in which the configuration of this apparatus is different from the configuration in Fig. 1;
- Fig. 6 is a plan view showing an enlarged detail of Fig. 5;
- Fig. 7 is a plan view which shows one of the above further elements shown in Fig. 4; and
- Fig. 8 is a plan view which shows another one of the above further elements shown in Fig. 4.

[0010] In the accompanying figures, like or similar elements shall be indicated by the same reference numerals.

[0011] In Fig. 1, a light impression apparatus according to a currently preferred embodiment is globally indicated with reference numeral 1. With reference to Fig. 8, the light impression apparatus 1 allows providing at least one graphic motif 2A on a textile fabric 3 to which a photosensitive substance is applied. It should be noted that the term "graphic motif" must be understood in a general way and can include, by way of a non limiting example, one or more relatively simple linear geometric patterns of either a real or more complex abstract image comprising portions having an even monochrome colour and/or portions having different hue gradations. For example, a graphic motif may include an image similar to that of a painting, realistic or abstract, or a photograph, for example a photograph of a landscape or a person. The expression "photosensitive substance" means in general any chemical or biochemical material which has the property of reacting, and more particularly of photo-oxidizing when exposed to a light radiation, such radiation being able to be emitted both in the frequency field of UV radiation and in that of visible radiation. In general, a photosensitive substance can include, by way of a non limiting example, crosslinking polymers, mixtures of non-photosensitive polymers with photosensitive activators or binders, mixtures thereof with photosensitive dyes. It should be noted, in particular, that the concept of reaction to light radiation of a photosensitive substance is extended to all forms of sensitivity of such a substance to light radiation, including those intermediate photosensitive reactions that require further chemical or physical processing.

[0012] The expressions "light impression apparatus" or "light impression method" refers to an apparatus or a method that allows producing or providing a graphic motif on a textile fabric by at least one light radiation suitable for photo-oxidizing a photosensitive substance and more preferably a photosensitive dye.

[0013] Again with reference to Fig. 8, in the example the textile fabric 3 comprises a T-shirt 3 on which a first graphic motif 2A is provided comprising a plurality of circles 2A.1, in particular twenty circles 2A.1. Note, however, that the textile fabric 3 may include in general both a piece of fabric adapted to assume an essentially flat configuration, such as a fabric handkerchief, and a piece of clothing such as a jacket, trousers, a T-shirt, a shirt, socks, etc. Preferably the material of the textile fabric 3 is a material consisting of or comprising cellulose fibers. However, the material of the textile fabric 3 can in general consist or include various textile fibers other than cellulose fibers, such as and not limited to protein fibers, polyamide fibers or polyester fibers. Note that in general the material of the textile fabric 3 can be selected according to the type of photosensitive substance used. In the embodiment presently preferred for example, in a non limiting manner, a photosensitive dye is used. In this regard it is noted that the term "photosensitive dye" means in general a dyeing substance that is able to react significantly when subjected to a light radiation, and more particularly a photosensitive substance that following light stress is transformed into a pigment sterically incorporated in the fiber and capable of forming a stable and definitive chromophore not sensitive anymore to additional light stresses, which also has the peculiarity of fixating to the textile fiber in a stable form. In particular, a photosensitive dye is capable of photo-oxidizing and simultaneously fixating to the textile fiber of a textile fabric without the need of applying fixative substances to the textile fabric. According to a particularly convenient embodiment, the photosensitive dye applied to the textile fabric 3 is a dye of the so-called "indhanthrene" dyes and more specifically a photosensitive dye of the so-called "indigosol" dyes, which have the peculiarity of being in the "leuco" (i.e. soluble) form thanks to the sulphur group introduced in the molecule. Indigosol dyes also have a remarkable air stability since they require a high energy of oxidation and humidity to reach the pigment form. It should be noted, however, that any photosensitive dye is suitable for being used in a light impression apparatus and method according to the present description. It should also be noted that the photosensitive dye may be applied to the textile fabric in many ways such as, by way of a non limiting example, bath impregnation, spraying, brushing and others.

[0014] Returning to Fig. 1, according to a preferred embodiment, the light impression apparatus 1 comprises an irradiation chamber 5 and a pair of support apparatus 10, each of which is preferably supported by a respective support structure 11, 12, 13. In the example, the light impression apparatus 1 comprises in particular a first and a second support apparatus 10 identical to each other and a first and a second support structure 11, 12, 13 identical to each other. Each support structure 11, 12, 13 preferably comprises two vertical support feet 11 and a horizontal support element 12 connected to the support feet 11. According to one embodiment, each support ap-

paratus 10 is slidably mounted to the respective support structure 11, 12, 13 preferably through appropriate guide elements 13, such as a pair of guide rails 13.

[0015] With reference to Fig. 5, which shows a schematic cross-sectional view of the irradiation chamber 5, it may be noted that according to the preferred embodiment chamber 5 is provided with a plurality of light sources 14A, 14B, in the example four lamps 14A, 14B, which are adapted to emit respective light radiation. In particular in the example, the irradiation chamber comprises two lower light sources 14A and two upper light sources 14B. Such light sources 14A, 14B include, by way of a non limiting example, four lamps equal to one other. According to an embodiment, the energy of the light radiation emitted by lamps 14A, 14B is entirely, or at least mainly, emitted in the visible light spectrum. In particular, it is preferable that the light radiation emitted by lamps 14A, 14B has a color temperature close to that of the solar radiation, between 5000 °K and 6000 °K. In the example, lamps 14A, 14B are lamps having a nominal power of 1200 W that are suitable to emit a light having a color temperature of about 5941 °K (very close to that of the sunlight), such as for example the lamps of the series HMI 2500 SE currently sold under the OSRAM brand.

[0016] Again with reference to Fig. 5, in order to ensure better diffusion of the light radiation emitted by lamps 14A, 14B, the irradiation chamber 5 is also preferably provided with optical elements 15A, 15B associated with lamps 14A, 14B. In the example, such optical elements include a lower reflector 15A associated to lamps 14A and an upper reflector 15B associated to lamps 14B.

[0017] Returning to Fig. 1, as will be better understood hereafter, each support apparatus 10 is suitable for supporting at least one filter sheet that is suitable to filter the light radiation emitted by at least one of lamps 14A, 14B.

[0018] According to a preferred embodiment, each apparatus 10 comprises a lower support portion 16A and an upper support portion 16B. The support portions 16A, 16B are respectively provided with a first irradiation window 17A, or lower irradiation window, and a second irradiation window 17B, or upper irradiation window 17B.

[0019] According to a particularly convenient embodiment, the upper and lower irradiation windows 17A, 17B are through openings 17A, 17B. The support portions 16A, 16B of each support apparatus 10 respectively comprise a lower support frame 16C and an upper support frame 16D preferably having a closed ring shape, and more preferably a quadrangular shape, preferably a generally rectangular shape. Such support frames 16C, 16D are extended respectively around the lower irradiation window 17A and the upper irradiation window 17B.

[0020] In the example, the support portions 16A, 16B of each support apparatus 10 are coupled with each other, and more preferably are hinged together using appropriate hinging elements. As can be seen for example in Fig. 2, the support apparatus 10 is suitable to assume a closed configuration in which the upper support portion 16B and the lower support portion 16A are facing and

close to each other. According to an embodiment, the supporting portions 16A, 16B can be locked or retained in the closed configuration by means of connecting elements 60, such as for example connecting clamps 60.

[0021] With reference to Fig. 4, the support portions 16A, 16B are respectively suitable for supporting a first and a second filter sheet 18A, 18B. In the non limiting example, the two filter sheets 18A, 18B are two same filter sheets. With cross-reference to Fig. 4 and Fig. 7, the first filter sheet 18A is suitable for filtering light radiation emitted by the lower lamps 14A and on a respective sheet portion is provided with a first negative graphic motif 22A corresponding to the negative of a first graphic motif 2A (Fig. 8) to be provided on a first side 3A of T-shirt 3.

[0022] With reference to Fig. 4, the second filter sheet 18B is suitable for filtering the light radiation emitted by the upper lamps 14B and is provided on a respective sheet portion with a second negative graphic motif 22B corresponding to the negative of a second graphic motif 2B provided on a second side 3B of T-shirt 3 which is opposite to said first side (such a side is not visible in Fig. 4). In the example, the negative graphic motifs 22A, 22B are equal to one another and the graphic motifs 2A, 2B, or positive graphic motifs 2A, 2B, are equal to one another. It should be noted, however, that in general, negative graphic motifs provided on the filter sheets 18A, 18B can also be different from each other as well as the graphic motifs 2A, 2B provided on T-shirt 3.

[0023] Again with reference to Fig. 7, it is noted that the first negative graphic motif 22A provided on the first filter sheet is defined by portions 22A.1, 22A.2 of the first sheet having different degrees of transparency to the light radiation emitted by the lower lamps 14A. In particular, in the example, the first negative graphic motif 22A is defined, for simplicity of representation, by a plurality of portions 22A.1 of the first filter sheet that are completely transparent to the light radiation emitted by lamps 14A, and a portion 22A.2 of the first filter sheet that is completely opaque to the light radiation emitted by lamps 14A. It should be noted, however, that in general the first negative graphic motif 22A can be defined in general in addition or alternatively, also by portions of the filter sheet partially transparent to the light radiation emitted by lamps 14A. For example, according to an embodiment, the first negative graphic motif 22A may comprise a photographic image characterized by hue gradations having different degrees of transparency to the light radiation emitted by lamps 14A. According to what discussed above, it is clear that these considerations also apply to the second filter sheet 18B and the second negative graphic motif 22B.

[0024] It should also be noted that, according to a preferred embodiment, the filter sheets 18A, 18B are made with a transparent glossy polyester film, for example a polyester film of 190 microns, preferably printable by technologies based on solvent, eco-solvent and UV. In general, the filter sheets 18A, 18B can in any case be

made with other materials, such as and not limited to PVC, acetate or other transparent printable material. According to a preferred embodiment, the filter sheets have dimensions substantially corresponding to the dimensions of the support portions, and more preferably substantially corresponding to those of the irradiation windows 17A, 17B.

[0025] With reference to Figs. 4 and 5, each support apparatus 10 is suitable to assume a loading/unloading configuration (Fig. 4) and an irradiation configuration (Fig. 5). In the loading/unloading configuration, the upper and lower support portions 16A, 16B are arranged in such a way as to allow arranging/removing T-shirt 3 between/from the lower and upper support portions. To this end, it is noted that in the example, in which the lower irradiation window 17A is a through opening, in the loading/unloading configuration T-shirt 3 may be arranged between the upper and lower support portions arranging it on the first filter sheet 18A fixed to the lower support portion (Fig. 4). In this case, T-shirt 3 can be supported in the practice indirectly by the lower support portion 16A through the first filter sheet 18A.

[0026] In the irradiation configuration (Fig. 5), the support apparatus 10 is arranged in the irradiation chamber 5 with the support portions 16A, 16B arranged mutually facing and with the lower and upper irradiation windows 17A, 17B which are arranged between the lower lamps 14A and the upper lamps 14B.

[0027] With reference to Fig. 1, according to a preferred embodiment, the light impression apparatus 1 comprises adhesion elements 25, 26 which are associated to each support apparatus 10. The adhesion elements 25, 26 are provided to make the first and second filter sheets 18A, 18B respectively adhere to the two opposite sides 3A, 3B of T-shirt 3 when the support apparatus assumes the irradiation configuration and the first and second filter sheets 18A, 18B are supported by the respective support portions 16A, 16B (Fig. 5).

[0028] With reference to Fig. 1, according to a preferred embodiment, the adhesion elements 25, 26 comprise an air suction member 25 and an airtight sealing element 26 associated with the suction member 25. As can be seen in Fig. 6, the air suction member 25 and the sealing element 26 are suitable to be operatively interposed between the lower and upper support portions 16A, 16B. With reference to Fig. 1 and Fig. 6, the air suction member 25 preferably comprises a tubular suction nozzle 25 which is operatively connected or connectable to an air suction apparatus (not shown because of the per se known type) preferably through a flexible hose 27. Such air suction apparatus is operable to draw air between the first and the second filter sheets 18A, 18B. According to a preferred embodiment, hose 27, in the operating conditions of apparatus 1, can be wrapped/unwrapped on a respective winding roller provided in a hose housing 28. In this case, the movement of hose 27 is preferably guided by a guide wheel 29. Housing 28 and wheel 29 are preferably fixed to a support wall (not

shown). Note that in Fig. 1, for simplicity of representation there are shown flexible hose 27, housing 28 and wheel 29 associated to only one of the support apparatus 10. In the example, a further flexible hose 27, a further hose housing 28 and a further guide wheel 29 (not shown) are in any case also associated to the other support apparatus 10.

[0029] With reference to Fig. 3, according to a preferred embodiment, the sealing element 26 comprises at least a sealing gasket 26A, 26B, and a gasket frame (not visible in the figures) to which the sealing gasket 26A, 26B and the tubular suction nozzle 25 are fixed. According to a preferred embodiment, the gasket frame is a plate-shaped frame and the sealing gasket 26A, 26B preferably includes a pair of sealing gaskets 26A, 26B fixed on two opposite sides of the gasket frame. The sealing element 26 is extended around a through opening 26C of sealing element and is removably coupled to the support apparatus 10. As can be seen for example by cross-reference of Figs. 1 and 5, the sealing element 26 is operatively extended along the perimeter of the upper and lower support portions 16A, 16B.

[0030] Again with reference to Fig. 3, according to a convenient embodiment, the support apparatus 10 includes an intermediate centring frame 30, or intermediate adjustment frame 30, which is coupled to the first filter sheet 18A. Preferably, the centring frame 30, as well as the sealing element 26 and the support frames 16C, 16D have a closed-loop and more preferably a quadrangular shape, for example rectangular.

[0031] The centring frame 30 is coupled or can be coupled in a movable manner with respect to the lower support portion 16A to allow adjusting the position of the first filter sheet 18A with respect to the position of the second filter sheet 18B fixed to the upper support portion 16B. To this end, the centring frame 30 is preferably provided with gripping elements, such as protruding gripping fins (not shown), which allow moving the centring frame even when the support apparatus 10 assumes the above closed configuration (Fig. 2). According to a preferred embodiment, the centring frame 30 is coupled in a removable manner to the lower support portion 16A. With reference to Fig. 3, the support apparatus 10 preferably comprises position adjustment elements 31, 32 to adjust the position of the centring frame with respect to the lower support portion 16A. The position adjustment elements 31, 32 comprise first coupling elements 31 provided on the intermediate centring frame 30 and second coupling elements 32, suitable to cooperate with the first coupling elements 31, which are provided on the lower support portion 16A. Preferably, the first coupling elements 31 comprise a plurality of adjustment pins 31, in the example two threaded pins 31, which protrude from one side of the centring frame 30. The second coupling elements 32 comprise a plurality of adjustment openings 32, in the example two adjustment openings 32, through which pins 31 are inserted. Preferably, the dimensions of openings 32 and pins 31 are such as to allow moving the centring

frame 30 coupled to the lower support portion 16A in at least two different directions lying on a horizontal plane.

[0032] In order to lock the centring frame 30 in the desired position relative to the lower support portion 16A, appropriate locking elements (not shown) may be used. In the example, such locking elements preferably comprise threaded nuts (not shown) that are screwed to the threaded pins 31. Such threaded nuts are inserted through access openings 33 provided on the lower frame 16C at the adjustment openings 32. In particular, to ensure an adequate locking of the centring frame and prevent pins 31 from falling out of the adjustment openings 32, between the threaded nuts and pins 31 there are preferably interposed perforated tubular sections or perforated bars (not shown) which are inserted into the access openings 33 and which are adapted to be crossed by pins 31 at the respective holes.

[0033] With reference to Fig. 2, according to a convenient embodiment, the light impression apparatus 1 comprises a mobile support base 40 for supporting T-shirt 3 in the loading/unloading configuration. As can be seen in this figure, the support base is selectively movable, for example by a linear actuator 41, such as an electric or hydraulic actuator, between a lower rest position (continuous lines) and an upper support position (dashed lines). In the lower rest position, the support base 40 is arranged inferiorly and faces the first irradiation window 17. In particular, in the lower support position of the support base 40 it is possible to move the support apparatus 10 so as to arrange the latter in the irradiation chamber 5. In the upper support position, the support base 40 is facing and located substantially at or above the first irradiation window 17A for supporting the first filter sheet 18A and T-shirt 3. According to a convenient embodiment, in the upper support position, base 40 is located slightly above the lower support frame 16C. This in fact advantageously allows reducing the amount of air to be sucked between the first and the second filter sheets 18A, 18B making the light impression process more efficient, and in particular quicker and cheaper.

[0034] With reference to Fig. 5, according to a convenient embodiment, the irradiation chamber 5 comprises a first and a second entrance inlet 51A, 51B for the cooling air flows. According to an embodiment, the irradiation chamber 5 also comprises at least one exhaust portion 61, more preferably two exhaust outlets 61, for exhaust air exiting chamber 5. Inlets 51A, 51B are connectable, for example through respective cooling ducts 52A, 52B, to at least one cooling apparatus (not shown because of the per se known type) which is suitable for generating a flow of cooling air. According to a preferred embodiment, inlets 51A, 51B are connected to two respective cooling apparatus, more particularly to two fans which are operatively connected each to a respective cooling duct 52A, 52B. The first and second inlet 51A, 51B, are arranged in such a way as to allow introducing the cooling air flows respectively towards the first and the second irradiation window 17A, 17B when the support apparatus

10 assumes the irradiation configuration. Preferably, inlets 51A, 51B comprise a lower inlet 51A and an upper inlet 52B which are located on two opposite sides of the irradiation chamber 5. Note that the fact of providing the entrance inlets 51A, 51B advantageously allows reducing or avoiding possible damage of the filter sheets 18A, 18B due to the heat generated by lamps 14A, 14B.

[0035] Again with reference to Fig. 5, according to a preferred embodiment, the irradiation chamber 5 comprises a first and a second access door 53A, 53B to allow the inlet/outlet of the first and second support apparatus 10 in/from the irradiation chamber 5. Preferably, the access doors 53A, 53B can be opened/closed for example by means of the respective vertically sliding closing panels 54A, 54B. The first and second support apparatus 10 are movable in such a way as to be alternately arranged in the irradiation chamber respectively through the first and second access door 53A, 53B.

[0036] Having described a preferred example of the structure of a light impression apparatus according to the present invention, an example of a light impression method is described below which can be carried out by such an apparatus with reference to the embodiment illustrated in the accompanying figures.

[0037] Considering one of the support apparatus 10 arranged outside the irradiation chamber 5 in the loading/unloading configuration (Fig. 4), the first filter sheet 18A is fixed to the intermediate centring frame 30, which is coupled to the lower support frame 16C, so that the first negative graphic motif 22A faces the first irradiation window 17A. The second filter sheet 18B is fixed to the upper support frame 16D so that the second negative graphic motif 22B faces the second irradiation window 17B. The first and the second filter sheets 18A, 18B are removably fixed to the support portions 16A, 16B, preferably by means of tearing fixing elements, such as Velcro strips arranged along a peripheral edge of the filter sheets 18A, 18B and along a peripheral edge of the centring frame 30 and the support frame 16D. By moving the centring frame 30 it is possible to adjust the position of the first negative graphic motif 22A provided on the first filter sheet 18A, relative to the position of the second negative graphic motif 22B provided on the second filter sheet 18B. Such centring operation can be performed for example by making the support apparatus 10 assume the closed configuration in which the support portion 16B above the lower support portion 16A are facing each other (Fig. 2) and moving the intermediate centring frame 30 by means of said protruding gripping fins. Once the centring task has been completed, the support apparatus 10 is returned to the loading/unloading configuration. At this point, T-shirt 3, on the sides whereof a photosensitive dye has been previously applied, is laid on the first filter sheet 18A arranging it with the first side 3A towards the negative graphic motif 22A of the first filter sheet 18A and in a predetermined position with respect to such graphic motif 22A. Preferably, before arranging T-shirt 3 on the first filter sheet, the support base 40 (Fig. 2) assumes

the upper support position so as to provide better support to T-shirt 3 and the first filter sheet. According to a convenient embodiment, in order to reduce or prevent the formation of unwanted creases on T-shirt 3, the latter is fitted on a tensioning shaped member 3C (Fig. 4) which is basically counter-shaped with respect to T-shirt 3. In the practice, T-shirt 3 is fitted on the tensioning shaped member 3C inserting such a member between the first and the second side 3A, 3B of T-shirt 3 so as to maintain the T-shirt tensioned and reduce or prevent the formation of undesired creases on the T-shirt.

[0038] At this point, the sealing element 26 is placed, preferably laid, on the first filter sheet 18A and the support apparatus 10 is returned again to the closed configuration (Fig. 2). In this configuration, each filter sheet is clamped between the sealing gasket 26A, 26B and the respective support portion 16A, 16B. Thereafter, the connecting clamps 60 are tightened and the suction nozzle 25 is connected to hose 27. By activating the suction apparatus connected to hose 27, air is drawn between the first and the second filter sheet 18A, 18B so as to make such filter sheets respectively adhere to the first and second side 3A, 3B of T-shirt 3. It should be noted that this air suction condition is maintained from this moment onwards until at least the end of the irradiation step in the irradiation chamber that will be described hereafter. The support base 40 is then brought through actuator 41 to the lower rest position in such a way that the support apparatus 10 may be arranged in the irradiation chamber 5 in the above irradiation configuration (Fig. 5). To this end it should be noted that Fig. 6 is only a schematic representation wherein the filter sheets are shown with a straight profile and parallel to each other. Actually, such filter sheets will be deformed and will have edge portions next to each other in particular due to the air suction effect between such sheets. The support apparatus 10 is introduced into the irradiation chamber, for example by manually moving it, via the guide rails 13 and the respective access door 53A, 53B. It is noted that during the introduction of apparatus 10 in the irradiation chamber, hose 27 is integral with the support apparatus 10. Once the support apparatus 10 has been arranged in the irradiation chamber 5, doors 53A, 53B are preferably closed by panels 54A, 54B and the irradiation step may start. During such an irradiation step, the first and second filter sheets are irradiated respectively by the upper and lower lamps 14A, 14B. In particular, the filter sheets 18A, 18B are irradiated so that the light radiation emitted by the upper and lower lamps 14A, 14B, passing through the portions of the filter sheets on which the negative graphic motifs 22A, 22B are provided, allow photo-oxidizing the photosensitive dye applied to sides 3A, 3B of T-shirt 3 so as to provide the graphic motifs 2A, 2B on sides 3A, 3B. Note that preferably, the upper and lower lamps irradiate the sides of T-shirt 3 simultaneously. However, the lower and upper lamps can also be activated alternately to irradiate alternately sides 3A, 3B of the T-shirt. It is also noted that the irradiation step of sides 3A, 3B of the T-

shirt is done in a controlled manner, namely by irradiating such sides 3A, 3B for a predetermined exposure time that is related to the type and number of photosensitive dyes used, the distance of lamps 14A, 14B from T-Shirt 3 and the material of T-shirt 3. According to an embodiment, such an exposure time is in general variable between ten seconds and three minutes, and more preferably is equal to about 1 minute.

[0039] During the irradiation step, cooling air flows are directed towards the filter sheets through the entrance inlets 51A, 51B so as to cool the filter sheets to reduce or avoid possible damage of such sheets.

[0040] At the end of the irradiation step, the support apparatus 10 is extracted from the irradiation chamber through the respective door 53A and, after turning off the suction apparatus, it is set to the loading/unloading configuration in order to allow the removal of T-shirt 3 from the support apparatus. Once the T-shirt has been removed from the support apparatus, the removal of the part of photosensitive dye that has not been adequately photo-oxidized is carried out in a per se known manner, for example by an appropriate washing of T-shirt 3. In this regard, it is noted that a proper removal of the photosensitive dye is important to avoid that the latter undesirably continues the photo-oxidation process once exposed to light.

[0041] Having described an example of structure and operation of an apparatus according to the present description, it is clear that changes and/or variations may be made to the what described and shown above by way of example.

[0042] For example, it is clear that a light impression apparatus according to the present description may also include, in general, a single support apparatus 10 instead of two or more support apparatus 10.

[0043] Note that in general it is not strictly essential that the lower and upper support portions 16A, 16B of each support apparatus 10 are stably coupled together, for example hinged together as in the example shown. In fact, according to an embodiment (not shown), the upper and lower support portions 16A, 16B are more generally couplable to each other. In this case, the upper support portion 16B can be completely uncoupled from the lower support portion 16A. For example, a support structure may be provided which extends above the upper support portion 16B and which is connected to such a support portion 16B through linear actuators adapted to allow a vertical translation of the support portion 16B in order to enable the support apparatus 10 to assume the above loading/unloading configuration with the upper support portion 16B completely uncoupled from the lower support portion 16A.

[0044] According to a less preferred embodiment because it entails a greater overheating of the filter sheets, the irradiation windows 17A, 17B may include transparent sheets 17A, 17B instead of being through openings. In this case, the light impression apparatus 1 will not include the mobile support base 40 and both the first filter

sheet 18A and the textile fabric will be directly supported by the lower support portion 16A.

[0045] According to a less preferred alternative embodiment, the adhesion elements to make the filter sheets adhere to the sides of the textile fabric may comprise compression elements instead of the air suction devices described above. For example, if the irradiation windows 17A, 17B include transparent sheets 17A, 17B, compression mats (not shown) transparent to the light radiation of lamps 14A, 14B may be interposed between the transparent sheets and the filter sheets to exert a compression on the filter sheets in the irradiation configuration of the support apparatus 1.

[0046] Note, again, that the number, type and arrangement of lamps 14A, 14B may be varied depending on the specific needs and graphic effects desired. In general, it is sufficient that a light impression apparatus according to the present description includes a first light source 14A and a second light source 14B arranged in such a way that in the irradiation configuration of apparatus 10, the irradiation windows 17A, 17B are interposed between the first and the second light source 14A, 14B.

[0047] Generalizing the above description, a method has been in practice also described for providing at least one graphic motif on a textile fabric, comprising:

- a step of providing the textile fabric 3, said fabric having a first and a second fabric face 3A, 3B opposite each other on which a photosensitive substance is applied;
- a step of providing a first light source 14A suitable for emitting a first light radiation;
- a step of providing a first filter sheet 14A suitable for filtering the light radiation emitted by the first light source 14A, the first filter sheet 18A being provided on a respective portion of sheet with a first negative graphic motif 22A corresponding to the negative of a first graphic motif 2A to be provided on the textile fabric 3;
- a step of interposing the first filter sheet 18A between the first fabric face 3A and the first light source 14A;
- a step of irradiating the first filter sheet 18A by

[0048] means of the first light source 14A so that the first light radiation, crossing the portion of the first filter sheet which the first negative graphic motif 22A is provided on, permits the photo-oxidation of the photosensitive substance on the first fabric face 3A to provide the first graphic motif 2A on the first fabric face 3A.

[0049] The light impression method includes:

- a step of providing a second light source (14B) suitable for emitting a second light radiation;
- a step of providing an irradiation chamber 5 in which said first and second light sources 14A, 14B are provided;
- a step of providing a second filter sheet 18B suitable for filtering the second light radiation, the second fil-

ter sheet 18B being provided on a respective portion of sheet with a second negative graphic motif 22B corresponding to the negative of a second graphic motif 2B to be provided on the textile fabric 3;

- a step of providing a support apparatus 10 to support said first and second filter sheet 18A, 18B, the support apparatus 10 comprising a lower support portion 16A and an upper support portion 16B which are respectively provided with a first and a second irradiation window 17A, 17B, the upper support portion 16B being coupled or

[0050] suitable for coupling to the lower support portion 16A;

- a step of coupling the first filter sheet 18A to the lower support portion 16A with the first negative graphic motif 22A facing the first irradiation window 17A;
- a step of coupling the second filter sheet 18B to the upper support portion 16B with the second negative graphic motif 22B facing the second irradiation window 17B;
- a step of positioning the textile fabric 3 on the first filter sheet 18A so that the textile fabric 3 is supported directly or indirectly by means of the lower support portion 16A, the first fabric face 3A being faced towards the first filter sheet 18A;
- a step of positioning the support apparatus 10 in the irradiation chamber 5 with the upper and lower support portions 16A, 16B positioned so as to be mutually facing and with the first and second irradiation windows 17A, 17B which are interposed between the first and second light sources 14A, 14B; and
- a step of irradiating the second filter sheet 18B by means of the second light source 14B so that the second light radiation, crossing the portion of the second filter sheet 18B which the second negative graphic motif 22B is provided on, permits the photo-oxidation of the photosensitive dye on the second fabric face 3B to

[0051] provide the second graphic motif 2B on the second fabric face 3B.

[0052] According to a preferred embodiment, the light impression method comprises a step of aspirating air between the first and the second filter sheet 18A, 18B to make said first and second filter sheets 18A, 18B adhere respectively to the first and second fabric faces 3A, 3B.

[0053] According to a preferred embodiment of the light impression method, the textile fabric 3 includes an item of clothing 3.

[0054] According to a preferred embodiment, the light impression method includes:

- a step of providing a tensioning shaped member 3C essentially counter-shaped to the item of clothing 3; and
- a step of fitting the item of clothing onto said tension-

ing shaped member 3C inserting the tensioning shaped member between the first and second fabric faces 3A, 3B so as to keep the fabric taut to reduce or prevent the formation of undesirable creases of the item of clothing 3.

[0055] According to a preferred embodiment, the light impression method includes:

- a step of providing a second support apparatus 10 analogous to the first support apparatus 10 in which a second textile fabric is housed to which a photo-sensitive substance is applied;
- a step of alternately positioning the first and the second support device in the irradiation chamber to irradiate alternately the first and the second textile fabric 3.

[0056] According to what described above, it is therefore possible to understand how a light impression apparatus and method according to the present description is able to achieve the objects mentioned above.

[0057] Note also that, thanks to the fact of providing in a light impression apparatus according to the present description at least one support apparatus provided with a lower support portion and an upper support portion to which two respective filter sheets can be coupled, it is advantageously possible to provide a graphic motif on the textile fabric, in a relatively simple, quick and inexpensive manner, which extends from one face of the fabric and continues on an opposite face of the fabric by matching almost perfectly, or at least with a very high accuracy, particularly in the joining zone between the two faces of the fabric, the portions of the graphic motif that are located on the two opposite faces of the fabric.

[0058] The principle of the invention being understood, the manufacturing details and the embodiments may widely vary compared to what described and illustrated by way of a non-limiting example only, without departing from the scope of the invention as defined in the annexed claims.

Claims

1. Light impression apparatus (1) for providing at least one graphic motif (2A) on a textile fabric (3) to which a photosensitive substance is applied, **characterised in that** it comprises:

- an irradiation chamber (5) provided with a first and a second light source (14A, 14B) suitable for emitting respective light radiations; and
- at least one support apparatus (10) to support at least one filter sheet (18A) which is suitable for filtering the light radiation emitted by at least one of the first or second light sources (14A, 14B);

wherein said support apparatus (10) comprises a lower support portion (16A) and an upper support portion (16B) which are respectively provided with a first and a second irradiation window (17A, 17B) and which are suitable for respectively supporting a first and a second filter sheet (18A, 18B) of said at least one filter sheet, the upper support portion (16B) being coupled or suitable for coupling to the lower support portion (16A);

wherein the support apparatus (10) is suitable for respectively assuming a loading/unloading configuration, wherein the lower and upper support portions (16A, 16B) are positioned so as to permit the positioning/removal of the textile fabric (3) between/from the lower and upper support portions (16A, 16B), and an irradiation configuration, wherein the support apparatus (10) is positioned in the irradiation chamber (5) and wherein the first and second support portions (16A, 16B) are positioned so as to be mutually facing and have the first and second irradiation windows (17A, 17B) which are interposed between the first and second light sources (14A, 14B).

2. Light impression apparatus (1) according to claim 1, wherein the textile fabric (3) comprises two fabric faces (3A, 3B) opposite each other and wherein the light impression apparatus (1) comprises adhesion elements (25, 26) associated to the support apparatus (10) which are provided to make the first and second filter sheet (18A, 18B) adhere respectively to said two fabric faces (3A, 3B) when the support apparatus assumes the irradiation configuration and the first and second filter sheets (18A, 18B) are respectively supported by the first and second support portions (16A, 16B).
3. Light impression apparatus (1) according to claim 2, wherein said adhesion elements (25, 26) comprise an air suction member (25) and an airtight sealing element (26) associated with the air suction member (25), the air suction member (25) and the sealing element (26) being suitable for being operatively positioned between the lower and upper support portions (16A, 16B), wherein the air suction member (25) is operatively connected or suitable for connecting to an air suction apparatus which is suitable for being activated to aspirate air between the first and the second filter sheet (18A, 18B), the airtight sealing element (26) being operatively extended along the perimeter of the lower and upper support portions (16A, 16B).
4. Light impression apparatus (1) according to claim 3, wherein the sealing element (26) comprises at least one sealing gasket (26A, 26B) and a gasket frame

to which said sealing gasket (26A, 26B) and said air suction member (25) are attached, said sealing element (26) being extended around a through aperture of the sealing element (26C) and being detachably coupled to the support apparatus (10).

5. Light impression apparatus (1) according to any of the previous claims, wherein said lower and upper support portions (16A, 16B) respectively comprise a lower support frame (16C) and an upper support frame (16D) which extend respectively around the lower irradiation window (17A) and the upper irradiation window (17B), said irradiation windows being through apertures.
6. Light impression apparatus (1) according to any of the previous claims, wherein the support apparatus (10) comprises an intermediate centring frame (30) to which the first filter sheet (18A) is suitable for coupling, said centring frame (30) being coupled or suitable for coupling in a movable manner in relation to the lower support portion (16A) to permit the adjustment of the position of the first filter sheet (18A) in relation to the position of the second filter sheet (18B) attached to the upper support portion (16B).
7. Light impression apparatus (1) according to claim 6, wherein said centring frame (30) is coupled in a removable manner to the lower support portion (16A) and wherein the support apparatus (10) comprises position adjustment elements (31, 32) to adjust the position of said centring frame (30) in relation to the lower support portion (16A), said position adjustment elements (31, 32) comprising first coupling elements (31) provided on the intermediate centring frame (30) and second coupling elements (32), suitable for cooperating with the first coupling elements (31), which are provided on the upper support portion (16A).
8. Light impression apparatus (1) according to any of the previous claims, comprising a mobile support base (40) to support the textile fabric (3) in the loading /unloading configuration, the mobile support base (40) being selectively movable between a lower rest position, in which said support base (40) is situated below and facing the first irradiation window (17A) and an upper support position, in which said support base (40) is facing and situated substantially at or above the first irradiation window (17A) to support the first filter sheet (18A) and the textile fabric (3).
9. Light impression apparatus (1) according to any of the previous claims, wherein the irradiation chamber (5) comprises a first and a second entrance inlet (51A, 51B) for flows of cooling air, said entrance inlets (51A, 51B) being suitable for connecting to at least one cooling apparatus suitable for generating a flow of cooling air, the first and the second entrance

inlet (51A, 51B) being positioned in such a way as to permit each of them to blow a flow of cooling air respectively towards the first and the second irradiation window (17A, 17B) when the support apparatus (10) assumes the irradiation configuration.

10. Light impression apparatus (1) according to any of the previous claims, comprising a first and a second support structure (11-13) and wherein said at least one support apparatus (10) comprises a first and a second support apparatus (10) which are slidably fitted respectively to the first and second support structures (11-13), the irradiation chamber (5) comprising a first and a second access door (53A, 53B) to permit the entrance/exit of the first and second support apparatus (10) in the /from the irradiation chamber (5), the first and the second support apparatus (10) being movable so as to be able to be positioned alternatively in the irradiation chamber (10) respectively through the first and second access door (53A, 53B).

11. Method of providing at least one graphic motif on a textile fabric, comprising:

- a step of providing the textile fabric (3), said fabric having a first and a second fabric face (3A, 3B) opposite each other on which a photosensitive substance is applied;
- a step of providing a first light source (14A) suitable for emitting a first light radiation;
- a step of providing a first filter sheet (14A) suitable for filtering the light radiation emitted by the first light source (14A), the first filter sheet (18A) being provided on a respective portion of sheet with a first negative graphic motif (22A) corresponding to the negative of a first graphic motif (2A) to be provided on the textile fabric (3);
- a step of interposing the first filter sheet (18A) between the first fabric face (3A) and the first light source (14A);
- a step of irradiating the first filter sheet (18A) by means of the first light source (14A) so that the first light radiation, crossing the portion of the first filter sheet which the first negative graphic motif (22A) is provided on, permits the photo-oxidation of the photosensitive substance on the first fabric face (3A) to provide the first graphic motif (2A) on the first fabric face (3A);

characterised by the fact of comprising:

- a step of providing a second light source (14B) suitable for emitting a second light radiation;
- a step of providing an irradiation chamber (5) in which said first and second light sources (14A, 14B) are provided;
- a step of providing a second filter sheet (18B)

suitable for filtering the second light radiation, the second filter sheet (18B) being provided on a respective portion of sheet with a second negative graphic motif (22B) corresponding to the negative of a second graphic motif (2B) to be provided on the textile fabric (3);

- a step of providing a support apparatus (10) to support said first and second filter sheet (18A, 18B), the support apparatus (10) comprising a lower support portion (16A) and an upper support portion (16B) which are respectively provided with a first and a second irradiation window (17A, 17B), the upper support portion (16B) being coupled or suitable for coupling to the lower support portion (16A);

- a step of coupling the first filter sheet (18A) to the lower support portion (16A) with the first negative graphic motif (22A) facing the first irradiation window (17A);

- a step of coupling the second filter sheet (18B) to the upper support portion (16B) with the second negative graphic motif (22B) facing the second irradiation window (17B);

- a step of positioning the textile fabric (3) on the first filter sheet (18A) so that the textile fabric (3) is supported directly or indirectly by means of the lower support portion (16A), the first fabric face (3A) being faced towards the first filter sheet (18A);

- a step of positioning the support apparatus (10) in the irradiation chamber (5) with the upper and lower support portions (16A, 16B) positioned so as to be mutually facing and with the first and second irradiation windows (17A, 17B) which are interposed between the first and second light sources (14A, 14B); and

- a step of irradiating the second filter sheet (18B) by means of the second light source (14B) so that the second light radiation, crossing the portion of the second filter sheet (18B) which the second negative graphic motif (22B) is provided on, permits the photo-oxidation of the photosensitive substance on the second fabric face (3B) to provide the second graphic motif (2B) on the second fabric face (3B).

12. Method according to claim 11, comprising a step of aspirating air between the first and the second filter sheet (18A, 18B) to make said first and second filter sheets (18A, 18B) adhere respectively to the first and second fabric faces (3A, 3B).
13. Method according to claim 11 or 12, wherein said textile fabric (3) comprises an item of clothing (3).
14. Method according to claim 13, comprising:

- a step of providing a tensioning shaped mem-

ber (3C) essentially counter-shaped to the item of clothing (3) and

- a step of fitting the item of clothing onto said tensioning shaped member (3C) inserting the tensioning shaped member between the first and second fabric faces (3A, 3B) so as to keep the fabric taut to reduce or prevent the formation of undesirable creases of the item of clothing (3).

15. Method according to any of the claims from 11 to 14, comprising:

- a step of providing a second support apparatus (10) analogous to said support apparatus (10) in which a second textile fabric is housed to which a photosensitive substance is applied;

- a step of alternately positioning said support apparatuses in the irradiation chamber to irradiate alternately the first and the second textile fabric.

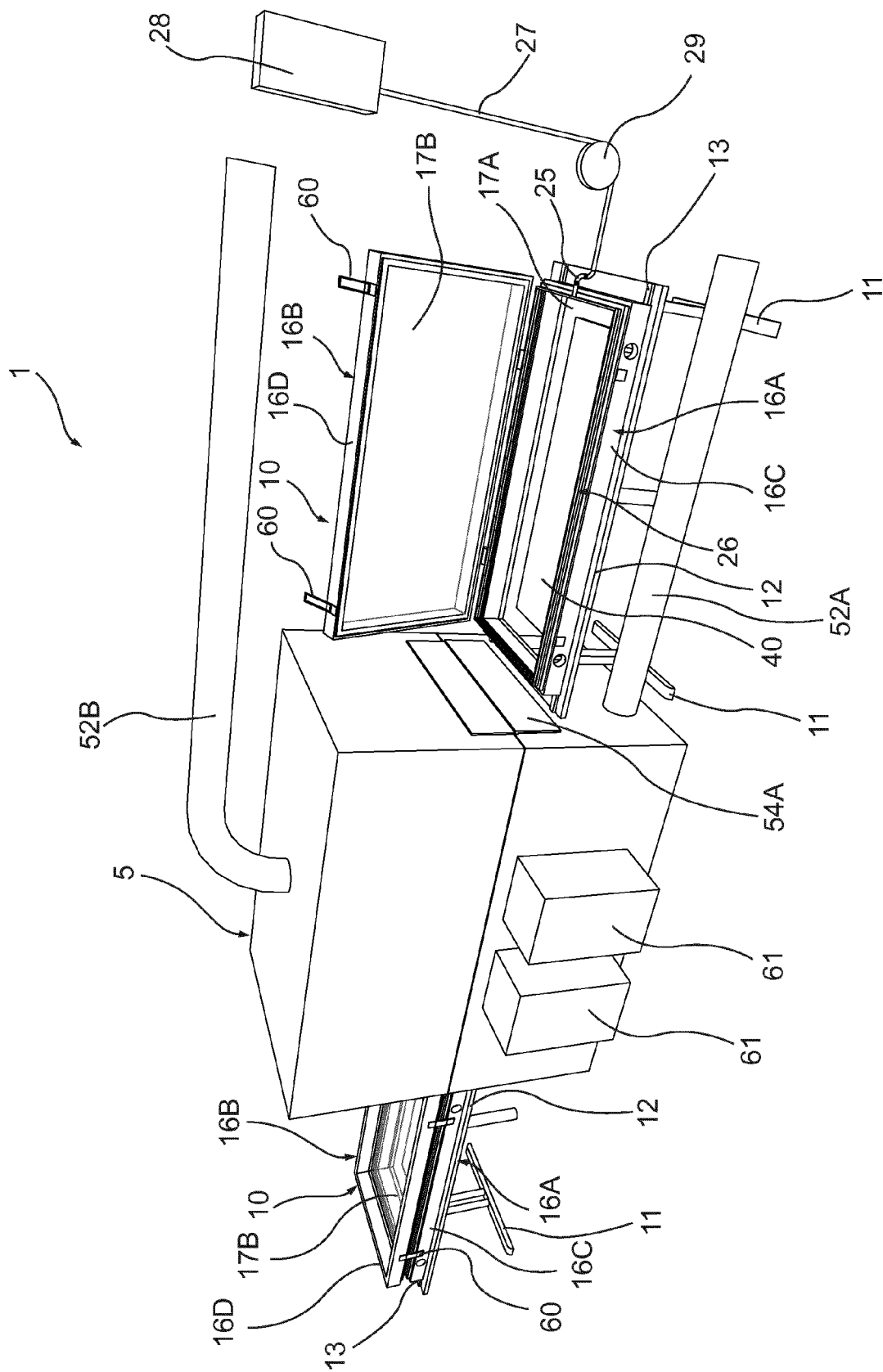


FIG. 1

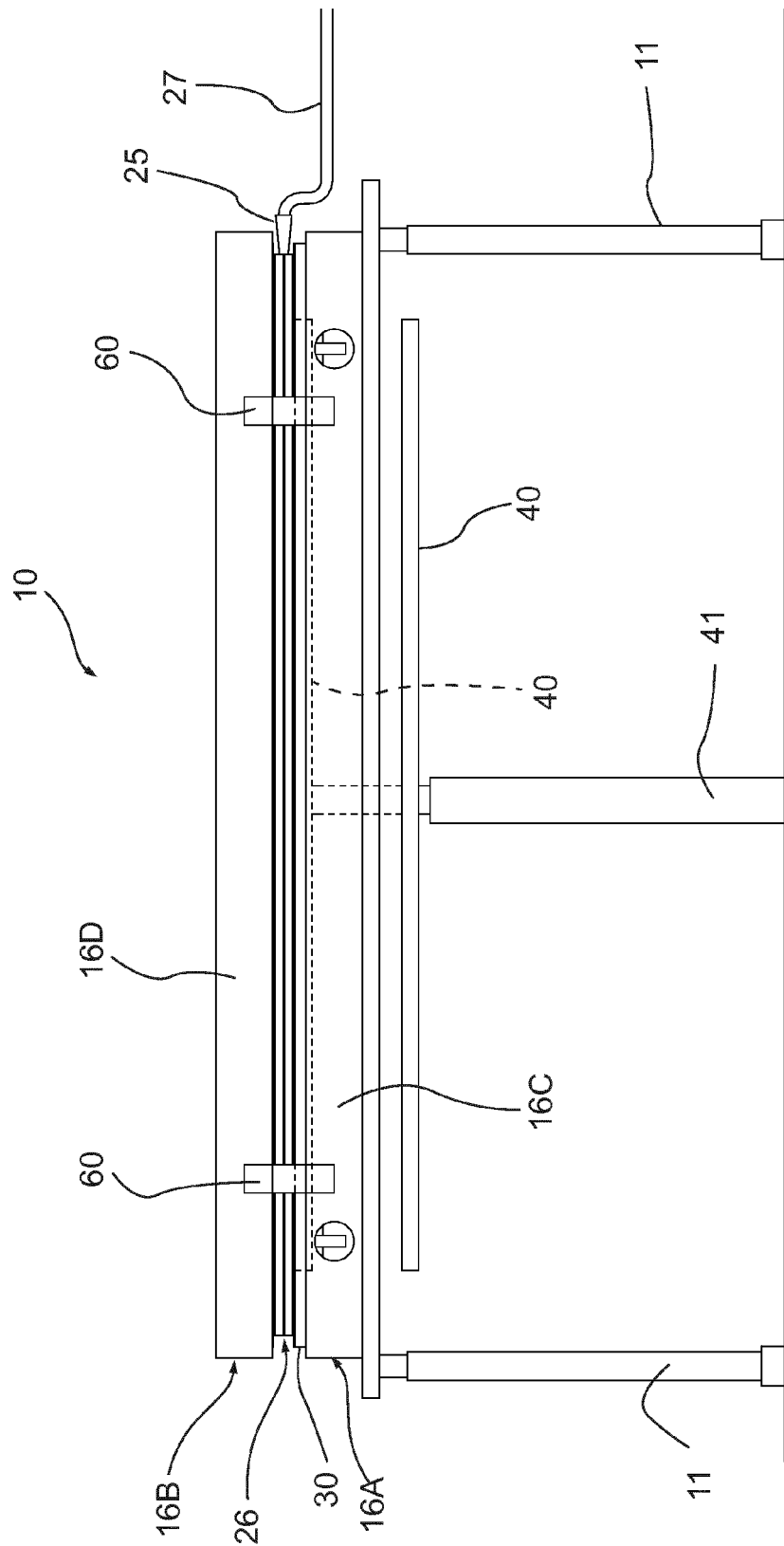


FIG. 2

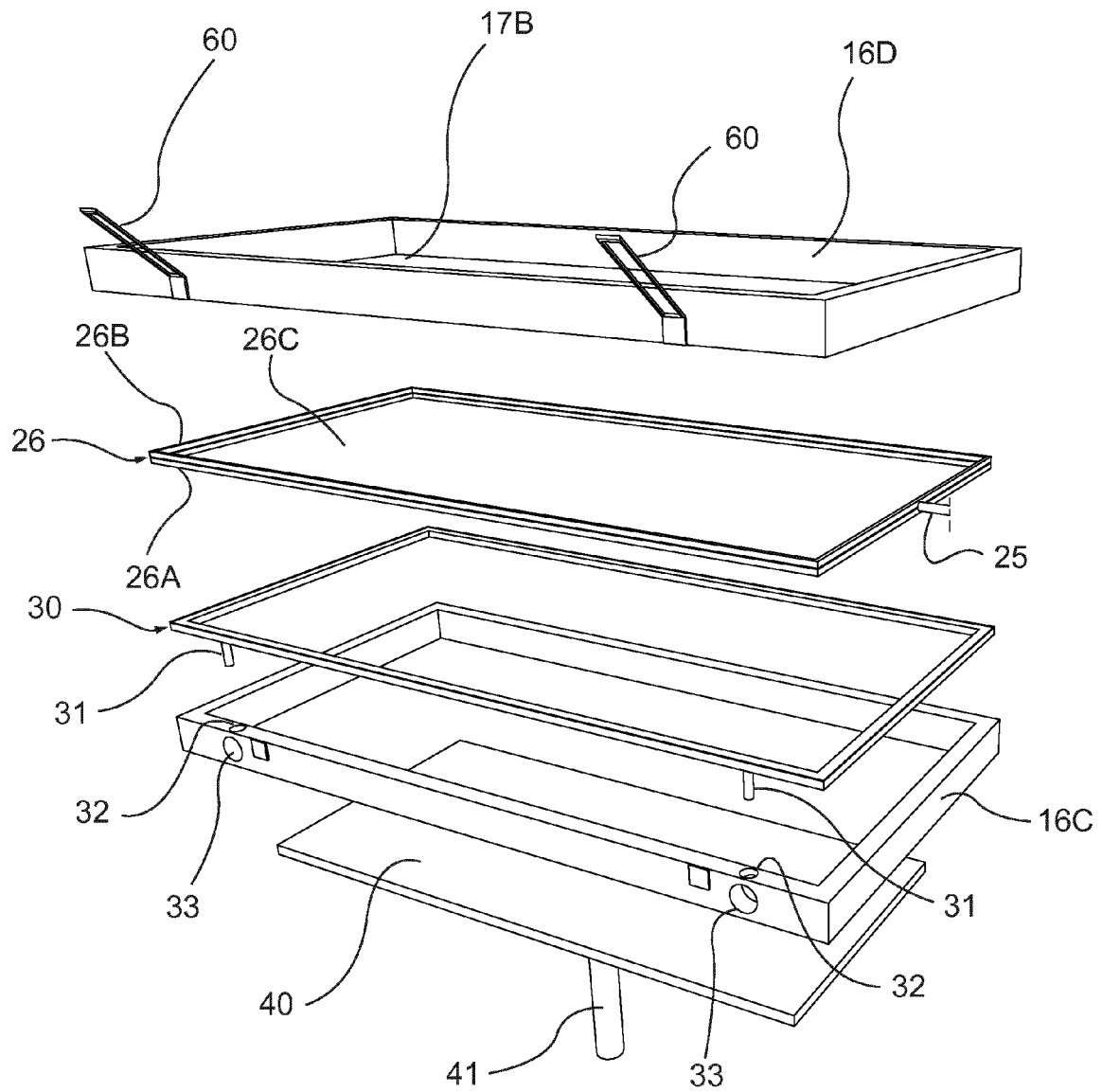


FIG. 3

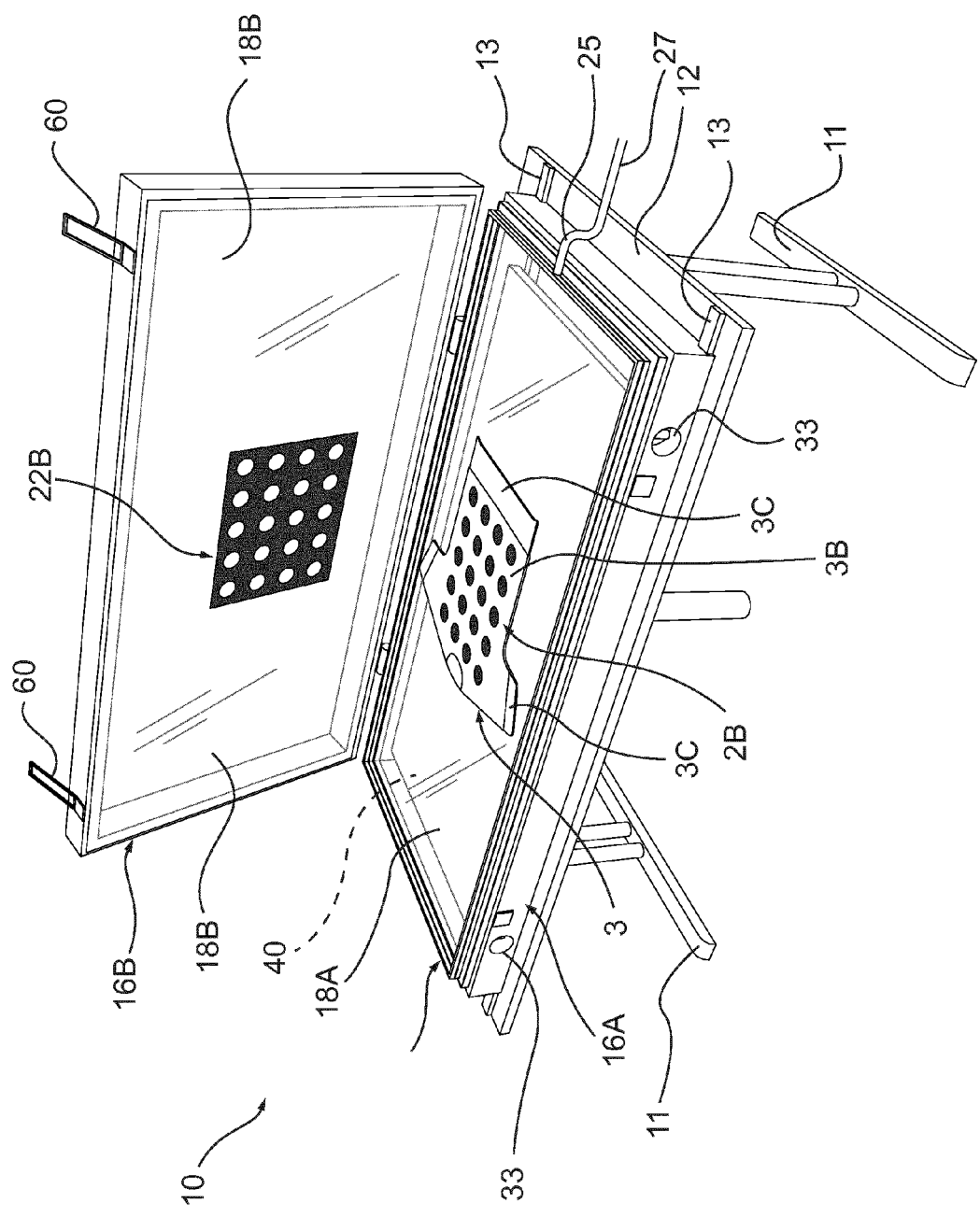
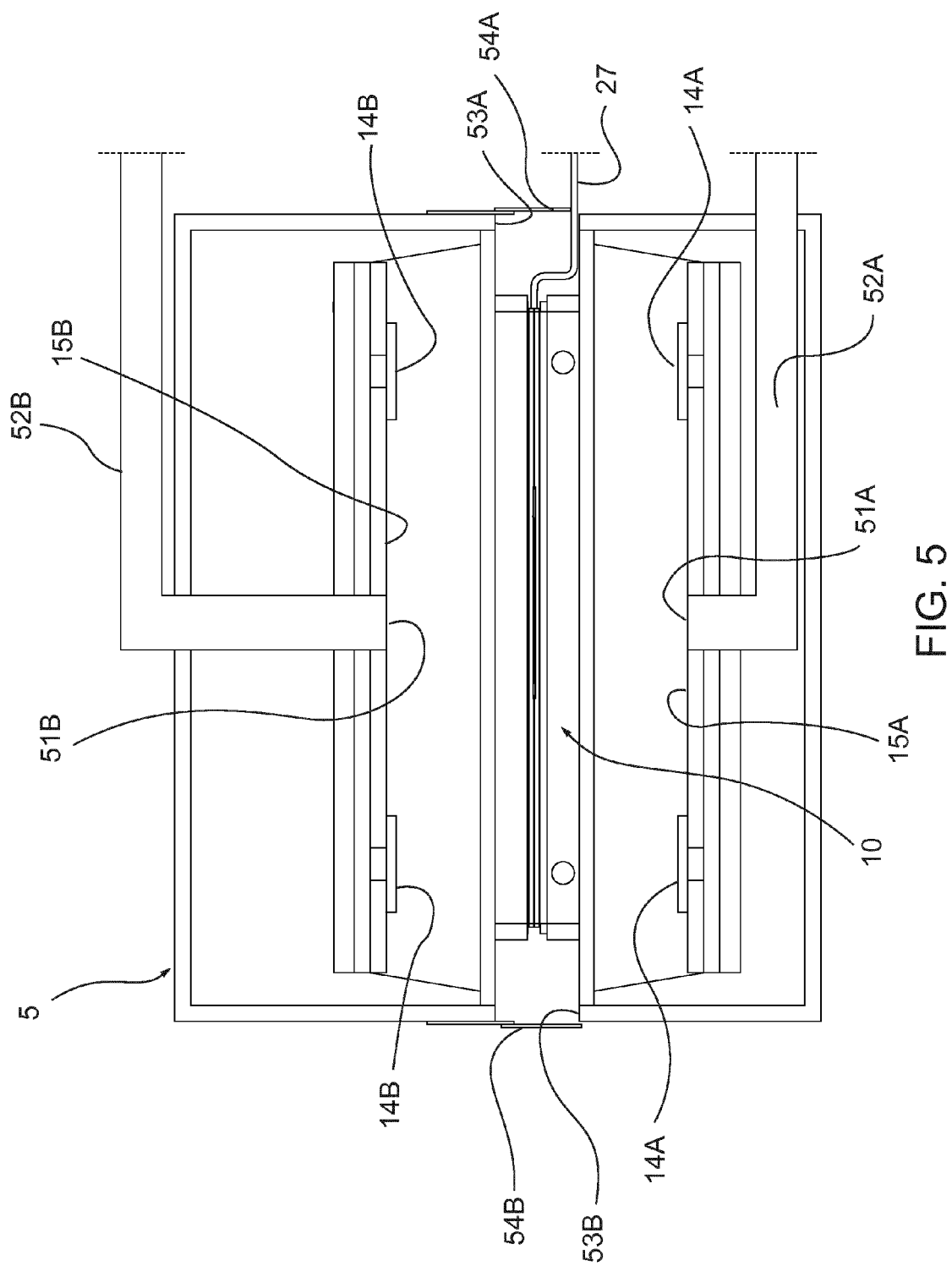


FIG. 4



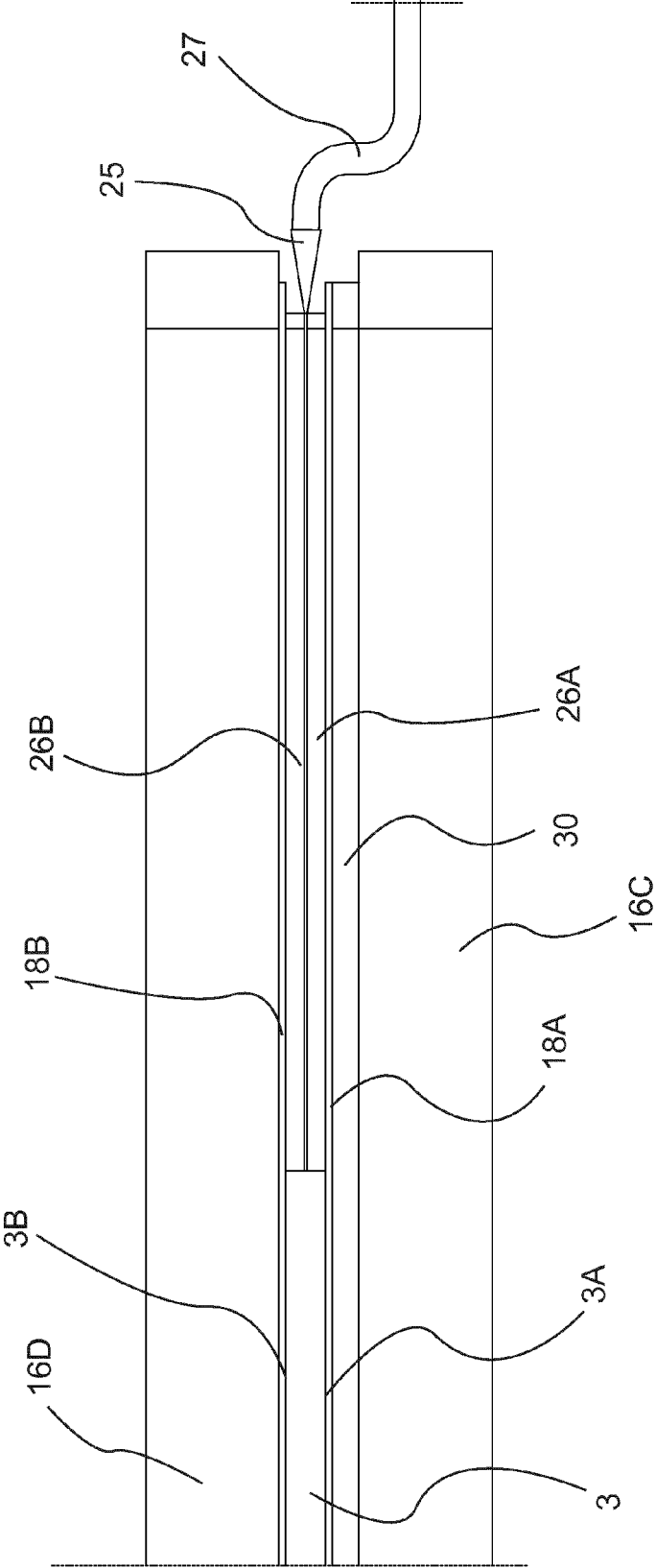


FIG. 6

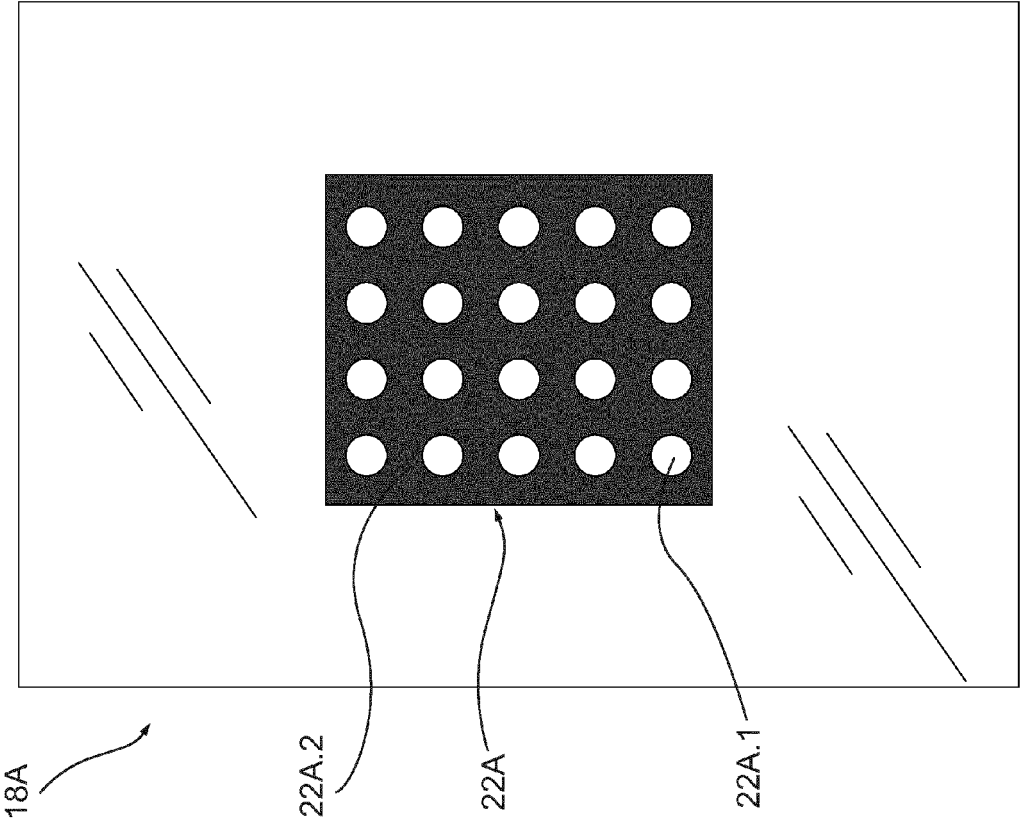


FIG. 7

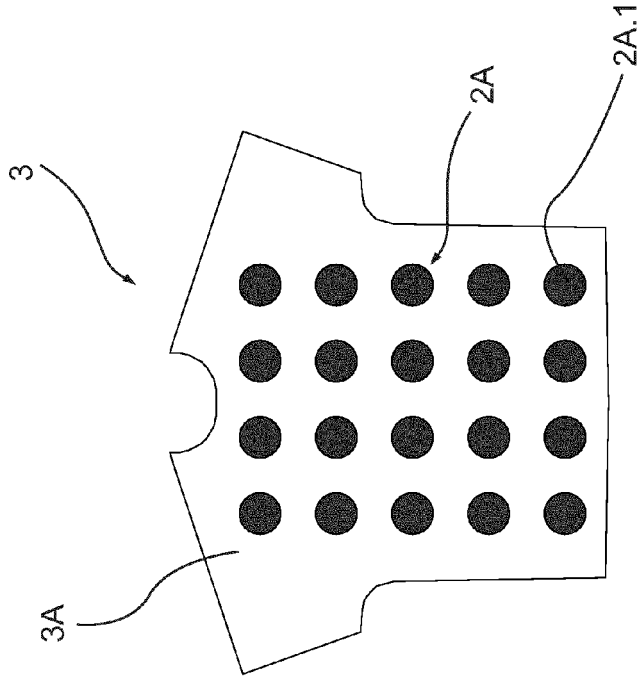


FIG. 8



EUROPEAN SEARCH REPORT

Application Number
EP 14 16 3913

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	GB 2 048 315 A (ISSEC LAB PHYS CHIM APPL; TISSAGES DE SOIERIES REUNIS) 10 December 1980 (1980-12-10) * page 13, lines 15-34; figure 8 * * page 9, lines 2-7 * -----	1-15	INV. G03G15/34 G03G15/00 G03C1/76
			TECHNICAL FIELDS SEARCHED (IPC)
			G03G G03C
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 16 July 2014	Examiner Mandreoli, Lorenzo
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 14 16 3913

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

16-07-2014

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2048315 A	10-12-1980	DE 2923261 A1	18-12-1980
		FR 2411432 A1	06-07-1979
		GB 2048315 A	10-12-1980
		US 4268600 A	19-05-1981

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82