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(54) **Process for printing on surfaces of appliances**

(57) The present invention relates to a Process for printing symbols, characters, words or decorations on surfaces of appliances comprising the following steps in order:

- a laser-pre-printing step in which a surface of an appliance is treated by a laser to ablate it only in a selected area in order to reproduce a desired printing;

- a coloring step in which a coloring substance is laid on said ablated selected area to obtain a desired colored printing.

In particular, the invention refers to a process for printing onto the surface of plastic, metallic, glass or ceramic components of for instance laundry washing and or drying machines, dishwashers, dryers, refrigerators, cleaners of domestic as well as industrial appliances.

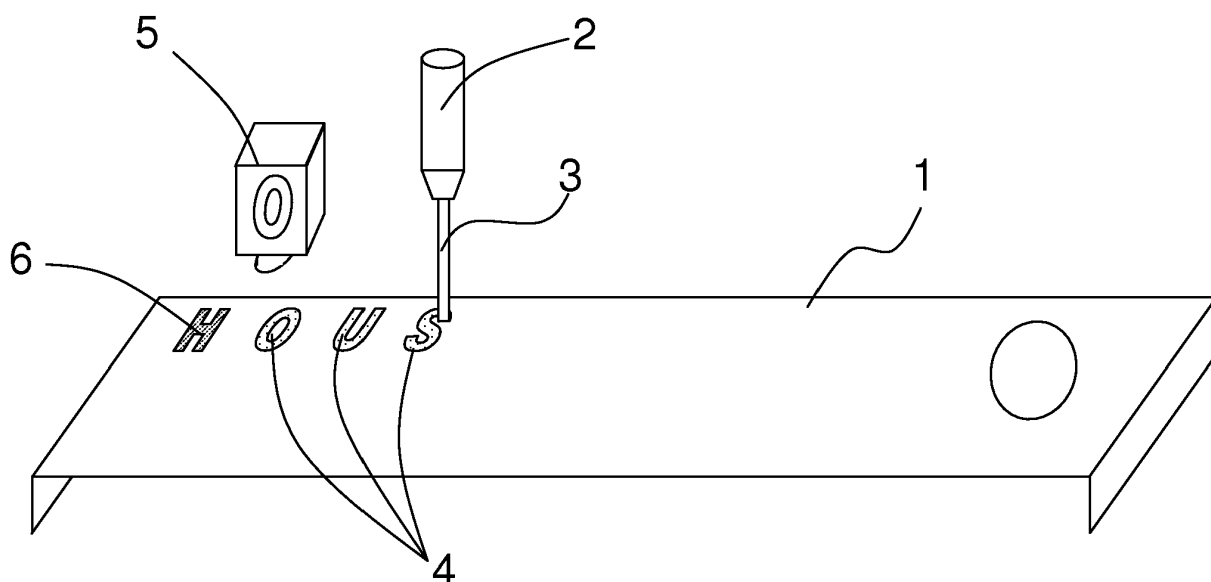


Fig. 4

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a process for printing information, symbols or decorations on surfaces of appliances. In particular, the invention refers to a process for printing onto the surface of plastic, metallic, glass or ceramic components of for instance laundry washing and/or drying machines, dishwashers, dryers, refrigerators, cleaners of domestic as well as industrial appliances.

BACKGROUND OF THE INVENTION

[0002] It is known to treat surfaces of several different materials in order to obtain printings thereon. The most common treatments for plastic surfaces are represented by serigraphy, pad printing and laser printing.

[0003] Serigraphy, or serigraphy printing, is a widely used printing technique used to produce images and graphics onto almost any kind of supports or surface by means of a tissue (printing tissue). This technique is mainly used to print images onto silk tissue, T-shirt, foulard, heats, CD and DVD, ceramic, glass, PP and PE plastics, paper, metal and wood. In general serigraphy uses a woven mesh to support an ink-blocking stencil. The stencil forms open areas of mesh that transfer ink or other printable materials which can be pressed through the mesh as a sharp-edged image onto a substrate (for instance paper, cloth, fabric, plastic materials, etc.). A roller or squeegee is moved across the screen stencil, forcing or pumping ink past the threads of the woven mesh in the open areas. The ink passed through the stencil deposits onto the substrate. The stencil is then removed and the substrate is let to dry. The stencil may be used again after being cleaned. It is possible to print substantially onto all kind of materials. The actual limit of this technology is represented by the irregularity of the surfaces; in fact the application of the above mentioned stencil to three-dimensional surfaces may be difficult. Moreover multicolor serigraphy requires the use of several stencils (one for each color), which increases the costs and the time required for the procedure. In general, serigraphy process results time consuming and laborious, and therefore difficult to automate.

[0004] Pad printing is a known printing process that can transfer a 2-D image onto a 3-D object; it is accomplished using an indirect offset (gravure) printing process that involves an image being transferred from a printing plate (cliché) via a silicone pad onto a substrate (surface to be printed). Pad printing is used for printing on otherwise impossible products in many industries including medical, automotive, promotional, apparel, electronics, appliances, sports equipment and toys.

[0005] It is to be noticed that pad printing, when it is applied to poliolephinic or similar resins, needs a pre-treatment step consisting of preparing the surface to firm-

ly receive the ink. In fact, it is well known that inks generally cannot firmly adhere to substrates as plastics or metals. Therefore, before transferring the image thereon, the whole surface of the substrates are pre-treated according to different processes as corona treatments or plasma or flame treatments before being subjected to printing. Without this pre-treatment there is in fact the risk that the printed images would be altered or deteriorated, for example by cleaning agents or the like. However the above mentioned pre-treatment is costly and time-consuming. Accordingly, also pad printing results in a quite complicated and costly process.

[0006] The laser printing technique consists of ablating selected regions of a plastic substrate corresponding to the symbol to be reproduced by means of laser. Consequently, because of the nature of the laser beam, the surface becomes more or less dark due to a surface burning. In this manner, the laser allows obtaining the printing in a single step. However laser printing is possible only to print information, symbols and decorations, in black or different black shades, but not color or multi-color printings, because the printing is a direct consequence of a burning of the substrate surface. This drawback is particularly evident when the substrate is a plastic one, for example used for decoration or giving information to users.

SUMMARY OF THE INVENTION

[0007] The technical problem faced in the present invention is, thus, to provide a process for printing on surfaces of appliances, which process allows indelible color (i.e. not necessarily only black and white) or multi-color printing involving simple and automatic steps.

[0008] Said problem is solved by a process for printing information, symbols or decorations on surfaces of appliances as covered in the attached claims.

[0009] In particular this problem is solved by a process for printing symbols, characters, words or decorations on surfaces of appliances comprising the following steps in order:

- a laser-pre-printing step in which a surface of an appliance is treated by a laser to ablate it only in a selected area in order to reproduce a desired printing;
- a coloring step in which a coloring substance is laid on the ablated selected area to obtain a desired colored printing.

[0010] Preferably, during or after said coloring step, a further laser-pre printing step is performed in a different selected area of said surface of said appliance, in order to reproduce a further desired printing on said different selected area, said further laser-pre printing step being followed by a further coloring step in which a coloring substance is laid on said ablated different selected area to obtain a further desired colored printing.

[0011] Advantageously, the laser-pre printing step and the following coloring step are carried out in a production line or plant comprising a first laser ablation station followed by a subsequent coloring station.

[0012] In a preferred embodiment the coloring substance comprises an ink. Advantageously the ink is selected from a solvent-based ink, oxidation-drying ink, reactive ink, baking ink, UV curing ink and sublimation ink.

[0013] In a further embodiment the coloring substance comprises a dye.

[0014] Advantageously the laser-pre-printing step is carried out with a Nd:YAG (neodymium-doped yttrium aluminium garnet) laser, preferably a optical fiber laser. In a preferred embodiment the coloring step is carried out by jet printing.

[0015] In a further preferred embodiment the coloring step is carried out by pad printing.

[0016] In the latter embodiment, preferably the pad printing is carried out by means of a printing head including at least one pad having the shape of the desired symbols, characters, words or decorations.

[0017] Advantageously the surface of the appliance is made of plastic or metal or glass or ceramic.

[0018] Opportunely the appliance is selected from laundry washing and/or drying machines, dishwashers, cleaners.

[0019] The invention also regards a control panel of an appliance comprising a printing obtainable according to the process according to the invention.

[0020] Further characteristics and the advantages of the process for printing will become more evident in view of the following detailed description of some embodiments given by way of a non limitative examples of the invention with reference to the drawing, wherein:

- Figure 1 schematically shows a first step of the printing process to print information onto a schematic control panel of an appliance according to the invention;
- Figure 2 shows a second step of the process for printing of the invention;
- Figure 3 shows a third step of the process for printing of the invention;
- Figure 4 shows a fourth step of the process for printing of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0021] According to the present invention, it is provided a process for printing information, symbols or decorations on surfaces, preferably of household appliances, comprising a laser-pre-printing step (called also surface laser ablation, or surface laser treatment, or pre-treatment with laser, or laser ablation step) followed by a coloring step in which a coloring substance is laid on the ablated surface.

[0022] Preferably, but not necessarily, the coloring substance is an ink, i.e. a substance, preferably a liquid,

which contains pigments and/or dyes, and is used to color a surface to produce an image, text, or design.

[0023] Ink can be a complex medium, comprising, for example, solvents, pigments, dyes, resins, lubricants, solubilizers, surfactants, particulate matter, fluoresces, and other materials.

[0024] The laser-pre-printing step is carried out to prepare the surface to receive any kind of coloring substance (e.g. an ink or a dye). In fact, it has been advantageously proposed to ablate the surface of a substrate with a laser in order to obtain a sort of seat (which may advantageously be microscopic, i.e. it may be invisible to the naked eye, or which may be visible) to be subsequently filled with a coloring substance (e.g. an ink or a dye). Therefore, the ablation can be advantageously performed only in selected areas reproducing the character, symbol or decoration to be obtained. Accordingly, the laser can be used to treat the target surface so as to render it suitable for receiving the selected coloring substance (e.g. an ink or a dye). In other words, laser is used to ablate the substrate in order to provide not only a precise seat but also a surface which is compatible with the chemical/physical characteristics of the coloring substance to be used. In fact, it is known, for example, that dyes can hardly remain attached to some surfaces, as for example plastics like, for instance, PP (polypropylene), during the whole life of the product (in particular if the product is often manipulated and cleaned) because of the very different surface tensions; thus, the above mentioned pre-treatment with laser allows using such dyes also with surfaces made of plastic material like for example Polyolephine resins.

[0025] According to the present invention, it has been proposed to combine a first laser-pre-printing step, having the double function of creating one or more receiving seats and to make the surface compatible with the chemical/physical characteristics of the coloring substance, and a further coloring step in which a desired coloring substance (e.g. an ink or a dye) is laid on the previously obtained seats. It is to be noticed that the treatment according to the invention is carried out only in selected areas which reproduce exactly the symbols, writings or decorations, thus not necessitating to treating the whole surface of the substrate. This allows reducing the costs and the time required for performing this operation, making the printed symbols, writings or decorations substantially indelible.

[0026] The kind of laser and corresponding working parameters depend on the substrate to be treated. In any case, the skilled person will be able to select suitable conditions.

[0027] For example a so called Nd:YAG (neodymium-doped yttrium aluminium garnet) laser, preferably a optical fiber laser, may be used for the purpose of the invention; since the light ray of this kind of laser has a small spot size and consequently marks the surface to be treated with a good resolution.

[0028] As schematically shown in the example of figure 1, during the laser-pre-printing a control panel 1 of an

appliance is subjected firstly to a laser-pre-printing step by means of a conventional laser device 2 whose beam 3 is controlled, for example, according to the above parameters. The laser device 2 is driven in order to follow a selected path corresponding to the target symbol, character, word or decoration. The command and control of the laser device can be carried out for example by means of a known control unit conventionally used in the art. Further, said control unit may advantageously be provided with suitable programs allowing driving the laser in the selected areas to be treated according to paths memorized within said unit. Similarly, the working parameters of the laser may be advantageously controlled through a suitable program running in the control unit.

[0029] After the laser-pre-printing treatment has been completed, a kind of pre-printing 4 of a first symbol, character, word or decoration has been obtained (figure 2) on the surface of the appliance. In other words, a specific area of the substrate has been ablated by the laser in such a way to identify the exact area to be subsequently printed with the coloring substance (for example and ink or a dye) and, at the same time, so as to prepare this exact area to receive the coloring substance itself (i.e. to make the surface of said exact area compatible with the chemical/physical characteristics of the coloring substance). Therefore, the further coloring step may now be carried out; for example a printing head 5 can be positioned just in correspondence of the print 4 for laying the coloring substance on the latter, so as to obtain a colored symbol, character, word or decoration 6 in correspondence of the print 4 (figure 4).

[0030] Advantageously, at the same time or subsequently, the laser device 2 can move to be positioned in a further selected area where a further laser-pre-printing can be carried out in the same manner as above and reproducing a further (eventually different) symbol, character, word or decoration.

[0031] The above laser-pre-printing treatment and the subsequent coloring step (i.e. the lying of the coloring substance on the area pre-treated by the laser) may be advantageously repeated for other symbol, character, word or decoration which has to be obtained one the control panel 1.

[0032] It is to be noticed that the coloring step can be carried out for example by means of pad printing or jet printing.

[0033] Pad printing, as stated above, is a well known printing technique widely used, for example, to print onto plastic substrates consisting of styrolic resins where, in order to obtain a good adhesion of the dyes, it is not necessary to perform the above plasma or flame pre-treatments and use of aggressive dyes. Accordingly, a detailed description of pad printing will be not made. However, for the purpose of the invention, the coloring step performed by pad printing can be carried out with different kind of coloring substances (e.g. inks, dyes). For instance, if a thermoplastic substrate is to be printed, a solvent-based ink is preferred. Oxidation-drying inks are

suitable instead for printing on metal and glass substrate. Reactive inks, i.e. inks requiring a catalyst to cure, provide good chemical and abrasion resistance. Other minor inks are represented by baking, i.e. inks requiring relatively high to high temperature to cure, UV curing inks and sublimation inks. However, some kind of recent UV inks have a wide diffusion thanks to selected cellulosic resin components and special adhesion promoter rendering such inks very performing. Inks used quite successfully in pad printing are thermoplastic inks, particularly suitable for glass and ceramic substrates.

[0034] Alternately, the pad printing can be performed using a pad having exactly the shape of the symbol, character or decoration to be reproduced.

[0035] Jet printing is also well known in the art and will not be explained in detail herein. This method comprises spraying ink onto the areas to be printed by means of well known devices. A jet printing process may be advantageously applied in the method according to the invention in order to lay the coloring substance (i.e. ink) exactly on the laser-pre-printed areas. Jet printing can be easily carried out just because the laser ablation also performs a chemical/physical modification of the surface tension of the substrates in order to render them compatible with almost any kind of inks and printing methods. According to the above, it is submitted that several important advantages have been reached.

[0036] First of all, the process for printing on appliance surfaces becomes fast and can be carried out real-time; in other words the laser-pre-printing process and the subsequent coloring step may be performed one directly after the other. Therefore the time required to carry out the whole process is very low, for example it can be generally comprised between 3 to 30 seconds depending on the printing to be reproduced, coloring, kind of character, symbol or graphic.

[0037] The process can easily be automatic since both the laser ablation step and the following coloring step can be carried out in a production line or plant comprising a first laser ablation station and a subsequent coloring station each provided with known devices controlled for example via a conventional control unit.

[0038] The printing cannot be anymore erased by cleaning agents thanks to the perfect adhesion of the coloring substance into the laser-ablated surfaces which on one hand creates a sort of seat filled by the coloring substance and on another hand adapts the surface tensions of the surface to the coloring substance to be applied. At the same time, it is eliminated the costly and time-consuming preliminary pre-treatment step of the prior art necessary to prepare the whole substrate (and not only the specific areas to be printed, as in the present invention) to receive the ink as well as the use of aggressive and somehow toxic inks.

[0039] The inventive process can be performed on several different substrates as almost any kind of plastics, in particular PP, PE, metals as for example inox steel, ceramics, glass.

[0040] The process according to the invention is particularly adapted to print onto control panels of appliances as laundry washing machines, dishwashers, dryers, cleaners, where the panels are made, for example, of PP.

[0041] In the following some embodiments have been given by way of non-limitative examples to carry out the invention in the field of household appliances.

Claims

1. Process for printing symbols, characters, words or decorations on surfaces of appliances comprising the following steps in order:

- a laser-pre-printing step in which a surface of an appliance is treated by a laser to ablate it only in a selected area in order to reproduce a desired printing;
- a coloring step in which a coloring substance is laid on said ablated selected area to obtain a desired colored printing.

2. Process, according to claim 1, wherein during or after said coloring step, a further laser-pre printing step is performed in a different selected area of said surface of said appliance, in order to reproduce a further desired printing on said different selected area, said further laser-pre printing step being followed by a further coloring step in which a coloring substance is laid on said ablated different selected area to obtain a further desired colored printing.

3. Process, according to claim 1 or 2, wherein said laser-pre printing step and the following coloring step are carried out in a production line or plant comprising a first laser ablation station followed by a subsequent coloring station.

4. Process according to one ore more of the previous claims, wherein the coloring substance comprises an ink.

5. Process according to claim 4, wherein said ink is selected from a solvent-based ink, oxidation-drying ink, reactive ink, baking ink, UV curing ink and sublimation ink.

6. Process according to claim 1 or 2 or 3, wherein the coloring substance comprises a dye.

7. Process according to any one of previous claims wherein said laser-pre-printing step is carried out with a Nd:YAG (neodymium-doped yttrium aluminium garnet) laser, preferably a optical fiber laser.

8. Process according to any one of previous claims, wherein said coloring step is carried out by jet print-

ing.

9. Process according to any one of claims 1 to 7, wherein said coloring step is carried out by pad printing.

10. Process according to claim 9, wherein said pad printing is carried out by means of a printing head including at least one pad having the shape of the desired symbols, characters, words or decorations.

11. Process according to any one of previous claims, wherein the surface of said appliance is made of plastic or metal or glass or ceramic.

12. Process according to any one of previous claims, wherein said appliance is selected from laundry washing and/or drying machines, dishwashers, cleaners.

13. Control panel of an appliance comprising a printing obtainable according to the process of any one of previous claims.

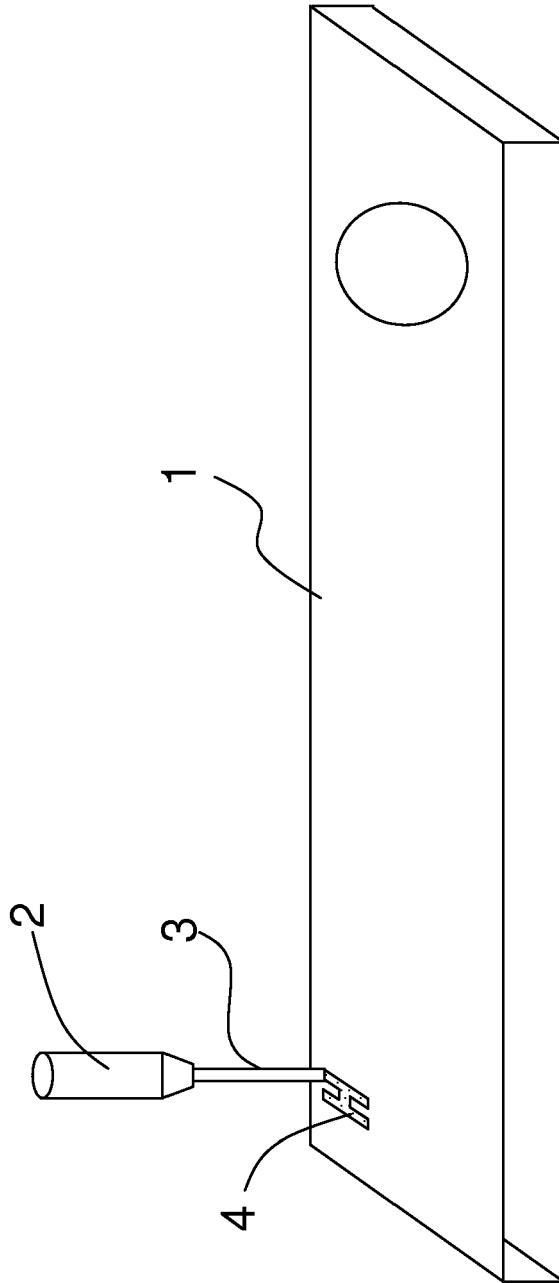


Fig. 1

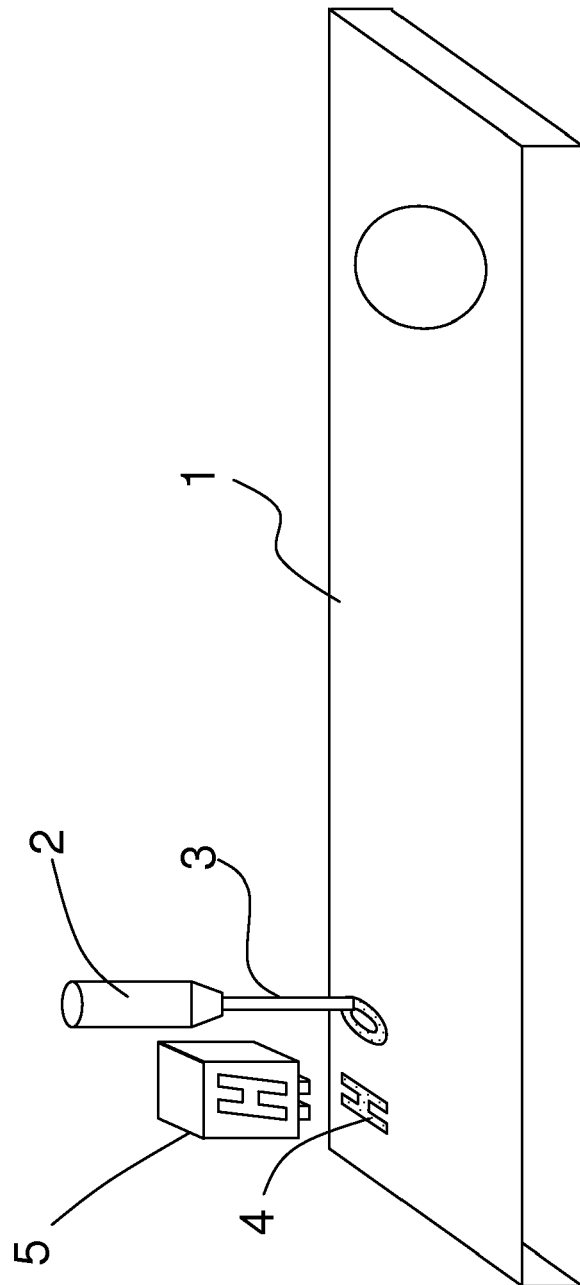


Fig. 2

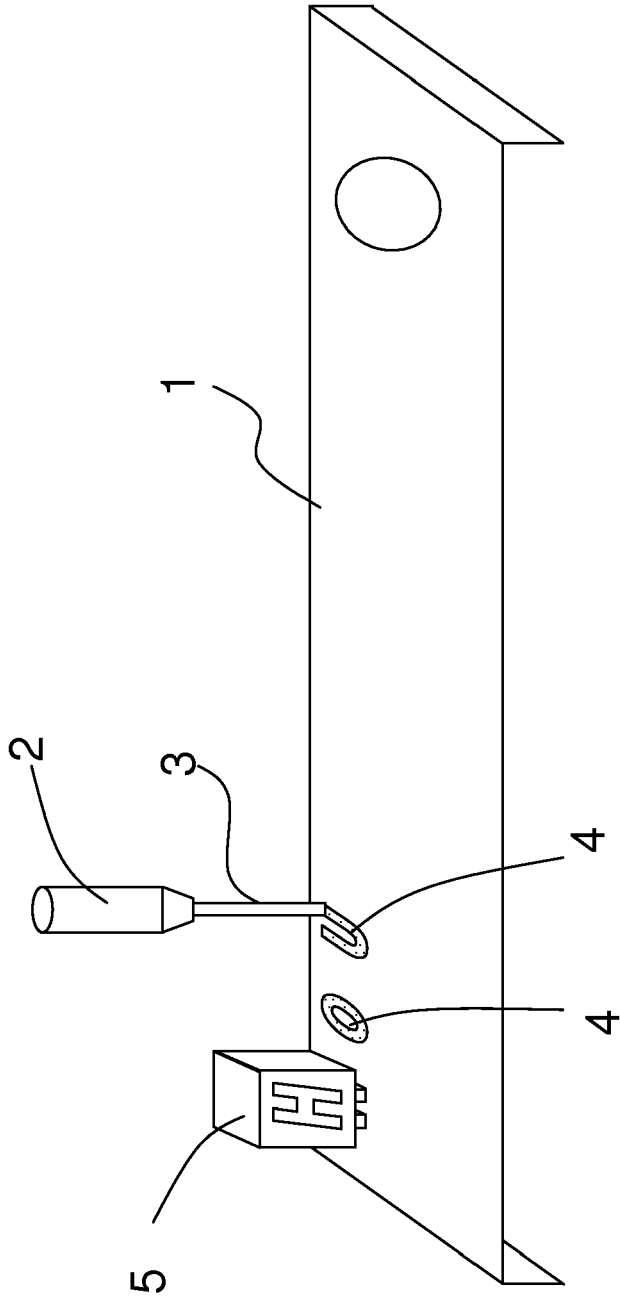


Fig. 3

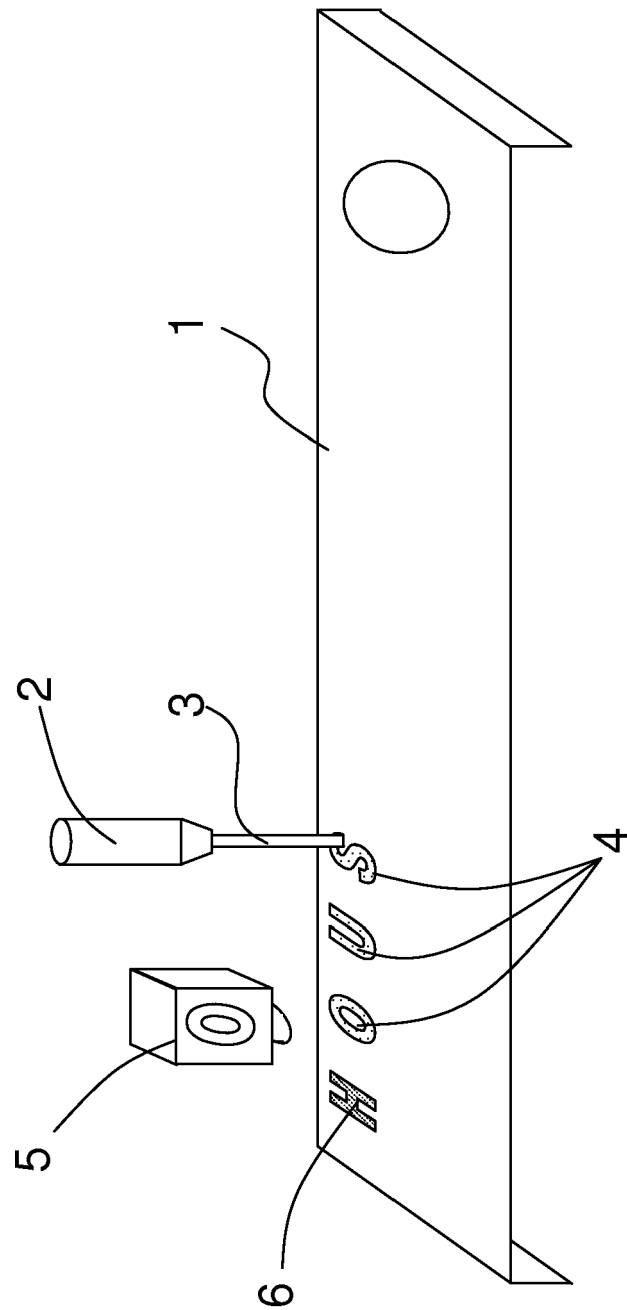


Fig. 4



EUROPEAN SEARCH REPORT

Application Number
EP 11 15 2747

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	WO 2006/025016 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]; WIELSTRA YTSSEN [NL]; VAN DE WOUDE) 9 March 2006 (2006-03-09) * page 1, line 27 - page 2, line 8 * * page 2, line 24 - page 3, line 2 * * page 3, line 14 - line 17 * * page 4, line 27 - line 33 * * page 5, line 29 - line 34; figures 3,4 * -----	1-13	INV. B41M5/24 B41M3/00 B41M1/14
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 26 April 2011	Examiner Pulver, Michael
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	

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

EP 11 15 2747

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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