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(54) Method for making a printing plate

(57) The invention relates to a method for making a printing plate for flexographic printing. To this end a basic plate is engraved by means of a laser beam, for example, a CO_2 or YAG laser. Where the laser beam has acted on the material of the surface of the basic plate, said material is removed, resulting in a printing plate with a printing image. The method according to the invention provides a very simple, quick and cheap method of making printing plates, in which chemical rinsing and etching fluids are no longer necessary. By means of the invention it is possible to perform an alignment while the printing plate is being engraved.

EP 1 228 864 A1

Description

[0001] The present invention relates to a method for making a printing plate. More in particular the invention relates to a method for making a printing plate from a basic plate, which printing plate is suitable for flexographic printing and in which the basic plate is engraved by means of a laser beam.

[0002] Such a method is known from the American patent US-A-5,840,463. The basic plate, which in accordance with the patent is used for making a flexographic printing plate, consists of several layers, each of a specific composition, and applied onto a backing layer. With the aid of an infrared laser a desired printing image (pattern) is formed on the plate, so that the exposed parts will be cured. In a subsequent processing step the entire plate is heated by means of a special device and the unexposed parts are removed from the thus processed plate. The parts treated with the infrared laser remain as printing image on the plate.

[0003] This known method has several disadvantages. A first disadvantage is that various steps are required to make the basic plate, because it consists of several layers. Then the basic plate has to be provided with a desired pattern by means of a laser, and finally the unexposed parts of the plate have to be removed. These various steps make the manufacture of such a flexographic printing plate laborious, time consuming and expensive. This method is not often used in practice.

[0004] According to a method generally used in the art, a not completely cured photopolymer plate ("green plate") is exposed through a negative of a printing image to be formed on the plate, so that the printing parts of the plate are cured. To this end the green plate is provided with a so-called slip-sheet coating to ensure static positioning of the negative on the green plate. The slip-sheet coating must subsequently be removed. After that, by means generally known in the art, e.g. by using chemicals or water containing a chemical, often in the form of a soap solution, the unexposed and thus uncured parts of the plate are washed off together with the slip-sheet coating. The plate is then dried and again exposed and, often in the same processing step, an anti-adhesion treatment is carried out with the aid of UVC lamps.

[0005] An object of the present invention is to provide an improved method for making a flexographic printing plate. A more specific object is to provide a method wherein the above-mentioned disadvantages do not occur.

[0006] In accordance with the invention an improved method for making a printing plate as described in the preamble is obtained, characterized in that the basic plate consists of a cured polymeric material and in that at least a part of the surface is removed by the laser beam. According to the invention therefore, the part of the surface not intended to form the printing image is removed from a cured, i.e. a polymerized plate with the aid of a laser.

[0007] In the method according to the invention, the basis may be formed by a photopolymeric printing plate generally used in the art (see, for example, the American patent specification US-5,259,311 to McCaughey jr.). According to the invention, such a plate is first completely cured, for example, by thoroughly exposing the entire plate to radiation of a suitable wavelength in order to completely polymerize the material. Simultaneously the anti-adhesion treatment is carried out by UVC-light radiation. A person skilled in the art is quite capable of carrying out such curing of the plate. Subsequently the slip-sheet coating (if present) has to be removed. After that, the non-printing part may be removed from the surface with the aid of the laser.

[0008] As printing plates the following categories may be listed:

1. Conventional soft plates, of a hardness ranging from 30°-70° Shore A, and which are washed with traditional non-water-based agents. Examples of suitable plates are: Cyrel (from DuPont), Flexlight (from MacDermid), Ohkaflex and Elaslon (from Tokyo Ohka Kogyo Co.), and APR (from Asahi);
2. soft aqueous plates, of a hardness ranging from 30°-70° Shore A and which are washed with water, optionally provided with additives. Examples of suitable plates are: Torelief (from Toray Industries), Fiexceed (from MacDermid), and Cosmolight (from Toyobo) ;

and

3. Liquid starting polymers (monomer mixtures, frequently comprising acryl monomers) that can be cured with the aid of UV light, and which can be polymerized to form plates of different degrees of hardness by changing the components in the mixture. Examples of mixtures are: Verbatim (from Chemence), Merigraph (from MacDermid), and APR (from Asahi).

[0009] Because the anti-adhesion treatment in accordance with the invention is carried out prior to the laser treatment, particles that are loosened during the laser treatment will not simply adhere to the surface of the plate. A later treatment to remove the particles is therefore not necessary.

[0010] In accordance with a preferred embodiment, the method according to the invention is carried out on a completely cured photopolymeric printing plate fabricated in one step, and which is immediately ready for laser treatment. To this end a plane bottom surface of a mask is provided with a removable sheet material over which subsequently a substantially liquid, still to be cured, starting material for the photopolymer plate is poured. The removable sheet material must not adhere to the photopolymer when the latter is being cured (photopolymerized). The liquid starting material is distributed

with the aid of a doctor blade or the like to obtain a uniform thickness. After that a backing layer is applied to adhere to the photopolymer. At its surface facing the photopolymer, said backing layer is provided with an adhesive that adheres very well to the cured polymer. In order to provide a good contact between the backing layer and the photopolymer, and in order to adjust to the required plate thickness, this treatment may be performed by applying pressure. For this purpose, for example, a plate may be used made of material that is permeable to curing radiation, e.g. if curing is performed with the aid of UV radiation it may be a glass plate, which glass plate will at the same time form a top surface of the mask.

[0011] Curing may occur from both sides of the mask simultaneously. A considerable advantage of the present invention is that the anti-adhesion treatment may be carried out simultaneously with the curing of the material, preferably using UVC light. Another advantage compared to the present-day methods is that in accordance with this preferred method of the invention, no slip-sheet coating is applied. This is economical with respect to the use of chemicals, which are necessary in the technique for the removal of the slip-sheet coating.

[0012] According to the invention it is possible to treat a simple basic plate made for example, from a polymer or a copolymer such as a photopolymer, and which is completely cured, with a suitable laser beam in order to remove parts from the surface of said plate. Thus the non-printing parts are removed from the surface.

[0013] It has been shown that it is possible with the method according to the invention to produce very fine patterns on the printing plate. A traditional and known laser suitable for carrying out the present method, a CO_2 laser, is certainly able to achieve a Didot grid of 60. In flexography a Didot grid of 40-60 is usual (a Didot grid of 56 corresponds with a raster of 150 lpi (lines per inch)).

[0014] According to a preferred embodiment, air extraction is used during laser engraving, producing an airflow above and in the vicinity of the surface treated with the laser, such as to extract gases being released by the laser, and possibly material particles. This prevents particles that loosened by the laser become burnt into the plate.

[0015] As an option, a supplementary rotating soft brush may be used to remove particles that have unexpectedly been left on the plate. The bristles of the brush should have a stiffness such that these do not damage or otherwise negatively affect the material surface of the photopolymer printing plate. The particles will then be removed by the extractor. Optionally the extractor may be integrated in the brush.

[0016] The extractor system optionally comprises a filter, for example an activated carbon filter. In this way the gases released during the laser treatment are filtered and adsorbed by the carbon filter, thereby preventing the emission of harmful substances into the environment.

[0017] By means of the present method it is possible to obtain very precise patterns. This is achieved in particular thanks to the fact that no further surface treatment is required after the material has been laser-engraved. In contrast, the prior art requires that after the exposure of the material, the unexposed parts be removed mechanically, for example, by using brushes. The possibility exists of the surface being damaged if brushes are used whose bristles are too hard, or if the brushes are applied with too much force.

[0018] A laser that according to the invention produces good results is a laser that, while irradiating the plate material, is capable of removing part of the surface of that material. Examples of such a laser are CO_2 or YAG lasers. The power of the laser greatly depends on the material to be engraved, e.g. the type of material, but also the depth of penetration, the engraving speed and the size of the printing plate. The power consumed will generally range from 10-300 watt, preferably from 20-1000 watt, more preferably from 25-500 watt. With a photopolymeric printing plate of A2 format, a CO_2 laser will generally have a power consumption ranging from 25-250 watt. These lasers are generally known in the art.

[0019] The flexographic printing plate as obtained with the aid of the method according to the present invention is in the printing process applied to a cylinder, which is then rolled over a surface to be printed. Due to the plate being bent, the pattern will become slightly distorted compared with the printing plate in the flat configuration; it may therefore be preferred to engrave the flexographic printing plate by means of the laser beam while the same is on the cylinder and has assumed the final configuration for its employment in the printing process. In this way it is possible to apply an undistorted printing pattern to a substrate. For that matter, it is also possible while designing the printing pattern or while forming the printing image on the plate when it lies flat, to compensate the distortion of the plate resulting when applying the same around a cylinder. Preferably the distortion factors to be applied are incorporated in the software of the laser-engraving machine. It is then very easy to perform the laser engraving process on a permanent cylinder.

[0020] It is especially preferred for the cured polymer plate to be applied around the printing cylinder prior to laser engraving. The printing plate may be attached to the printing cylinder by means of an adhesive bond, but it is also possible to affix the printing plate on a sleeve, which after the printing plate has been laser-engraved, may be slid over a printing cylinder. At the same time, such a sleeve endows the printing plate with sufficient rigidity for further handling and for applying it tautly around a cylinder. This is generally known in the art. The position of the printing image on the printing cylinder can be determined precisely by the software of the engraving machine. In the case of polychromatic printing, for

example when printing in six colours, six printing cylinders are required, each with a separate printing image. Thanks to the software of, for example, the engraving machine, the position of each of the printing images on the printing cylinder is exactly known, so that it is no longer necessary to individually register the printing plates on the printing cylinders.

[0021] According to the prior art, the printing plates have to be aligned on the printing cylinders manually or with the aid of very costly machines. This is very time-consuming. A further advantage is that the currently used alignment symbols, which are provided on a printing plate next to the printing pattern, may be omitted. This makes a saving in printing plate material possible.

[0022] It will be obvious that with flexographic printing a printing plate is used which exhibits a difference in height between the printing and the non-printing parts. This height may be adapted as desired, the height being determined chiefly by the type of material to be printed, as well as by the type of printing plate material. In general, the plate thickness will vary from 0.5 to 10 mm. A plate thickness from 0.76 to 6.35 mm is preferred. The height of the relief may vary from 0.4 to 9.9 mm. A height of 0.66 to 6.15 mm is preferred.

[0023] The hardness of the printing plate may also vary within a wide range. In particular, the hardness will range from 30 to 70° Shore A.

[0024] The material being used for the printing plate has to be suitable for the intended purpose. To begin with, the plate must be flexible enough to be able to apply it, if desired, around a printing cylinder. In addition, the material must exhibit a suitable affinity with the printing ink, the material of the printing plate, at least the printing parts, having to become thoroughly wetted by the printing ink. Different kinds of printing ink, of different compositions, may render it necessary for the printing plate to be made of a specific material. It is possible to use the materials that are used according to the prior art manufacture of flexographic printing plates. Preferred materials are radiation-curable materials, for example, materials that can be crossed-linked by radiation and/or polymerizable materials.

[0025] Radiation-curable materials generally comprise a binding agent, a photoinitiator or a photoinitiator system, and a radiation-curable component that may be at least one of (a) a low-molecular monomer or oligomer that is polymerizable, (b) reactive groups pendant to the binding agent and suitable to interact, or (c) reactive groups pendant to the binding agent and a cross-linking agent capable of reacting with the reactive groups.

[0026] Materials that can be used as binding agent comprise polymers and copolymers of acrylates, methacrylates, acrylamides, styrene, vinyl acetate, and their partially hydrogenated derivatives, including amphoteric interpolymers. Gelatine- and cellulose-esters and -ethers and elastomeric materials such as polymers and copolymers of butadiene and isoprene may also be used.

[0027] The photoinitiator system is a system that, when exposed to actinic radiation, will form compounds that will initiate either a free-radical reaction or a cationogenic cross-linking or polimerization reaction. Actinic radiation refers to high-energy radiation including, but not limited to, UV, electron, X-ray, and visible radiation.

[0028] Photoinitiator systems for the free-radical reactions are generally known in the art, and do not need to be depicted here. This holds true also for the photoinitiator systems that are suitable for cationogenic cross-linking or polymerisation reactions. It is also possible to add sensitizing agents to the polymerizable material from which the basic plate is made. Sensitizing agents are generally speaking materials that absorb wavelengths other than the wavelengths absorbed by the reaction initiator. The sensitizing agents are then able to transmit the absorbed energy to the reaction initiator. The addition of sensitizing agents therefore allows the wavelength of the activation radiation to be controlled.

[0029] Examples of monomers and other starting materials for making the plate according to the present invention are cited in generally available literature relating to flexographic printing plates.

[0030] The requirements that have to be met by a printing plate according to the invention are firstly that the plate has to have a uniform thickness. Since the printing plate is cured in its entirety, it is easy to fulfil this requirement. The manufacture of uniformly thick plates of a polymer material is generally known in the art.

[0031] The printing plate must also allow excellent wetting with the printing ink. By a correct choice of starting materials it is possible to provide a suitable interaction with practically any printing ink usable in flexography. To this end it is necessary for the material of the printing plate to allow proper wetting with the printing ink as mentioned before, but also to allow a uniform transfer of the ink to the substrate to be printed.

[0032] The printing plate is preferably also wear-resistant. This makes it possible to use the printing plate for a long time. Moreover, the quality of the print will remain unchanged.

[0033] Finally, the printing plate has to be made from a material that can be engraved by means of a laser in a manner such that a precise pattern can be applied to the surface in order to transfer by means of a printing process, for example, a fine raster pattern onto the substrate to be printed.

[0034] With the method according to the invention it is possible to choose materials that meet all the above-mentioned requirements. For the removal of part of the surface it is in general so that virtually all materials are suitable for engraving by means of a laser such as the one that can be used in accordance with the invention.

[0035] According to the invention, a printing plate can be formed with a laser, wherein the laser removes the non-printing parts from the surface of the plate. The height of the relief can be easily controlled. The laser can very simply be controlled directly by means of a dig-

ital system in which it is possible to have a simple coupling between a program for designing a pattern for the printing plate, and the laser. A person skilled in the art of computer programming is quite capable of doing this.

[0036] Because there is direct digital control of the laser, very fine raster points and lines can be produced in the printing plate. In addition, as no hard brushes are used with etching, the fine points and lines do not become damaged. The height of the relief can be simply controlled by adjusting the intensity of the laser and/or the length of time the laser is allowed to act on a particular position on the plate. It is also very simple to adjust the slope of the relief.

[0037] According to the invention it is a considerable advantage that no further liquid chemicals are required for removing the unexposed parts from the printing plate, as is the case with the prior art technique. This means that it is much more harmless to the environment. Likewise, the hazard to the operator's health is eliminated.

[0038] The present invention makes it possible to produce a flexographic printing plate of excellent quality in far fewer steps than were necessary up till now. In addition, fewer materials are necessary for the manufacture of the plate. Firstly, no negative is needed for the exposure of the plate, secondly, the plate no longer needs to be etched with chemicals and no lengthy drying times and/or extra exposures are necessary. It is also no longer necessary to afterwards treat or dispose of the chemicals used in the prior art.

[0039] According to the invention, the plate does not need to be held with grips or clamps during engraving, as was common practice until now. The result is a not inconsiderable savings, possibly up to 5%, in plate material. Furthermore, after the laser treatment according to the invention, the plate is immediately ready for printing. This is an advantage over the printing plates produced in accordance with the known methods, in which the same have undergone a number of treatments with liquids. These materials will absorb a quantity of liquid causing them to swell. The materials according to the prior art will have to dry in order to loose the absorbed liquid. An additional drawback of the known materials is that after drying they may exhibit a difference in thickness.

[0040] According to the invention it is possible to omit aligning. With the method according to the invention it is possible to realize a savings in energy of up to 80% in comparison with the presently applied methods.

[0041] The method according to the invention therefore provides a vastly improved method for making printing plates for flexographic printing.

Claims

1. A method for making a printing plate from a basic plate for flexographic printing, in which the basic plate is engraved by means of a laser beam, **characterized in that** the basic plate consists of a cured polymeric material and **in that** at least a part of the surface of the basic plate is removed by the laser beam.

2. A method according to claim 1, **characterized in that** non-printing parts are removed from the surface of the basic plate by the laser beam.

3. A method according to claim 1 or 2, **characterized in that** the laser beam removes non-printing parts from the surface of the basic plate to a depth of 0.4 to 9.9 mm.

4. A method according to claim 1, 2 of 3, **characterized in that** the laser beam is a CO_2 or YAG laser.

5. A method according to claims 1 to 4, **characterized in that** the basic plate is made from a flexible material.

6. A method according to one of the preceding claims, **characterized in that** the plate is made from a material obtained by photopolymerization.

7. A method according to one of the preceding claims, **characterized in that** the plate is a completely cured polymeric plate.

8. A method according to one of the preceding claims, **characterized in that** during engraving, the basic plate is mounted around a permanent cylinder, a removable printing cylinder, or a removable sleeve.

9. A printing plate obtained by a method in which a surface of a basic plate made from a polymerized polymerizable material is engraved by means of a laser beam, whereby the parts treated with the laser beam are removed from the surface of the basic plate.

10. A method for making a photopolymeric printing plate for use in a method according to one of the claims 1-8, **characterized in that** the same comprises the following steps:

    a) providing a first substantially plane mask surface, optionally provided with a removable film;
    b) applying to the mask surface a layer of substantially liquid, polymerisation-curable polymeric starting material;
    c) providing a backing layer on the layer of polymeric starting material;
    d) by means of pressure intimately contacting the liquid layer and the backing layer by placing on the backing layer a second mask surface, such that the polymeric starting material is cov-

ered on two sides by the first or second mask surface respectively,

the first and second mask surface being permeable for curing radiation; and

e) through the two mask surfaces exposing the polymeric starting material to curing radiation in order to polymerize said polymeric starting material, such as to form a polymeric plate, and simultaneously carrying out an anti-adhesion treatment;

such that polymerization effectuates the adhesion between the backing layer and the polymeric plate.

Amended claims under Rule 86 (2) EPC

1. A method for making a printing plate from a basic plate for flexographic printing, in which the basic plate is engraved by means of a laser beam, **characterized in that** the basic plate consists of a cured polymeric material and **in that** at least a part of the surface of the basic plate is removed by the laser beam.

2. A method according to claim 1, **characterized in that** non-printing parts are removed from the surface of the basic plate by the laser beam.

3. A method according to claim 1 or 2, **characterized in that** the laser beam removes non-printing parts from the surface of the basic plate to a depth of 0.4 to 9.9 mm.

4. A method according to claim 1, 2 of 3, **characterized in that** the laser beam is a CO_2 or YAG laser.

5. A method according to claims 1 to 4, **characterized in that** the basic plate is made from a flexible material.

6. A method according to one of the preceding claims, **characterized in that** the plate is made from a material obtained by photopolymerization.

7. A method according to one of the preceding claims, **characterized in that** the plate is a completely cured polymeric plate.

8. A method according to one of the preceding claims, **characterized in that** during engraving, the basic plate is mounted around a permanent cylinder, a removable printing cylinder, or a removable sleeve.

9. A method according to claim 8, **characterized in that** a removable sleeve is provided on its surface with the cured photopolymeric material.

10. A method according to claim 1, **characterized in that** the basic plate consists of a sleeve which is provided with a layer of cured photopolymeric material; at least a part of the surface of the layer of polymeric material is removed by the laser beam; and wherein the thus treated sleeve can be positioned on a printing cylinder.

11. A method according to claim 10, **characterized in that** the thus treated sleeve can be positioned on a printing cylinder without the subsequent need of registering the printing cylinder.

12. A printing plate obtained by a method in which a surface of a basic plate made from a polymerized polymerizable material is engraved by means of a laser beam, whereby the parts treated with the laser beam are removed from the surface of the basic plate.

13. A method for making a photopolymeric printing plate for use in a method according to one of the claims 1-8, **characterized in that** the same comprises the following steps:

a) providing a first substantially plane mold surface, optionally provided with a removable film;
b) applying to the mold surface a layer of substantially liquid, polymerisation-curable polymeric starting material;
c) providing a backing layer on the layer of polymeric starting material;
d) by means of pressure intimately contacting the liquid layer and the backing layer by placing on the backing layer a second mold surface, such that the polymeric starting material is covered on two sides by the first or second mold surface respectively,

the first and second mold surface being permeable for curing radiation; and

e) through the two mold surfaces exposing the polymeric starting material to curing radiation in order to polymerize said polymeric starting material, such as to form a polymeric plate, and simultaneously carrying out an anti-tack treatment;

such that polymerization effectuates the adhesion between the backing layer and the polymeric plate.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 20 1770

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 August 2001	Hazel, J

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
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 20 1770

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
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