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(54) **Direct printing plate for waterless planographic printing and utilizing thereof.**

(57) A direct plate for waterless planographic printing is disclosed.

this plate has a base with an ink-repelling silicone layer laminated on the front surface thereof. The rear surface of the base is colored so as to have an optical density of not less than 0.3.

The plate is used by forming an image with an image-forming material on the silicone layer, and heating at least the layer of coloring material on the base with radiation to fuse the image-forming material to the surface of the silicone layer.

EP 0 113 925 A2

DIRECT PRINTING PLATE FOR WATERLESS PLANOGRAPHIC PRINTING AND UTILIZING THEREOF

This invention relates to a direct plate for planographic printing using no dampening water, and the utilizing of such a plate.

Forming a toner image on a lithographic plate which is used for offset printing using a dampening solution, and then heating the toner to be fused to a surface of the lithographic plate, is known. Since the affinity of a toner with the surface of the plate is comparatively high, the fixing of the toner can be done easily, so that no specially big problems of the printing durability of an image arise during an off-set printing operation using dampening water.

On the other hand, direct plate-making methods including an electrophotographing method, in which a toner image is formed on a plate to carry out printing without using dampening water, have been proposed in many patent specifications in recent years but none of these methods have been practically used. In order to carry out printing without using dampening water, it is necessary that a printing plate, a non-image area of which has excellent ink-repelling characteristics, be

used. Accordingly, a surface of a plate material must be coated with, for example, silicone or a fluorine compound. However, such ink-repelling substances have, just as the ink, repellency with respect to all kinds of polymers including a toner. Thus, it is difficult to bond the image-forming material to a plate material. Therefore, in order to obtain an image having a sufficiently high printing durability, it is necessary that special consideration should be given both a material which forms an image on a plate, such as a toner, and a surface of a plate. Namely, the image-forming material must have a high affinity with the plate surface on which it is fixed. However, even when a toner and a surface of a printing plate which have a high affinity with each other are available, the toner tends to be fixed insufficiently to the plate surface, and troubles are likely to occur in the way of fixing dots and thin lines, especially, in a highlighted portion of an image.

An image-forming material such as a toner is fixed to the surface of a printing plate usually by melting the former with heat. In an image portion of a printing plate, the areas of a toner on a dot of a high-lighted part, a thin line, and shadow and solid parts differ greatly, so that the condition of the fixing of these parts to the surface of a plate is not

uniform depending on the manner in which the toner is heated. The melt-fixing of a toner is generally done with the convection of hot air, heat transfer from a plate or a roll or radiation heating. These heating means of fixing a toner to the surface of a plate material requiring no dampening water have both merits and demerits. When these heating means are used, it is difficult to fix toner images of different areas uniformly, speedily and at a low cost. A toner image cannot be fixed easily to a plate surface, particularly in cases of material requiring no dampening water. Therefore, when the conventional heating methods are used as they are, various problems would arise. For example, when the heat from a heating roll is used, it is difficult to fix a toner to the surface of a plate sufficiently without being set off onto the roll. When the portion of the radiant light from a lamp which has a large wave length, i.e. far infrared rays, are used, an image-forming material can be fixed to the surface of a printing plate excellently. However, a far infrared heater generally takes much time to elevate a temperature thereof, and must be kept turned on during a toner-fixing operation. This prevents a plate-making efficiency from being improved, and the energy from being saved. A lamp emitting the portion of radiant light which has a small

wave length, i.e. near infrared rays and white light attains heat equilibrium in a short period of time. However, when this kind of lamp is used, it is difficult to fix a toner to a printing plate uniformly. Among these phenomena, the uniformity and lack of uniformity in the condition of a toner thermally fixed occur due to a difference in wave lengths of rays of light absorbed therein. The absorption rate of the far infrared rays does not vary greatly with the color of an object (the far infrared rays enable the temperatures of a high-lighted portion and a shadow portion of a dot and a portion surrounding a toner, to increase uniformly), whereas the absorption rate of the near infrared rays or white light vary greatly with the color of an object. When the convection of hot air from an oven is used, both the toner and the surface of a printing plate can be heated uniformly, so that the toner is fixed to the plate excellently. However, such an oven requires much time for elevating the temperature thereof, and has a large energy loss. Moreover, the dimensions of such a heating means tend to increase.

An object of the present invention is to provide an improvement in a direct plate for waterless planographic printing, in which a simple and

energy-saving system for heating a toner with rays of light having a small wave length is mainly utilized to fix the toner to the plate uniformly.

The present invention relates to a direct plate for waterless planographic printing, which has one colored surface of an optical density of not less than 0.3, and the utilizing of the same plate, consisting of the steps of forming an image with an image-forming material, such as a toner on a non-colored ink-repelling surface thereof, and heating at least a colored surface of the plate, which is on the opposite side of the ink-repelling surface thereof, with radiant light to fuse the toner to the mentioned surface of the plate.

The optical density referred to in the present invention is defined by the following equation:

Optical density (D) = -log I/Io

wherein Io is an intensity of light entering a surface to be measured, at an angle of 45°, and I that of the light reflected on this surface to advance in the perpendicular direction thereof.

According to the present invention, it is necessary that an optical density of one surface, i.e. a rear surface of a plate be not less than 0.3. This optical density is preferably not less than 0.5, and

still preferably not less than 0.7. A base for the plate has a light color provided that it is not coated with a coloring material, and an optical density of less than 0.3. Therefore, according to the present invention, it is necessary that the rear surface of the plate be colored. In order to color a plate, a method of applying a liquid, which contains carbon as an essential component, in which a dye or a pigment is dispersed or dissolved as necessary, to the plate with a roll, an air knife, a doctor blade, a slit die, or a sprayer, and a method of printing the plate with printing ink, can be employed.

Another method can also be employed, in which a sheet or a film, which has a high optical density, is laminated on the rear surface of the plate. A base which has been colored in advance may, of course, be used for the plate. A substance which increases an optical density of the rear surface of the plate may initially have an optical density of less than 0.3 provided that the optical density of the substance increases to 0.3 or higher during the toner-heating operation using heating rays, to enable a sufficiently good toner-fixing effect to be obtained. The simplest and most effective method of increasing an optical density of the rear surface of a plate is, for example, to coat the same with black printing ink or black ink

for use in calligraphy. This method enables an optical density of the rear surface of a plate to increase easily to at least 1.

A rear surface of a plate, which requires to be colored, preferably consists of an insulating surface having an electric resistance of 10^9 Ω/cm^2. In order to form an image on a surface of a plate, direct plate-making methods, such as electrophotography, an ink jet method, handwriting, and typewriting are used. Among these image-forming methods, the electrophotography is utilized most frequently since it enables a plate to be made simply and accurately on the basis of a block copy. A plate used in the electrophotography, by which an image is formed in the present invention, has no photoconductive nor photosensitive surface. Therefore, a plain paper copying system is used, in which a toner image formed on the surface of a photoconductive and photosensitive material is transferred to the surface of a plate. Accordingly, it is necessary that the colored rear surface of a plate has an insulation resistance of not less than 10^9 Ω/cm^2 for carrying out the electrostatic transfer of a toner image. When the electric resistance of the rear surface of a plate does not exceed this level, a toner image cannot be sufficiently transferred to a plate, so that no printing plate having

a high density can be obtained. Consequently, no printed matter having a required, sufficiently high optical density can be obtained. When an image is formed by hand-writing, typewriting, or an ink jet method, the electric resistance of the rear surface of a plate may not meet the above-mentioned requirements.

Even when the optical density of the rear surface of a plate reaches a required level after the surface is coated with a coloring material, a value of electric resistance of the surface may decrease in some cases to less than 10^9 Ω/cm^2 to prevent the formation of an electrophotographic image unfavourably. The reason is that the rear surface of a plate becomes conductive due to its high carbon content. A carbon-containing composition (which is to be left as solid matter on the rear surface of a plate), with which the rear surface of a plate is colored, preferably contains some other non-conductive material, preferably a polymer so as to reduce the carbon content to at most 40 wt%.

The radiation used in the present invention is electromagnetic waves, and preferably infrared rays, visible rays and ultraviolet rays of a wave-length range preferably of 0.3 to 4 μ. Of all light rays, those having a wave length below 0.38 μ inclusive are called ultraviolet rays, while those of a wave length of 0.38

to 0.75 μ being called visible rays, those of a wave length of 0.75 to 4 μ being called infrared rays, and those of a wave length exceeding 4 μ inclusive being called far-infrared rays. Of the ultraviolet rays, then, those having a wave length exceeding 0.3 μ inclusive are called near-ultraviolet rays, while those having a wave length not reaching 0.3 μ are called far-ultraviolet rays, and although the former can be effectively utilized for purposes of the present invention since it then is feasible to make use of a UV glass for a lamp, the latter cannot advantageously be utilized since it then is indispensable to use quarts for the lamp, which means a rise in the cost. In the case of a far-infrared rays of a wave length exceeding 4 μ inclusive, unavailable is a lamp which can afford the required effect of irradiation at rapidity, and it should preferably be avoided to employ such far-infrared rays for purposes of the invention. A heater or a lamp, the radiation intensity of which reaches a normal level in a short period of time, is also used preferably.

A lamp to be used for or in the present invention may be any of infrared lamps, carbon-arc lamps, xenon-arc lamps, tungsten lamps, halogen lamps, mercury-vapor lamps, sunlamps, argon glow lamps, fluorescent lamps, metal-halide lamps and so forth. A plate-fixing

rate is around 1 to 20 plates/minute, and preferably around 2 to 10 plates/minute, which is 1 to 10 cm/sec in terms of a feed rate.

A plate is heated from at least a rear surface thereof, and may be heated from the front surface additionally as necessary. Unlike the rear surface of a plate, the front surface may or may not be colored. However, it is necessary that the coloring of the front surface of a plate be done in such a manner that a toner image can be inspected without trouble.

A plate used in this invention consists of a base, and a film formed on the base and having a toner-fixing and ink-repelling silicone layer. A film having such characteristics is formed with a special elastomeric silicone resin. Such a silicone elastomer is a cross-linked polymer containing dimethylsiloxane bonds as a main component thereof. The cross-linked polymer has on its side chain a polar group including an oxygen, nitrogen, halogen or sulfur atom, or a phenyl group and, in some cases, a metal bond.

Silicone resins usable for this purpose include, for example, those disclosed in the United States Patents 4,308,799; 4,259,905 and 4,020,761, Japanese Patent Publication No. 19755/1980 (Laid-open No. 74702/1976), Japanese Patent Laid-open No. 42602/1976 and Japanese

Patent Laid-open No. 56608/1977. Among these silicone resins, the system disclosed in the United States Patent 4,308,799 is particularly preferable since it has a high adhesion with respect to an image-forming material and a high stability with the lapse of time.

The thickness of a plate to be used for waterless planographic printing is not more than 500 μ, and preferably 50 to 300 μ. In a plate having a thickness of more than 500 μ, a propagation velocity of the heat absorbed by the rear surface and transmitted to the front surface decreases. This causes a decrease in the efficiency of an image-fixing operation. In order to form a base for a plate, a material capable of retaining an ink-repelling coating film on its surface is used, which include paper, plastic film, a sheet of a natural or modified natural product, woven cloth and metal. Among these materials, paper, plastic film, metal foil, and laminations thereof are most preferably used.

When a rear surface-colored plate is heated even with rays of a small wave length, a toner can be fixed thereto uniformly. More desirable results than those in the case where a non-colored plate is used can be obtained even when some other heating system, for example, a hot air oven or a far infrared heating means is used.

A toner applied to the plate according to the present invention contains a resin, a coloring agent and an electric charge controlling agent, the preferable resin including a modified epoxy resin, a polyester resin and an acrylic copolymer resin.

As described above, one surface of the plate for waterless planographic printing according to the present invention consists of a colored surface having an optical density of not less than 0.3. In using this plate practically, a toner image is formed on a non-colored surface thereof, and at least a colored surface of the plate is heated with radiation to fuse the toner to the surface thereof. Accordingly, this plate has the following great advantages:

(1) Since the rear surface, i.e. the surface to which the radiation is applied, of a plate has an optical density of not less than 0.3, the rear surface absorbs at a high rate the heat generated by the radiation of light, so that a temperature of the plate increases rapidly. This enables an image-forming material, such as a toner, to be fused to the plate speedily.

(2) Since the rear surface of a plate is heated with the radiation of light, the heating equipment for supplying convection currents of hot air becomes unnecessary, so that the dimensions of a fixing machine

can be reduced. Furthermore, the present invention uses a lamp heater of which the discharge energy reaches a normal level in a very short period of time. Therefore, it is not necessary to keep the lamp turned on throughout an operation of a fixing machine. Namely, the lamp may be turned on to supply the image-fixing energy to a printing plate when the plate is inserted into a fixing machine. Accordingly, an energy-saving image-fixing operation can be carried out.

(3) According to the present invention, a plate is heated mainly from its rear surface. When a plate is subjected to a fixing operation, a temperature of the plate as a whole increases uniformly, so that strain does not occur between an image area and a non-image area of the plate.

When a plate is heated only from its front surface by a conventional lamp which emits light of a small wave length, differences in temperatures of various portions of the plate, which occur due to a difference in the heat absorption rate of an image area of the plate and that of a non-image area thereof, become large to cause strain to occur therebetween in a large scale. The reason why such strain occurs resides in the following. A temperature of a colored image area which has a high heat absorption rate increases to as high as

200° C when the light is applied to the plate from a lamp. On the other hand, a temperature of a non-image area which reflects the light from the lamp increases to lower than 100° C. In the image area of the plate, the water contained in the paper base is evaporated momentarily to cause the paper base to contract and, in the non-image area of the plate, the water contained in the paper base is evaporated little. It is considered that such a difference in the degree of contraction between the image area and non-image area causes the above-mentioned strain therebetween. Such strain occurs in a specially large scale when an area of the image area is large. In order to prevent the occurrence of such strain, the water may be supplied to the paper base, from which the water has been evaporated, until the water content of the paper base reaches an original level, to thereby eliminate a difference in the water content among the portions of the paper base which are in the vicinity of the image area and non-image area. In order to carry out such an operation, a long period of time is required. Therefore, a plate requiring such a water supplying operation cannot be used conveniently in the printing in a private office, in which printing must be done immediately after a plate has been made.

According to the present invention, in which a plate is heated mainly from its rear surface to melt-fix a toner image to the plate, a temperature of a paper base for the plate increases to 100° C or higher in all parts thereof. Accordingly, the water content of the surface of a plate, to which a toner image has been fixed, does not substantially differ in different portions thereof, so that the surface of the plate is not strained.

Needless to say, the strain in a plate is very troublesome; it prevents the plate from being set closely on a printing cylinder during a printing operation, and yields a printed matter having wrinkles and a shifted image.

(4) A material with which the rear surface of a plate is colored contains carbon and an organic material such as various kinds of polymers. Therefore, the water and moisture resistance of a rear surface coated with such a coloring material become superior to those of a rear surface not coated with such a coloring material, of a plate of the same kind.

The effect of the present invention will now be described in more detail with reference to Examples.

Example 1:

Paper plates [the paper base for which comprises "Mirror Kote" paper (manufactured by Kanzaki

Paper Manufacturing Co., Ltd.) having a thickness of 145 μl, which had been coated with toner fixing silicone at $3g/m^2$, were colored at their respective rear surfaces with printing ink (black) to make printing plates having optical densities of 0.1, 0.6 and 1.0, respectively.

The composition of the silicone applied to the plate is as follows. After the plate had been coated with the coloring material, it was dried in the atmospheric air and then cured in a 160° C oven for 2 minutes to obtain a printing plate.

1. Dimethylpolysiloxane (containing terminal OH groups, molecular weight Mw = about 22000, manufactured by Toray Silicone K. K.) ..... 100 parts
2. Mixture of γ-glycydoxypropyltrimethoxysilane and γ-methacryloxypropyltrimethoxysilane (both of which are manufactured by Toray Silicone K. K.) at a ratio of 1:10 ..... 10 parts
3. Di-i-propoxytitanium bisacetylacetonate (manufactured by Nihon Soda K. K.) ..... 3 parts
4. Isopar E (manufactured by Esso Kagaku K. K.) ..... 958 parts

The rear surface of printing plate was subjected to offset printing with ink containing 29.8% of resin, 10% of carbon and 5% of alkali blue toner with the balance being a vehicle.

Images of a toner of a modified epoxy resin were formed on these printing plates by using a plate-making machine (a copying machine EP530R manufactured by Minolta Camera K. K.). A similar image was formed on a similar plate having a non-colored rear surface. The condition of the fixed toner images on these four plates was compared. During the formation of these images, a fixing machine having a 700-watt halogen lamp (having a length of 35 cm) set under a moving block copy and a 400-watt halogen lamp (having a length of 35 cm) set above the moving block copy was used. The plates (having a length of 40 cm) having toner images formed thereon were passed between these halogen lamps at 80 cm/min to be thermally treated and give printing plates. These plates were set in an offset printer to carry out printing with no dampening water used. As a result, at least 300 sheets of clear printed matter was obtained from each of the plates having optical densities of 0.6 and 1.0. The printed matter thus obtained has the same value as the one obtained by using a plate obtained by carrying out fixing treatment (at 160° C and for 1 minute) in an oven, in which no rear surface-blackening treatment is required. However, it was ascertained that, when the plate having an optical density of 0.1 and the one having a non-colored rear

surface were used, insufficient deposition of the toner image in a minute dot occurs quite often.

Example 2:

The relation between the optical densities of the rear surfaces of plates and the bonding strength of toners on the plate surfaces, which have been combined together, was determined.

The plates used in this Example were prepared in the following manner. Paper bases comprising Mirror Kote paper "Gold" (having a basis weight of 127.9 g/m^2 and a thickness of about 145 μm and manufactured by Kanzaki Paper Manufacturing Co., Ltd.) and having colored rear surfaces were coated with a liquid of the following composition in such a manner that the weight of the liquid applied and measured after it has been dried is 3 g/m^2.

Composition of the coating liquid:

1. Dimethylpolysiloxane (containing terminal OH groups, molecular weight Mw = about 22000, manufactured by Toray Silicone K. K.) ..... 100 parts
2. Mixture of γ-glycydoxypropyltrimethoxysilane and γ-methacryloxypropyltrimethoxysilane (both of which are manufactured by Toray Silicone K. K.) at a ratio of 1:5 ..... 5 parts
3. Di-i-propoxytitanium bisacetylacetonate (manufactured by Nihon Soda K. K.) ..... 3 parts

4. Isopar E (manufactured by Esso Kagaku K. K.)

..... 961 parts

After the paper bases were coated with this liquid, they were dried in the atmospheric air and then cured at 160° C for 2 minutes to obtain object plates.

The pieces of Mirror Kote paper used as the paper bases had been printed at their rear surfaces in black color in advance so that the rear surfaces thereof would have various optical densities. The rear surface of each printing plate was subjected to offset printing with ink containing 29.8% of resin, 10% of carbon and 5% of alkali blue toner with the balance being a vehicle. (The content of carbon in the whole solid portion is 22.4%.)

Solid images of a predetermined toner were formed on the plates, the rear surfaces of which have various optical densities, by an electrophotographic copying machine to be fixed thereto by a fixing machine, which is adapted to irradiate the rear surface of the plate with a lamp provided thereon. The bonding and peeling strength of toners and plate surfaces were then determined.

The fixing machine used in this Example was the same as that used in Example 1. The fixing rate of a plate, on which an image was formed, was 120 cm/min.

The bonding and peeling strength of a solid image of a fixed toner with respect to the surface of the relative plate was determined in the following manner.

An emulsion type bonding agent was applied to the solid image of a fixed toner to be dried in the atmospheric air. Paper identical with the Mirror Kote paper which constitutes the base paper of the plate was then pasted. The obtained product was pressed at 5 kg/cm^2 for 1 minute, and then heated at 80° C for 3 minutes. The product thus obtained was cut to a predetermined size to prepare test pieces. A tensile strength tester was used to determine values of strength of the test pieces when peeled at 180° C. The optical densities of the rear surfaces of plates and bonding strength thus determined of the toners and surfaces on which the toners were fixed of the plates are shown in the following table.

No.	Optical densities of rear surfaces of plates	Bonding and peeling strength (g/cm) of toners and plate surfaces
1	0.00	43
2	0.10	65
3	0.28	73
4	0.39	78
5	0.55	88
6	1.05	107
7	1.14	128

A plate, to which a toner image has not been fixed, was heat-treated in an oven at 160° C for 1 minute to enable the plate to display a practical printing durability in a printing operation. The bonding and peeling strength of the toner and the surface of the plate, which was determined under the conditions mentioned above, was 75 g/cm.

The toner used in the measurement consists of a material containing a modified epoxy resin as its base. A copying machine EP530R manufactured by Minolta Camera K. K. was used to form the solid images.

Example 3:

The rear surfaces of plates were subjected to blackening treatment to determine the relation between

the values of electric resistance to the rear surfaces and the quality of toner images formed on the plates by the electrophotography.

In order to blacken the rear surfaces of the plates, China ink (having a trademark of "Sumino Sei" manufactured by Bokuundo K. K.) was used. Various quantities of polyvinyl alcohol was added to the China ink so as to vary the values of electric resistance of the rear surfaces of the plates when the China ink is applied thereto. Water was added to the resultant mixture in such a manner that a stock China ink to be finally obtained is diluted two-fold. The China ink solution was applied to the paper bases (comprising the same Mirror Kote paper as was used in Example 1) with a bar coater. After the rear surfaces of the paper bases were blackened, silicone was applied to the front surfaces thereof in the same manner as in Example 1 to obtain printing plates.

Toner images were formed by using a copying machine EP530R manufactured by Minolta Camera K. K., on the plates thus obtained and having various electric resistances in their rear surfaces, and the following results were obtained.

Concentration (wt%) of PVA	Optical density of rear surface	Value (Ω/cm^2) of electric resistance	Quality of toner image
10	1.07	2.7×10^9	Excellent
9	1.01	2.6×10^9	Excellent
8	1.02	1.2×10^9	Good
7	1.00	1.6×10^8	Image density is low
6	0.98	4×10^8	Image density is low.
2	1.01	4×10^5	Image density is low.

Needless to say, when 100% China ink is used, the electric resistance of the rear surface of a plate and the density of an image on the plate decrease, so that the plate cannot be used. The China ink is a liquid prepared by dispersing carbon in water by using a water-soluble material such as glue.

Example 4:

Plates having blackened rear surfaces were prepared. Toner images were formed on these plates by the electrophotography. The toner images were then fixed on the plates by using a fixing machine adapted to heat a moving plate from the upper and lower sides thereof. The printing durability of these plates was tested.

The rear surfaces of the plates were blackened by applying doubly-diluted China ink mentioned in Example 3 and containing 10% polyvinyl alcohol to Mirror Kote paper (identical with the paper used in Example 1), which constitute their respective paper bases. The plates were prepared by applying to the paper bases the same silicone in the same manner as in Example 2. Images of a toner of a modified epoxy resin were formed on these plates by using a copying machine EP530R manufactured by Minolta Camera K. K. This toner consists of positively chargeable minute particles having an average particle size of about 10 μm, and is prepared by subjecting to a reaction both terminals of molecules of a bisphenol type epoxy resin and about 2 mole of piperazine to modify the resin, and adding an electric charge controlling agent and some other additives to the obtained product.

The fixing of toner images formed on plates was done by using a fixing machine provided with halogen lamps above and below a path of a plate. (One 8 watt/cm lamp is provided above a path of a plate, and two lamps, i.e. one 11 watt/cm lamp and one 8 watt lamp below the same path. Each of the lamps is provided with upper and lower reflecting shades). The plates were fed at 2 cm/sec while an image was fixed to a plate.

The plates thus obtained were subjected to a printing test by using a printing press A-B Dick 309 and ink for waterless planographic printing. As a result, at least 1000 sheets of printed matter could be obtained by each plate with 85 lines/inch, 10% dot toner images kept fixed. Each of the plates, to which an image had been fixed, had no strain between its solid image area and non-image area; printing could be done normally.

Also, a silicone layer was formed on a paper base, a rear surface of which is not blackened, i.e. left white, in the mentioned manner to prepare a plate, on which an image was then formed in the mentioned manner. The image was fixed at 2 cm/sec by a fixing machine having an upper lamp alone (halogen lamp having an illuminance of 23 watt/cm) to obtain a printing plate. A solid image area of the printing plate thus obtained absorbed intense heat from the lamp, and the corresponding portion of the paper base became brown and contracted, strain having occurred in a large scale between the image area of the plate and non-image area thereof.

This plate was subjected to a printing test by using a printing press A-B Dick 309 in the same manner as mentioned above. After less than 300 sheets of printed matter had been obtained, an insufficient

deposition of the toner image (85 lines/inch, 10% dot) was observed. In addition, some sheets of printed matter had shifted images, which were seemingly due to the strain in the plate.

CLAIMS

1. A direct printing plate for waterless planographic printing, comprising a base, an ink-repelling silicone layer provided on the front surface of said base, and a layer of a coloring material provided on the rear surface of said base and having an optical density of not less than 0.3.

2. A direct printing plate according to Claim 1, wherein said optical density is not less than 0.5.

3. A direct printing plate according to Claim 1, wherein said optical density is not less than 0.7.

4. A direct printing plate according to Claim 1, wherein the rear surface of said base is colored with a carbon-containing coating material.

5. A direct printing plate according to Claim 1, wherein the rear surface of said base has electric resistance of not less than 10^9 Ω/cm^2.

6. A direct printing plate according to Claim 1, wherein said plate has a thickness of 50 to 300 μ.

7. A direct printing plate according to Claim 1, wherein said base consists of a material selected from the group composed of paper and a composition containing paper as a main component.

8. A direct printing plate according to Claim 1, wherein silicone layer consists of a cross-linked polymer

containing dimethylpolysiloxane bonds, said polymer having on its side chain at least one of a polar group including oxygen, nitrogen, halogen, or sulfur; phenyl group; and a metal.

9. A method of utilizing a direct printing plate for waterless planographic printing, which direct plate consists of a base colored at its rear surface in such a manner that said rear surface has an optical density of not less than 0.3, and an ink-repelling silicone layer laminated on the front surface of said base, comprising the steps of forming an image with an image-forming material on the surface of said silicone layer, and heating at least the colored rear surface of said base with radiation to fuse said image-forming material to an outer surface of said silicone layer.

10. A method according to Claim 9, wherein said radiation is a light having a principal wave length region of 0.3 to 4 μ.

11. A method according to Claim 9, wherein said image-forming step consists of at least one method selected from the group composed of electrophotography of a plain paper copying system, an ink jet printing method, and handwriting method.