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MULTICOLOR ELECTROSTATIC PRINTING

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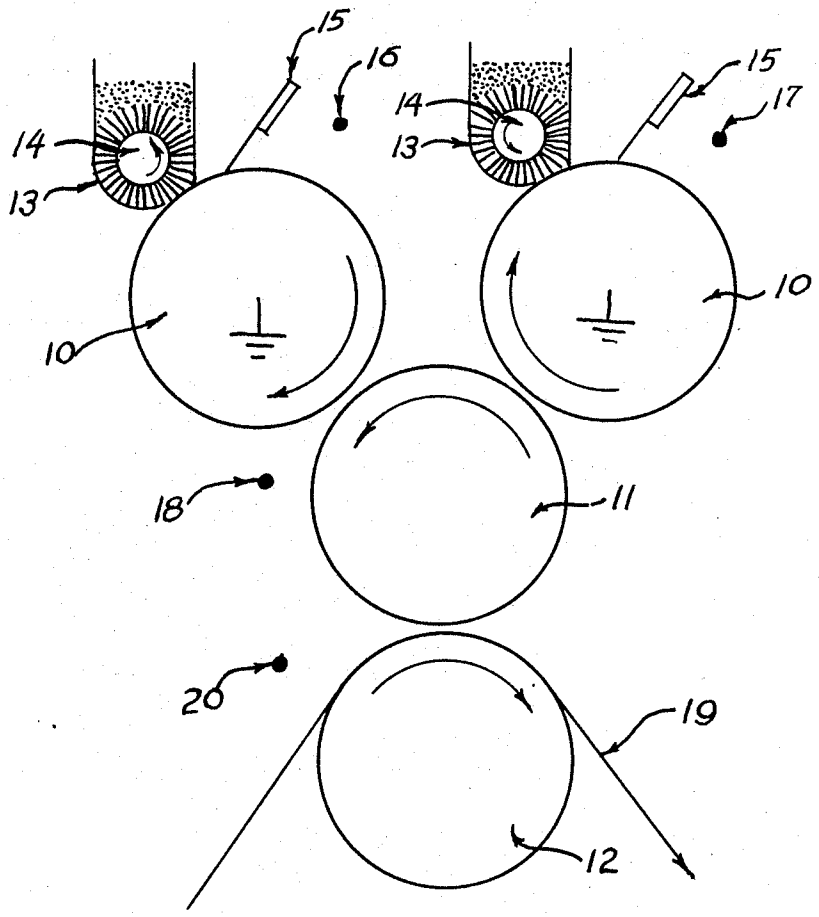


FIG. 1

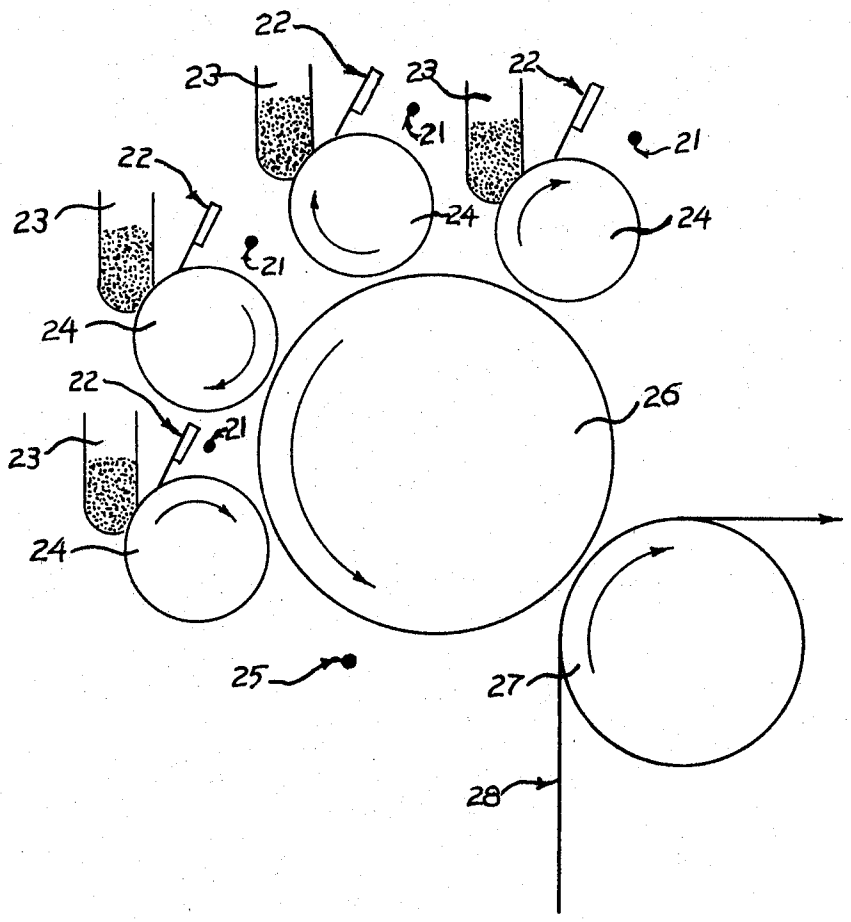


FIG. 2

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MULTICOLOR ELECTROSTATIC PRINTING

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This invention relates to multicolor printing. More particularly, the invention relates to multicolor offset printing wherein two or more differently colored powders are printed in register on a common carrier and then simultaneously transferred to another substrate to form the final image.

Multicolor printing with liquid inks wherein one ink is superimposed, or printed in register, upon a previously applied liquid ink of a different color before the previously applied ink is dried is referred to in the trade as "wet printing" or "trapping." Usually three or four differently colored inks are used in process printing, where it is necessary that the tacks of the different inks be adjusted in such manner that each previously applied ink will trap the successively applied ink. In order to trap several different inks successively, the inks must be applied to the substrate in the order of their decreasing tackiness, i.e. the ink first laid down must have the highest tack while the ink laid down last must have the lowest tack.

It has hitherto been impossible to perform process printing by offset printing methods from a single blanket because, for instance, once a multicolor image is formed by process printing on an offset blanket it would be impossible to transfer it to the desired substrate. Attempts to use the offset method for multicolor process printing has necessitated the use of a different transfer blanket for each color, each ink being successively transferred to the substrate in register in the order of decreasing tack of the ink.

The offset method of printing is very extensively used for printing on uneven surfaces such as the rough papers and cardboard that are often used in packaging and on curved surfaces such as food and beverage containers. This is because the offset blanket, or cylinder, is generally composed of a resilient and flexible material, such as rubber, that can be made to conform to the irregularities of the substrate being printed.

The present invention greatly expands the usefulness of the offset printing method for multicolor printing. The present invention provides a method for offset printing with powdered inks wherein a complete reverse image in multicolor is transferred from an offset blanket or cylinder to the surface to be printed. Use of powdered inks in the offset printing process to produce multicolored prints solves the problem of "trapping" that has heretofore necessitated separate blankets for each color. To produce multicolor prints with liquid inks by superimposing one ink on another, it is necessary to adjust the tack of the inks in such manner that each previously applied ink will trap the next ink. It is obvious that such trapping is not feasible in the offset process except by use of a separate offset blanket for each color.

The method of the present invention comprises the sequential transfer of colored powdered inks from printing plates or cylinders onto an offset member to produce the reverse image of the desired final print and having the colored inks superimposed; the multicolor design is then transferred to the substrate to be printed. The transfer of powders from printing plate to blanket is brought about by electrostatic forces. Preferably the transfer from the blanket to the surface to be printed is also done electrostatically. Thus another definition of the invention is that it is a method of electrostatic multicolor printing by single transfer offset.

In the practice of the invention the photomechanical image, formed by conventional means, can be typographic, gravure, planographic, or screen stencil.

The general techniques of charging and electrostatic transfer are known to the art. In the instant process two general methods of offset printing may be used; the increasing potential method and the charge reversal method. The increasing potential method comprises applying a potential on the offset member to transfer the powder from the photomechanical images on the print rolls to the offset member. The transfer to the printing substrate from the offset member is made by applying a still greater potential on the transfer member, over which the substrate travels. The potentials necessary to effect transfer depend on the gaps between the surfaces. The greater the gap, the greater the potential required. The powder is applied on the surface of the print cylinder from the powder-feed hopper and, with the aid of the doctor blade, fills the engraved portions to be printed. The powder is precharged with ions produced by a corona wire, about 4 to 6 mils in diameter, above the print cylinder. Generally a potential of 6 to 8 kilovolts on a wire about ⅜ inch to ½ inch from the print roll produces sufficient charge on the powder. With gaps from 2 mils to 10 mils between the print roll and the offset cylinder, potentials of 0.5 kv. to about 1.5 kv. are required on the offset cylinder to transfer the charged powder to the offset cylinder from the grounded print roll. Contact transfer to paper is effected with a potential of about 2 kilovolts on the transfer roll. Greater voltages are, of course, required when there is a gap between the paper and the offset roll. If the powder is charged positively, negative potentials are applied on offset and transfer cylinders. If the powder is charged negatively, positive voltages are used to transfer the powder.

The charge reversal method is carried out by reversing the charge on the powder after the transfer to the offset member. The transfer to the paper can be made with the transfer electrode grounded. Reversal of the charge is accomplished with a corona charging wire near the offset cylinder. This system has the advantage that only one cylinder has to be insulated in order to maintain both transfer fields.

To print on a bottle, the transfer cylinder is removed and replaced with the bottle in approximately the same position, with respect to the surface of the offset roll. The bottles are supported by a cradling device. Potentials of 8 to 10 kilovolts are applied to the bottle to transfer the powder from the offset roll onto the bottle in the same way as in the increasing potential method of printing on paper.

Transfer of the powder from the offset roll to the bottle, paper, or other substrate may be carried out by other methods, for instance by heating the substrate so that the powder sticks to the surface when contact is made, but electrostatic transfer is preferred without direct contact of substrate and offset member.

Although the process is not limited to use of any particular powder material, the preferred printing powders are combinations of resinous materials with colorants dispersed therein. Such resinous materials may be, for example, ethylcellulose, polystyrene, copolymers of butadiene and styrene such as "Pliolite S–5E (1 part butadiene to 6 parts styrene), "Saran F120" (a copolymer of vinylidene chloride and acrylonitrile), "Vinylite VYHH" (a copolymer of 87% vinyl chloride and 13% vinyl acetate), "Pliolite VTL" (a vinyl toluene/butadiene copolymer), "Epon 1004" (an epichlorohydrin/bisphe-

nol type of solid epoxy resin having an epoxide equivalent of about 875–1025 and a M.P. of about 95–105° C.), polymethylmethacrylate, or "Gelvatol 40–10" (a polyvinyl alcohol with 37–42% of residual polyvinyl acetate). The colorants dispersed in the resins can be, for example, carbon black, titanium dioxide, various earths like the umbers, red oxides of iron, ochres, etc., the series of well known oil dyes like Nigrosine Spirit Soluble (Colour Index No. 864), Sudan I (Colour Index No. 24), Sudan II (Colour Index No. 24) Sudan IV (Colour Index No. 258), Amino Azo Toluol (Colour Index No. 17) Alizarin Astrol B (Colour Index No. 1075), Oil Yellow (Colour Index No. 19), Amino Azo Benzol (Colour Index No. 15), Quinoline Yellow Spirit Soluble (Colour Index No. 800) and Sudan R (Colour Index No. 113); the Colour Index numbers ar those in use in, for example 1955; chromate pigments like zinc chromate, lead chomates, various organic pigments, etc. Fillers may also be added such as finely ground silica, clay, diatomaceous earth, asbestos, wood flour, aluminum hydrate, etc.

The powders may be made up by grinding the resin/colorant dispersions. The pigment may be milled into the resin before grinding. Powders with mean-mass sizes of about 11 to 18 microns in diameter are preferred.

Besides printing on paper and glass bottles, the subtrates may be wood, cloth, plastics, rubber, etc. in the form of sheeting or paper, plastic, metal, cloth, etc. in the form of a web.

It is convenient to have the glass bottles come to the printing station hot enough to cause the powder to stick at the points of application. The optimum temperatures for adhesion will naturally vary with the softening range and adhesive properties of the particular powder. Temperatures from about 300° F. to about 500° F. constitute a practical range for printing on glass with resinous printing powder, but bottles have been successfully printed at around 1200° F. by this method, using ceramic frits as the printing powder.

Referring now to the drawings, FIG. 1 shows schematically one form of press adapted to carry out the process of this invention in the form of two-color offset printing.

10, 10 are electrical ground print or plate cylinders having gravure engraving on their peripheries;

11 is an offset or blanket roll supplied with an electrical conection for grounding or applying various potentials;

12 is a transfer or impression roll supplied with an electrical connection for grounding or applying various potentials;

13, 13 are powder-feed hoppers supplied with rotating brushes;

14, 14 for applying powder to the print cylinder;

15, 15 are doctor blades for removing excess powder from the non-printing areas of the cylinder;

16, 17 are corona units for charging the powders with ions;

18 is a corona unit for applying a charge to the surface of the offset cylinder, if desired, and

19 is paper or other flexible sheeting, which receives the printed design from the offset cylinder;

20 is a corona unit for applying a charge to the surface of the transfer cyinder when desired.

FIG. 2 shows schematically a press adapted for four color offset printing according to this invention.

24, 24, 24, 24, are electrically grounded print or plate cylinders having gravure engraving on their peripheries;

26 is an offset or blanket roll supplied with an electrical connection for grounding or applying various potentials;

27 is a transfer or impression roll supplied with an electrical connection for grounding or applying various potentials;

23, 23, 23, 23, are powder feed hoppers, each one filled with a powder of different color such as red, blue, yellow, and black;

22, 22, 22, 22 are doctor blades for removing excess powder from the non-printing areas of the cylinder;

21, 21, 21, 21 are corona units for charging the powders with ions;

25 is a corona unit for applying a charge to the offset cylinder, if desired; and

28 is paper or other flexible sheeting, which receives the printed design from the offset cylinder.

What is claimed is:

1. The method of multicolor printing wherein a multicolor image is formed on a substrate with a dry printing powder which comprises:

(a) furnishing printing powders of different colors to the printing area of each of at least two different printing elements, said powders being adapted to receive and retain an electrostatic charge;

(b) depositing an electrostatic charge on the surface of the powder on each printing element;

(c) bringing the surface of an offset member sequentially into proximity with the powder on each printing element while said powder still retains charge;

(d) creating an electrostatic field with respect to each of said printing elements, at a location for each element where said offset member is in proximity with the powder and while said powder still retains a charge, said electrostatic field being of such strength that said printing powders are transferred from the printing elements to the said offset member to form a multicolor image; and

(e) offsetting the said multicolor image in a single transfer from said offset member to a desired substrate.

2. The method of multicolor printing as defined in claim **1** wherein the printing elements are gravure plates.

3. The method of multicolor printing as defined in claim **1** wherein the printing elements are gravure cylinders.

4. The method of multicolor printing defined in claim **1** wherein the multicolor image is transferred in a single transfer operation to the desired substrate by electrostatic forces.

5. The method of multicolor printing defined in claim **1** that includes the step of heating the substrate to a temperature high enough to fix the powders to the substrate.

6. The method of multicolor printing defined in claim **1** wherein the offset member is a cylinder.

7. The method of multicolor printing defined in claim **1** wherein the substrate is a web.

8. The method of multicolor printing defined in claim **1** wherein the substrate is sheeting.

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