United States Patent

Tsuboi et al.

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[54] HOT SCREEN PRINTING MACHINE

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** .....**219/216,** 100/93 RP, 219/469

[51] **Int. Cl.** **H05b 1/00**

[58] **Field of Search**.....219/216, 244, 388, 469–471, 219/338, 528, 529, 538, 544, 549, 552; 29/130, 132; 100/93 RP; 338/212, 223–225

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[57] **ABSTRACT**

A practical and useful hot screen printing machine having at least one rotatable cylindrical printing drum comprising a flexible plane heater on the outer surface thereof and an electrical insulating layer surrounding the plane heater.

4 Claims, 4 Drawing Figures

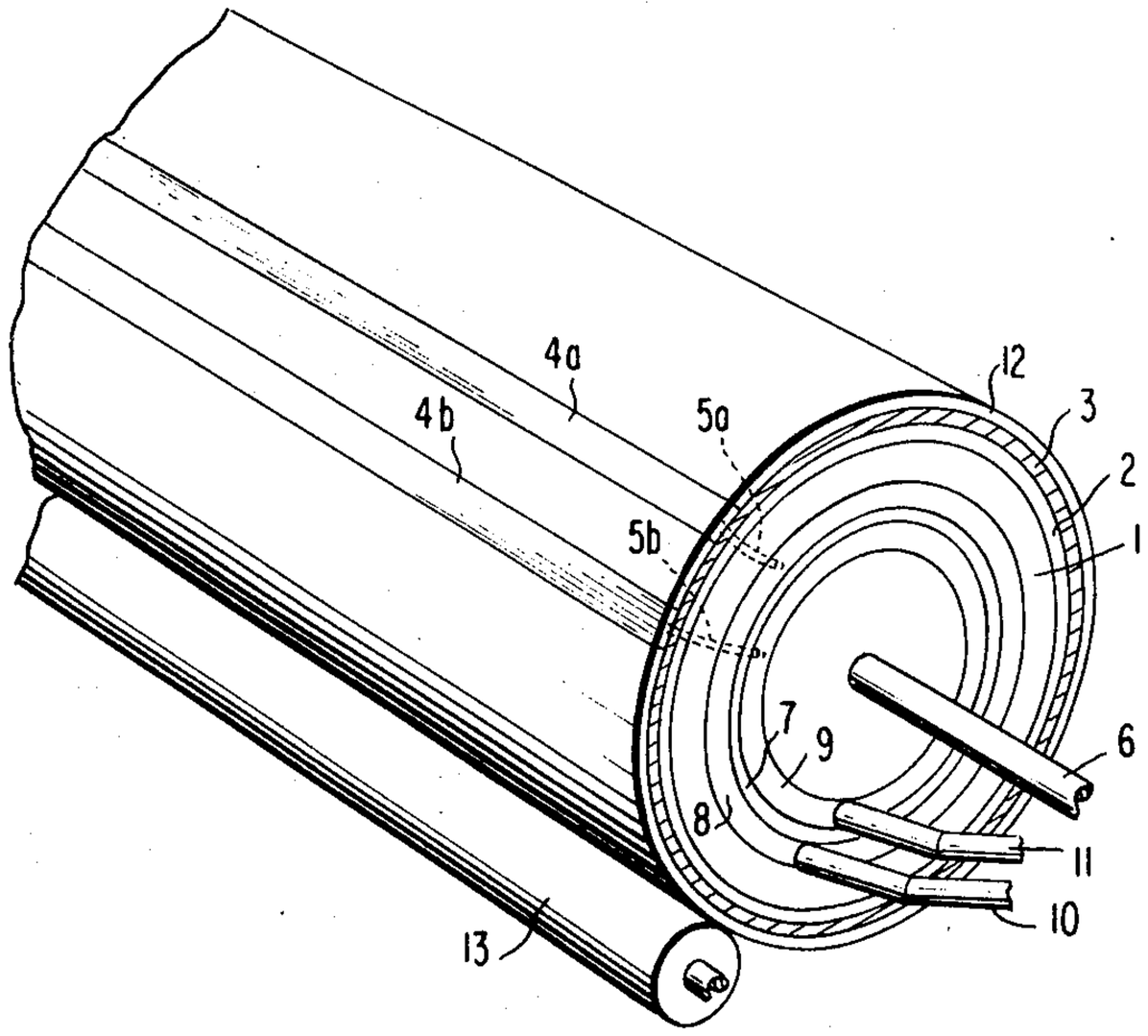


FIG. 1

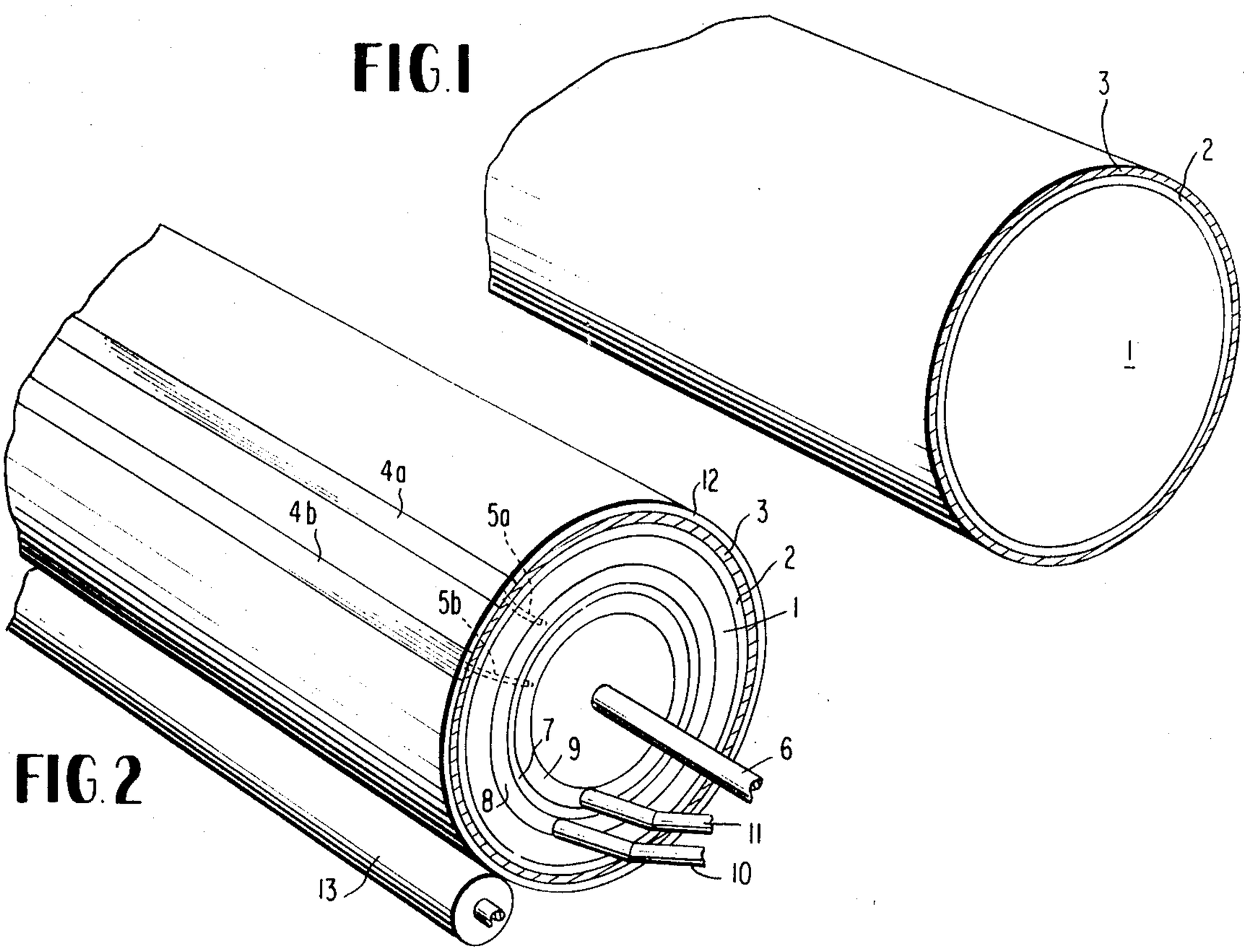


FIG. 2

FIG. 3

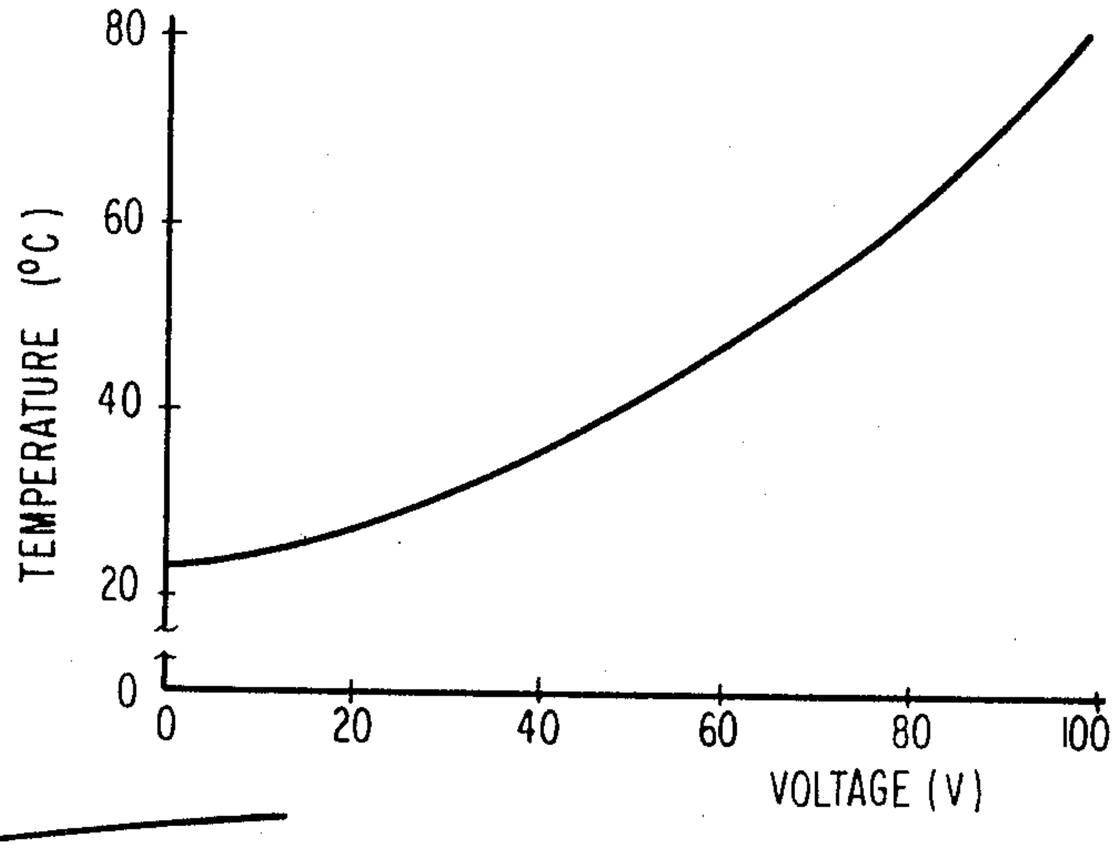
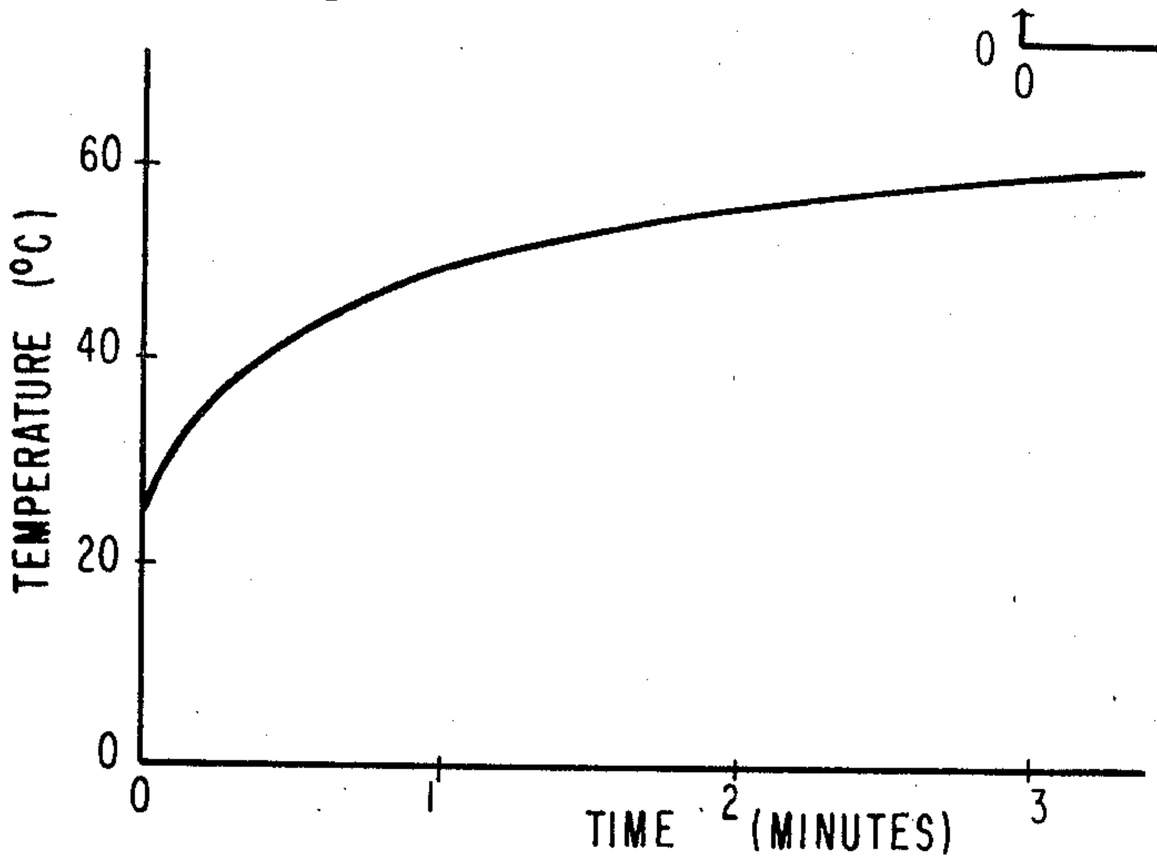


FIG. 4



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HOT SCREEN PRINTING MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to a hot screen printing machine. More particularly, the present invention is concerned with a hot screen printing machine comprising a flexible plane heater on the printing drum.

The heating of the printing drum in presently known hot screen printing processes has been generally conducted indirectly by means of an electric heater such as nicrome wire, infrared rays, hot air or steam.

In a series of studies of the hot screen printing process, we have found that an excellent print can be easily obtained in the combination of the hitherto known screen printing machine having a printing drum, for example, single or double drum type printer, with a plane heater as the heating source.

SUMMARY OF THE INVENTION

That is to say, the hot screen printing machine of the present invention comprises at least one rotatable cylindrical printing drum provided with an electric insulating layer surrounding a plane heater having electrodes on the outer surface of the printing drum thereof.

An object of the present invention is to provide an improvement in a screen printing machine. Another object of the present invention is to provide a practical and useful hot screen printing machine as mentioned hereinafter and illustrated in the drawings.

Another object of the present invention is to propose a practical screen printing process suitable to obtain printed matter with a very clear image in an easy operation by using the improved hot screen printing machine.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view, partly in section, of a portion of the printing drum of the hot screen printing machine of the present invention; and

FIG. 2 is another perspective view of a portion of the hot screen printing machine of the present invention.

FIGS. 3 and 4 are respectively temperature versus voltage and time graphs for the heater of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 illustrates a printing drum 1 for use in the single drum type screen printing machine of the present invention. The drum 1 comprises a plane heater 3 on the outer surface thereof, and an insulating layer 2 disposed inwardly of the heater 3.

As shown in FIG. 2, electrodes 4*a* and 4*b*, substantially parallel to the center shaft 6, are disposed on the surface of the plane heater 3. Lead wires 5*a* and 5*b* connected to the electrodes 4*a* and 4*b* respectively, are contacted with circular electrodes 8 and 9, respectively, which are positioned at the side of the printing drum 1 and separated by an annular insulating layer 7. The circular electrodes 8 and 9 are connected with a source of electricity (not shown) by current collectors 10 and 11.

In this case, the prevention of an electric shock may be easily effected by providing an insulating layer 12 on the surface of the plane heater 3.

Alternatively, the electrodes 4*a* and 4*b* may be positioned along one end of the circumference of the printing drum 1.

Although the drawing illustrates a single drum type printing machine, a double drum type may be utilized in accordance with the teachings of the present invention.

The other parts in the hot screen printing machine according to the present invention are similar to the hitherto known screen printing machine; namely, a hand-operated lever or an automatic rotating apparatus (not shown) is provided for rotating the drum shaft 6, and a pressure roller 13 is in engagement with the printing drum 3.

The plane heater 3 may be formed, for example, of a molded plastic material of any suitable type. As illustrative examples, a film-forming polymer may be mixed with an electrically conductive material, or such a polymer may be applied uniformly with an electrically conductive material onto a suitable base, such as glass cloth, the polymer preferably being of the heat-resistant type. Also, it may be possible to use a cloth made up of an electrically conductive fiber.

The electrically conductive material for the plane heater 3 may be selected from the group consisting of carbon black or grafted carbon, aluminum powder, silver powder and copper power, used singularly or in combination. A plane heater having a thickness of 20 microns to 2 mm. is preferable so that it is sufficiently flexible to be easily wound around the printing drum 1.

The insulating layer 2, for example, may be selected from the groups consisting of polyethylene terephthalate film, cellulose triacetate film, felt or sponge.

The temperature of the ink layer used in the hot screen printing machine of the present invention should be below the limit of heat resistance temperature of the screen stencil and it is usually at a temperature less than about 90° C. Since the surface temperature of the plane heater 3 does not have to be more than 20° C. higher than the temperature of the ink layer, the heater 3 may generally be maintained at a temperature less than about 110° C.

The plane heater 3 may be charged with either a direct current or an alternating current, but usually an alternating current is preferable. A pair or more of the electrodes 4*a* and 4*b* parallel to the shaft 6 of said printing drum 1, or a pair or more of the electrodes along the circumference of the drum, may be equipped and charged with a sufficient voltage such that said plane heater 3 is maintained at the desired temperature.

The relation of the charged voltage with the temperature in case where the plane heater 3, having 170 microns thickness, prepared by adding 20 percent by weight of carbon black to cellulose triacetate, is charged through electrodes (25 cm. distance) is illustrated in FIG. 3. The relation between the temperature and the time in case of charging the electrodes with 80 v. is illustrated in FIG. 4. As is understood from FIGS. 3 and 4, it requires only about 90 seconds for reaching 80 percent of the thermal variation from room temperature 26° to 60° C., namely, 53.2° C., and the thermal fluctuation on the surface of said plane heater 3 is within 3° C.

The application of the plane heater 3 to the hot screen printing machine is markedly advantageous in view of the simplicity of the attachment of the heater to the printing drum, owing to its flexibility in addition to the possibility of rapid elevation of temperature with maintaining a uniform thermal distribution.

The printing machine of the present invention makes it possible to use an ink which is at a solid state at ordinary temperatures, due to the possibility of printing at a temperature higher than an ordinary temperature, thereby conducting the printing operation with less staining of hands, etc., during the operation.

In the practice of screen printing by means of the hot screen printing machine of the present invention, an ink for screen printing is directly applied from a tube or a can to the insulating film 12 overlying the plane heater, and the printing operation can be run at a constant temperature elevated from ordinary temperatures.

With respect to the supply of the ink, a method of using an ink sheet is very superior to the above. The term "ink sheet" is used herein is intended to cover one prepared by applying an ink on a sheet of a support inactive to the ink or a support that is not permeated by the ink at a temperature range imparting the fluidity. If an ink, which is solid at ordinary temperatures, but fluid only when heated to a temperature higher than an ordinary temperature, is used for the screen printing machine of the present invention, there is no fear of staining hands and clothes with the ink, other than when actually printing.

Consequently, if a solid ink having a fluidity desirable for printing at a temperature ranging from 50° to 70° C. is employed in the hot screen printing machine of the present invention, the solid ink can be easily heated to a temperature imparting the desirable fluidity within 1 to 3 minutes, and thereby the screen printing can be effectively conducted in a conventional screen printing stencil.

The following specific examples are intended to show the nature of the invention without limiting it to the examples themselves.

EXAMPLE 1

A printing drum of a single drum type rotary mimeographic copying machine (for example, Sekisei Rotary Copying Machine) was remodeled as follows.

A polyester film having 15 microns thickness was wound around an aluminum printing drum having 4.5 cm. in radius to insulate the drum, and a cellulose triacetate film (170 microns thickness) containing 20 percent by weight of carbon black content as the plane heater was layed on the polyester film layer, and further a polyester film having 100 microns thickness as an insulator was wound around the heater.

Aluminum foil having 0.5 cm. in width was adhered in the direction parallel to a shaft of the printing drum to both ends (25 cm. distance) of the plane heater by using an electrically conductive paste to make electrodes respectively, and lead wires and brush type current collectors were connected to the electrodes.

When the hot screen printing machine was charged with 80 v. of alternating current, the surface temperature became 54.5° C. within 2 minutes.

An ink sheet, which was prepared by applying to a cellophane sheet (30 × 40cm.) so as to leave 4 cm. of the circumference free, 15 g. of ink made up mainly of 90 parts of paraffin, 3 parts of cellulose flock and 7 parts of carbon black, and was at a solid state at an ordinary temperature under 60° C., was set on the printing drum of the hot screen printing machine and, after laying a mimeographic stencil paper cut with a typewriter on the ink sheet, the printing was started while beginning to impart fluidity to the ink.

In this process, 100 sheets of clearly printed matter were produced.

EXAMPLE 2

The plane heater used was prepared by applying an 80 percent concentration dispersion of grafted carbon (produced by Nippon Gas Chemical Industries, Ltd.) containing 50 percent by weight of carbon black onto a glass cloth and drying it. The hot screen printing machine was made up as in example 1.

In this case, since the glass cloth served as an insulating layer for the aluminum drum, the polystyrene film having 15 microns in thickness was not required.

When the machine was charged with 70 v. of alternating current through the electrodes (25 cm. distance), the surface temperature became 70° C. within 25 minutes.

As the ink supplying source, there was used an ink sheet prepared by applying a colorless ink containing a dye base to a support, and then the hot screen printing was conducted using clay paper, applied with an acid clay, as the printing paper.

The term "dye base" used herein is intended to cover a leuco pigment, a lactone derivative of pigment, a lactam derivative of pigment and the like.

The colorless ink was prepared by mixing 1.5 g. of crystal violet lactone, 15 g. of diphenyl tetrachloride, 20 g. of triphenyl chlorinate and 30 g. of paraffin having a melting point of 62° C. under heating.

We claim:

1. A hot screen printing machine comprising at least one rotatable cylindrical drum;

a flexible sheet of electrically conductive material wrapped around the drum and capable of generating heat comprising a heat resisting polymer film containing a material selected from the group consisting of carbon black, grafted carbon, aluminum powder, silver powder, and copper powder;

an electrically insulating layer on the outside surface of the drum and above the sheet of electrically conductive material and formed of a material selected from the group consisting of polyethylene terephthalate film, cellulose triacetate film, felt and sponge, and

means for supplying electricity to the heat generating flexible sheet including a pair of electrodes positioned parallel to the drum and extending across the surface of the flexible sheet beneath the insulating layer.

2. A hot screen printing machine as in claim 1, where the means for supplying electricity further includes lead wires and brush type current collector means connected to the electrodes and positioned at one end of the drum radially inward of the electrodes.

3. A hot screen printing machine as in claim 2, where the thickness of the flexible sheet is between 20 microns and 2 mm.

4. A hot screen printing machine as in claim 3, where the temperature of the flexible sheet will remain within 3° C. at steady state and the electrodes will be positioned approximately 25 cm. apart on the flexible sheet.

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