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METHOD AND MEANS FOR EMBOSSING THERMOPLASTIC SHEETS

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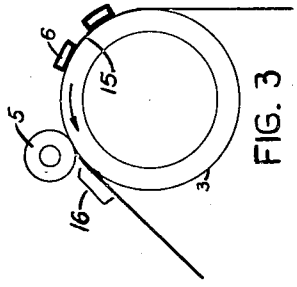


FIG. 3

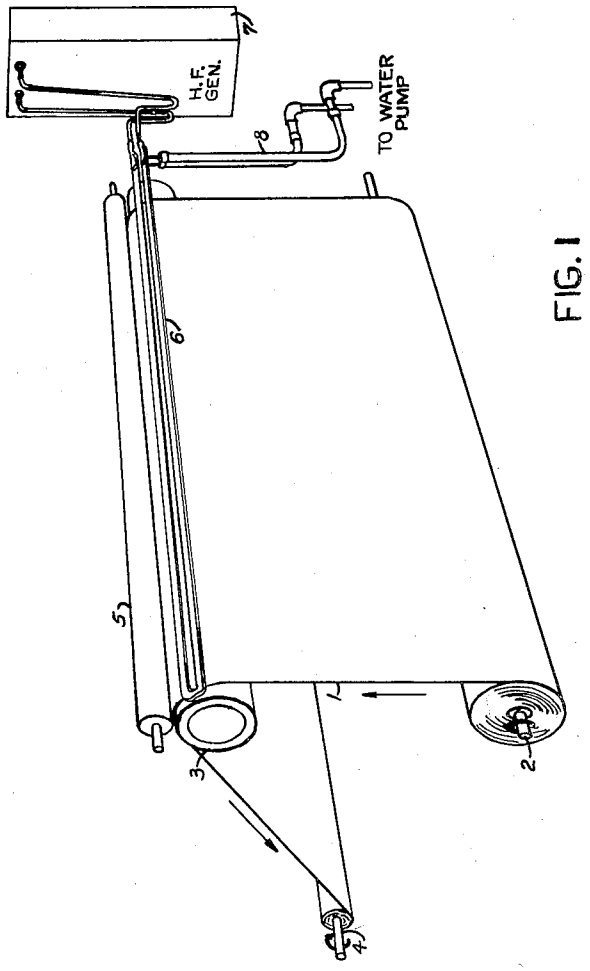


FIG. 1

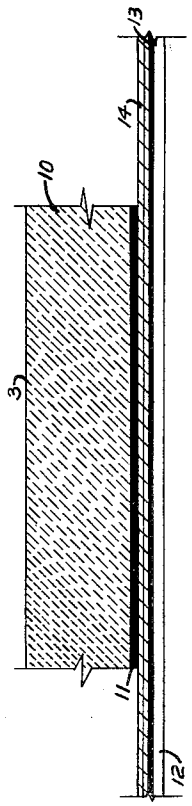


FIG. 2

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METHOD AND MEANS OF EMBOSSING THERMOPLASTIC SHEETS

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9 Claims. (Cl. 18—56)

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This invention relates to the production of glossed or embossed surfaces on lacquered paper and thermoplastic sheets or thermoplastic coated sheets.

Heretofore in producing a highly glossed surface on paper having a lacquer or plastic coating it has been necessary to use elaborate equipment for heating and cooling the plastic material. The method and apparatus of my invention are capable of producing glossed or embossed surface on lacquered paper with great rapidity and a very small expenditure of heat.

The apparatus consists of a metallic roller over which the lacquered paper is run with the lacquered surface against the roller. A long coil, energized by high frequency currents, heats a narrow longitudinal strip of the roller to a sufficient temperature to plasticize the lacquer coating. As the lacquered paper continues in contact with the roller beyond the heated strip thereof, the lacquer is cooled and solidifies. Thus changes in the lacquered surface due to changes of curvature before the lacquer is solidified is prevented.

The object of my invention is to rapidly and efficiently produce a desired surface on paper or other sheets having a thermoplastic coating.

Another object of my invention is to heat a thermoplastic material rapidly without using the extremely high frequencies and high voltages required in dielectric heating.

Still another object of my invention is to heat a thermoplastic material so that the heating is substantially independent of the electrical properties of the thermoplastic material.

The invention will be fully understood from the following description and the drawing in which:

Figure 1 is a perspective view of one embodiment of my invention.

Figure 2 is a detail sectional view of the roller and the material to be treated.

Figure 3 is an end view of a portion of my apparatus indicating the operation thereof.

Referring to Figure 1 there is shown the paper or other sheet material 1 which may consist of a base material 12 (see Figure 2) having a glazed surface 13 and a thermoplastic coating 14. Generally the thermoplastic coating is a lacquer. The sheet 1 is fed from a roller 2 and is trained over another roller 3 onto a final roller 4. The rollers may be driven by any suitable means. One or more idler rollers 5 may be provided to hold the sheet 1 against the roller 3. A suitable coil 6 extends across the entire roller 3 in very close proximity thereto. The coil 6 is connected to the

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high-frequency generator 7 for passing a high-frequency current through the coil 6. The coil 6 is hollow as indicated in Figure 3 and has connections 8 to a water pump (not shown) for cooling the coil in operation. The generator 7 may have a frequency of the order of one megacycle.

The roller 3 is preferably made of a dielectric material such as porcelain or glass 10 having a thin coating of metal such as nickel, Kovar, or any other suitable metal. The metal coating 11 may be smooth and highly polished to put a high gloss on the thermoplastic coating or may be provided with a desired design for embossing the thermoplastic coating. The coil 6 may consist of two hollow rods spaced about as shown in Figure 3, or may take any other form known in the art of induction heating.

The operation of my apparatus is as follows:

The sheet 1 having a thermoplastic coating is fed from the roller 2 onto the roller 3. A narrow longitudinal strip 15 along the circumference of the roller 3 is heated by the eddy currents induced by the coil 6 to a temperature above the temperature of plasticity of the thermoplastic coating. Thus the coating is plasticized and acquires a surface corresponding to that of the roller 3. The sheets continue round the roller past the idler 5. Since the heat is dissipated in the roller very rapidly because only a very narrow thin strip thereof is heated, the thermoplastic coating is cooled and solidified before reaching the portion 16 of the roller 3. The sheet 1 leaves the roller 3 beyond the region 16 and then there is no possibility of the thermoplastic coating tearing away from the base of the sheet or of cracking or otherwise developing flaws. The speed of the roller 3 and the temperature to which it is heated by the induction coil may be adjusted so that the thermoplastic material is plasticized only to a very small depth thereof in order to reduce the possibility of impairing the material.

Although I have described a single embodiment of my equipment and only one preferred application thereof, it will be obvious to those skilled in the art that my invention can be applied to other materials and that various elements of my invention may be varied within the scope of my claims.

I claim:

1. The method of imparting a desired surface to a thermoplastic coating on a long sheet of material comprising the steps of: running the material over a roller having an imprint of the desired surface with the coating against the surface of said roller, heating successive narrow

strips taken transversely to the circumference of said roller in time succession to a temperature which causes the portions of said coating which are in contact with said strips during said heating to plasticize and receive the imprint of said roller, and continuously abstracting heat from said entire roller.

2. The method of imparting a desired surface to a thermoplastic coating on a long sheet of flexible material comprising the steps of: running the material over a metallic roller having an imprint of the desired surface with the thermoplastic coating held against the surface of the roller, subjecting only successive narrow strips taken transversely of the circumference of said roller to a high frequency electro-magnetic field of such magnitude as to raise the said strips of said roller successively to a temperature sufficient to plasticize said thermoplastic coating, whereby said thermoplastic coating receives the imprint of said roller, abstracting heat from said roller at all points of the surface thereof, and maintaining said material in contact with said roller until completion of a heating and subsequent cooling operation has been completed at each element of area of said thermoplastic material.

3. The method of imparting a desired surface to a thermoplastic coating on long flexible sheets of material comprising the steps of: running the material over a metallic roller with the thermoplastic coating against the surface of the roller, inducing eddy currents in successive narrow transverse strips of the circumference of said roller, said eddy current being of such magnitude as to raise the temperature of said strips of said roller successively above that required to plasticize said thermoplastic coating, cooling said entire roller, and maintaining said material in contact with said roller until said heated thermoplastic coating is cooled and solidified.

4. Apparatus for heating a thermoplastic sheet of material comprising, a metallic roller, means for rotating said roller, means at a fixed location for inducing high frequency current in successive thin narrow transverse strips only of the circumference of said metallic roller during the rotation thereof, said metallic roller being elsewhere subject to cooling, said high frequency current being of sufficient magnitude to raise the temperature of said strips while adjacent said fixed location only to a value higher than the temperature of plasticity of said thermoplastic sheet, and means for running the sheet over the metallic roller and against the metallic surface thereof to and beyond said fixed location until said thermoplastic sheet is cooled and solidified.

5. Apparatus for imparting a desired surface to a thermoplastic coating on a long flexible sheet of base material comprising, a roller, said roller comprising a relatively thin layer of metal secured on a relatively thick base of dielectric material adapted for rapidly abstracting heat from said thin layer of metal; means for running said flexible sheet over said roller with said thermoplastic coating held against said metallic surface of said roller; a coil extending along and adjacent to the entire length of said roller externally thereof and subtending a very small arc of the circumference thereof; means for supplying high frequency current to said coil for heating a portion of said layer of metal located adjacent to said coil and thereby a corresponding portion of said thermoplastic coating; and means for maintaining said thermoplastic coating in contact with said roller beyond said very small arc for a time sufficient to accomplish cooling of said thermoplastic coating below the temperature of plasticity of said thermoplastic coating before separating said sheet from said roller.

6. Apparatus for imparting heat to a thermoplastic flexible sheet of material comprising, a rotating roller formed of a dielectric material and having a thin metallic layer on the exterior surface of said rotating roller formed of a dielectric material, means at a fixed location for inducing high frequency current in successive narrow transverse strips of said metallic coating during rotation of said roller, said high frequency current being of such intensity as to raise the temperature of said heated strips in succession above that of the temperature of plasticity of said thermoplastic sheet, means for maintaining said sheet against said roller over a considerable arc thereof, said considerable arc including arc portions at and beyond said fixed locations in the direction of rotation of said roller, and means comprising said dielectric material for rapidly abstracting heat from said thin metallic layer and thereby rapidly cooling said successively heated strips as they pass beyond said fixed location during rotation of said roller, whereby the thermoplastic sheet in contact with said roller is cooled to a temperature sufficiently low to enable solidification of said thermoplastic sheet.

7. The method of subjecting a long traveling sheet of material to rapid heating which comprises running the material around a metallic roller, subjecting successive narrow very thin transverse strips of said roller to a high frequency electro-magnetic field to heat only the said successive strips of the roller, and cooling said strips rapidly after their subjection to said high frequency electro-magnetic field, whereby successive portions of said sheet in contact with the said successively heated and cooled strips are momentarily heated thereby and thereafter cooled thereby.

8. Apparatus for rapidly heating and then cooling a long moving sheet of thermoplastic material which comprises, a metallic member having a relatively large area thereof continually in contact with said sheet, means at a fixed location for inducing high frequency eddy currents in said metallic member and concentrating said eddy currents in a relatively narrow strip only of said relatively large area of said metallic member which is in contact with said moving sheet to heat the said strip only to a high temperature sufficient to plasticize said material, and means for abstracting heat from all portions of said metallic member continuously, whereby a portion of said sheet is rapidly heated while said portion of said sheet is adjacent said fixed location and is cooled after said portion of said sheet has passed said fixed location.

9. Apparatus for heating a long sheet of thermoplastic material comprising a metallic rotating roller, means for continuously abstracting heat from all portions of said metallic rotating roller, means for running said sheet over and in continuous contact with said metallic roller, means for inducing high frequency current over a small area only of the periphery of said metallic roller, said high frequency current being of sufficient intensity to heat the said small area of said metallic roller to a high temperature sufficient to plasticize said thermoplastic material, and means for maintaining said sheet in contact with a relatively large area of said metallic roller

including said small heated area of the periphery of said roller and a coated area advanced in the direction of rotation of said rotating roller to cool said thermoplastic material to setting temperature.

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