March 19, 1946. W. F. GRUPE 2,396,946

METHOD AND APPARATUS FOR APPLYING THERMOPLASTIC MATERIAL TO A SHEET OR WEB

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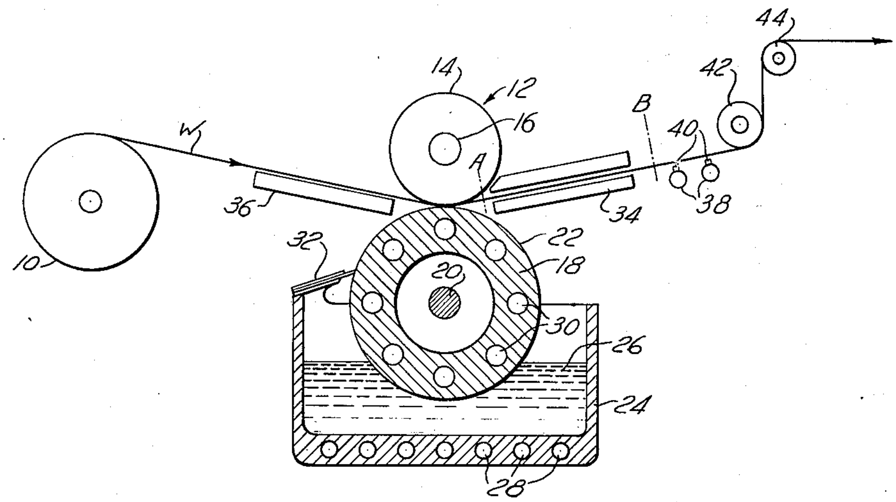

FIG. 1

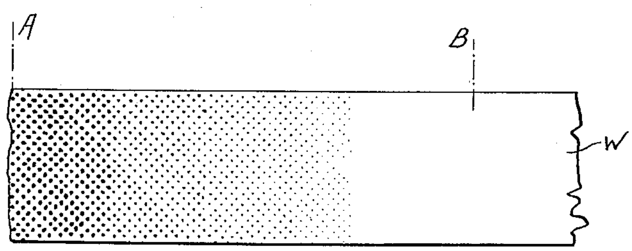

FIG. 2

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METHOD AND APPARATUS FOR APPLYING THERMOPLASTIC MATERIAL TO SHEETS OR WEBS

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8 Claims. (Cl. 117—65)

This invention relates to the art of printing or coating, and particularly to an improved method and apparatus for the continuous overall coating of webs or sheets of paper, cloth and the like with a continuous and uniform film of thermoplastic material, i. e. material which is solid or set at normal room temperatures and which becomes liquid when heated to an elevated temperature. The present application is a continuation in part of my copending application Serial No. 96,836, filed August 19, 1936, which issued as Patent No. 2,170,140 on August 22, 1939.

At the present time, thermoplastic materials have been developed to a point where they are adapted for wide use in the printing and coating of sheets or webs of paper and similar materials. One of the most common methods of applying such materials to the surface of a sheet or web has been through the use of a smooth faced roller which is in contact with the web under sufficient pressure to effect positive contact between the web and the applied material. With this procedure however, it is difficult to control the amount of material applied and to prevent its being forced into the pores of the web. To overcome this difficulty, it has been suggested that the material may be applied to the web by means of a gravure cylinder having the usual etched screen surface which results in laying the material upon the surface of the web in closely spaced but segregated uniform quantities. While this procedure has the advantage of definitely regulating the amount of material applied, its use with thermoplastic materials has been limited. That is, if a continuous and overall film is to be applied, the only thermoplastic materials that may be used with procedures and apparatus now available are those which have a relatively low viscosity when melted and remain fluid over a comparatively long temperature range and therefore will flow and form a continuous film after application. Such materials cannot be handled without damage or marring and readily offset at normal room temperatures. Because of this, the gravure cylinder has only been used in applying the coating materials in the making of carbon paper, such as disclosed in C. L. H. Supligeau et al. Patent No. 1,911,592, entitled "Method for forming copying sheets." The method has not been useful in the production of continuous films of thermoplastic materials having a viscosity, when fluid, greater than the viscosity of the materials used in the carbon coating, and having softening and melting points sufficiently high that the materials can be handled and will not offset at normal room temperatures.

I have discovered that thermoplastic materials having a higher viscosity when melted than the wax mixtures used in carbon coating and having melting and softening points sufficiently high that, when set, the materials can be handled and will not offset or transfer at normal room temperatures, may be effectively applied to a moving web or sheet by means of an intaglio printing couple and subsequently integrated or smoothed into a continuous and overall film of substantially uniform thickness throughout.

In accordance with my invention, a travelling web of sheet material may be coated with a high viscosity thermoplastic material having a melting point over 100° C. by applying the coating material to the sheet in relatively closely spaced but segregated quantities, by means of a heated intaglio roller and a cooperating impression roller. Substantially immediately after application, the closely spaced but segregated quantities of high viscosity thermoplastic material are integrated into a substantially smooth and continuous film by the application of heat thereto. This method of applying these thermoplastic materials has the advantage of producing a continuous film which is of substantially uniform thickness throughout. Moreover, the sudden and intense application of high heat thereto produces an outside surface having a high gloss and smoothness.

The above and other objects and advantages of my invention will become apparent upon consideration of the following detailed description and the accompanying drawing in which:

Fig. 1 is a diagrammatic side elevational view, partly in vertical section, of one form of apparatus embodying my invention and suitable for the practice of my improved method; and

Fig. 2 is a fragmentary plan view of the portion A—B of the coated web, illustrating the integrating of the closely spaced but segregated quantities of thermoplastic material into a smooth and continuous film.

Referring to the drawing, it will be observed that a web W of paper, cellulose film or sheeting, metal foil, metal sheet, fabric or other material to be coated is led from a suitable supply roll 10 to a coating apparatus 12 where one side thereof is coated with a thermoplastic material of the type having a relatively abrupt and high melting point and a high viscosity when melted. One example of a material which I have found suitable for coating paper, in that it produces a hard tough film which will not transfer or offset at ordinary room temperature, comprises the following mixture:

	Per cent
Soluble zinc resinate	30–40
Hydrogenated castor oil (melting point about 83° C.)	60–70

Although hydrogenated castor oil has a melting point of about 83° C., the addition of 30–40 per cent of soluble zinc resinate thereto produces a mixture having a softening point at about 100° C. and a melting point from about 130–160° C. This material becomes sufficiently fluid at a temperature of about 160° C. for proper application to the web W.

In order definitely to regulate the amount of material applied to the web 12, I prefer to employ a coating apparatus comprising an impression cylinder 14 having a shaft 16 and an intaglio or coating cylinder 18 having a shaft 20. The two shafts 16 and 20 may be journalled in suitable side frames (not shown) in any convenient manner. Intaglio or gravure coating cylinder 18 may comprise a conventional gravure cylinder having the usual screen or etched printing surface 22. I have found that a screen having about sixty lines to the inch produces satisfactory results when used in the practice of my invention. It will be apparent that the size and type of screen used in any instance depends upon the depth of coating required. For a high grade finish equal to the best grade of lacquer coating, a screen having about sixty lines to the inch and a depth of about six thousandths of an inch has been found suitable. For a medium grade finish which is somewhat thinner, a depth of only three thousandths of an inch is sufficient; and for general commercial label work, a screen having one hundred and twenty lines to the inch and a depth of about two thousandths of an inch is desirable. In any case, a coarse screen should be used for heavy coats and a fine screen used for thin or light coats.

The coating cylinder 18 is arranged to rotate in a suitable housing 24 containing a quantity of the thermoplastic coating material 26. The housing 24 is heated, to a temperature at which the thermoplastic material will melt and become fluid, in any convenient manner, such as by circulating a heating fluid through passages 28 provided in the housing or by the use of cartridge heaters in said passages. Although the coating cylinder 18 rotates in this heated bath and will become heated thereby, it may be found desirable to supply additional heat thereto as by circulating a heating fluid through or providing cartridge heaters in passages 30 provided in said coating cylinder 18. Excess coating material is removed from the screen surface 22 of the coating cylinder and said surface is properly conditioned for application of the coating material 26 to the under surface of the web W in closely spaced but segregated quantities by means of a conventional doctor blade 32 mounted for the usual reciprocatory movement upon the housing 24.

In Fig. 2, I have shown a plan view of the section A—B of the web W, which view illustrates the appearance of the web immediately after passing beyond the coating apparatus 12. It will be observed that due to the relatively high viscosity of the coating material employed and the rather sharp melting point thereof, the screen pattern produced by the coating or printing surface 22 will be visible. This obviously would not provide the type of coated or printed surface that would be useful in wrapping materials, for example, since the visible screen pattern has a rather dull appearance. I have discovered, however, that the closely spaced but segregated quantities thus produced can be integrated into a continuous and glossy film by the application of sufficient heat thereto to maintain the applied material in a fluid condition until the closely spaced quantities flow together or toward one another filling the spaces between them, thus providing a completely smooth and glossy continuous film, as indicated at the point B in Fig. 2.

Such heat may be applied at least to the freshly coated surface by means of a heater 34 through which the web W passes. The heat itself may be produced in any convenient manner, such as by means of carbon filament infra-red lamps, resistance heating elements, or the like. When the web is moving at a relatively high rate of speed, I find it advantageous to employ a heater of the radiant type using glow bars of Carborundum or radiant gas burners, either type of heater being fitted with movable shields or other means to prevent the application of the intense heat when the web is moving very slowly or is stopped. Heating elements of this character are adapted to produce a temperature of about 780° C. and thus permit rapid heating of the surface coating to the melting temperature, or proper maintenance of the coating at such temperature, thereby allowing the spaced mounds or segregated quantities to flow together into a continuous film. I have also found that effective integrating of the closely spaced quantities of coating material may be effected by means of blasts or jets of heated air or other gases maintained at a temperature of from about 300° C. to about 500° C. and supplied to the web at a velocity of about 3000 to about 10,000 feet per minute, the pressure and velocity of application causing the coating material to be flattened or leveled out so that the closely spaced quantities flow properly together. Any of these methods of remelting the applied coating material or maintaining it at melting temperature until a continuous film is formed tend to remove all dull areas, streaks, mounds, or defects caused by the mechanical action of applying the coating material.

Since the relatively low temperature of the web W is at least partially responsible for the initial setting of the coating material immediately after application and thus prevents the production of a continuous overall film without the use of some additional smoothing or integrating operation, it is often desirable to preheat the web W, or at least the under surface thereof, by means of a suitable heater 36. This heater may be of any desired type, similar to the heater 34, and the preheating caused thereby, is adapted to raise the temperature of the web at least to about 100° C. to 150° C. so as to reduce or avoid any detrimental hardening or setting of the coating material and to permit free side flow of the mounds or segregated quantities after application to the web. It will be understood that the temperature of the web and the applied coating material immediately after application, as well as the web speed and type of coating material used, will partially control the extent of post heating required by the heater 34 to produce a flat smooth continuous film.

After the coating material has been smoothed into a continuous film by passage through the heater 34, it may be initially set by the application of a blast or plurality of blasts of cool air thereto. These blasts may be provided by means of suitable conduits 38 having nozzles 40 therein for directing the cooled fluid upon the freshly coated and smoothed surface. The web W may then be passed over a cooling roller 42 for a further lowering of temperature and over guide rollers 44 to any subsequent web treating device.

While I have shown my invention, in the preferred embodiment described herein, applied to the continuous and overall coating of a moving web or sheet, it will be understood that the principles thereof may be employed in partial or spot coating or in printing sheets or webs with thermoplastic marking or coating materials. Moreover, various changes may be made in the construction and method and certain features or steps may be employed without others without departing from my invention or sacrificing any of its advantages.

What I claim is:

1. A method of printing or coating a travelling web of sheet material with a thermoplastic material having a higher viscosity when melted than wax mixtures used in carbon coating and having softening and melting points sufficiently high that the materials, when set, can be handled and will not offset or transfer at normal room temperatures of about 25° C., which comprises applying such material, heated to a liquid state, to a surface of the sheet material in relatively closely spaced but segregated and uniform quantities; and, substantially immediately after application, integrating said relatively closely spaced but segregated and uniform quantities into a smooth and continuous film by a treatment which includes the application of sufficient heat to melt the applied thermoplastic material.

2. A method of printing or coating a travelling web of sheet material with a thermoplastic material having a higher viscosity when melted than wax mixtures used in carbon coating and having a melting point above 100° C. so that the materials, when set, can be handled and will not offset or transfer at normal room temperatures of about 25° C., which comprises applying such material, heated to a liquid state, to a surface of the sheet material in relatively closely spaced but segregated and uniform quantities; and, substantially immediately after application, integrating said relatively closely spaced but segregated and uniform quantities into a smooth and continuous film by the continued application of heat thereto.

3. A method of printing or coating a travelling web of sheet material with a thermoplastic material having a higher viscosity when melted than wax mixtures used in carbon coating and having a melting point above 100° C. so that the materials, when set, can be handled and will not offset or transfer at normal room temperatures of about 25° C., which comprises applying such material, heated to a liquid state, to a surface of the sheet material in relatively closely spaced but segregated and uniform quantities; integrating said quantities into a smooth and substantially continuous film by the application of heat thereto; and thereafter fixing the integrated film on the surface of the sheet material by a cooling treatment.

4. A method of printing or coating a travelling web of sheet material with a high viscosity thermoplastic material having a melting point above 100° C., which comprises applying said thermoplastic material in a heated liquid condition to a surface of the sheet material in relatively closely spaced uniform quantities by means of a heated intaglio roller and a cooperating impression cylinder; integrating said quantities into a smooth and substantially continuous film by a treatment which includes the application of sufficient heat to melt the thermoplastic material; and thereafter fixing the integrated film on the sheet material by a cooling treatment.

5. A method of printing or coating a travelling web of sheet material with a high viscosity thermoplastic material having a melting point above 100° C., which comprises applying said thermoplastic material in a heated liquid condition to a surface of the sheet material in relatively closely spaced uniform quantities by means of a heated intaglio roller and a cooperating impression cylinder; and maintaining said thermoplastic material in a sufficiently heated condition to allow said spaced quantities to flow into a uniform and substantially continuous film.

6. A method of printing or coating a travelling web of sheet material with a high viscosity thermoplastic material having a melting point above 100° C., which comprises applying said thermoplastic material in a heated liquid condition to a surface of the sheet material in relatively closely spaced uniform quantities by means of a heated intaglio roller and a cooperating impression cylinder; and integrating said quantities into a smooth and substantially continuous film by the application of a high velocity blast of heated gas thereto.

7. A method of printing or coating a web of sheet material with a high viscosity thermoplastic material having a relatively sharp melting point above 100° C., which comprises preheating said web to a temperature above 100° C.; applying said thermoplastic material in a heated liquid condition to a surface of the sheet material in relatively closely spaced uniform quantities; integrating said quantities into a smooth and substantially continuous film by applying heat thereto; and thereafter fixing the integrated film on the surface of the sheet material.

8. Apparatus for applying a high viscosity thermoplastic material having a melting point over 100° C. to a travelling web of sheet material, comprising a heated intaglio roller and a cooperating impression cylinder for applying such material in melted condition to a surface of the web in relatively closely spaced quantities of uniform size and shape, and heating means positioned beyond the intaglio roller and impression cylinder in the direction of travel of the web for raising the temperature of the applied material and integrating said quantities into a smooth and substantially uniform film.

WILLIAM F. GRUPE.