Dec. 5, 1972 T. W. BUSCH 3,705,049

METHOD FOR THE MANUFACTURE OF DOUBLE COATED SHEETS WITH PRESSURE-RUPTURABLE MATERIALS

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FIG. 1

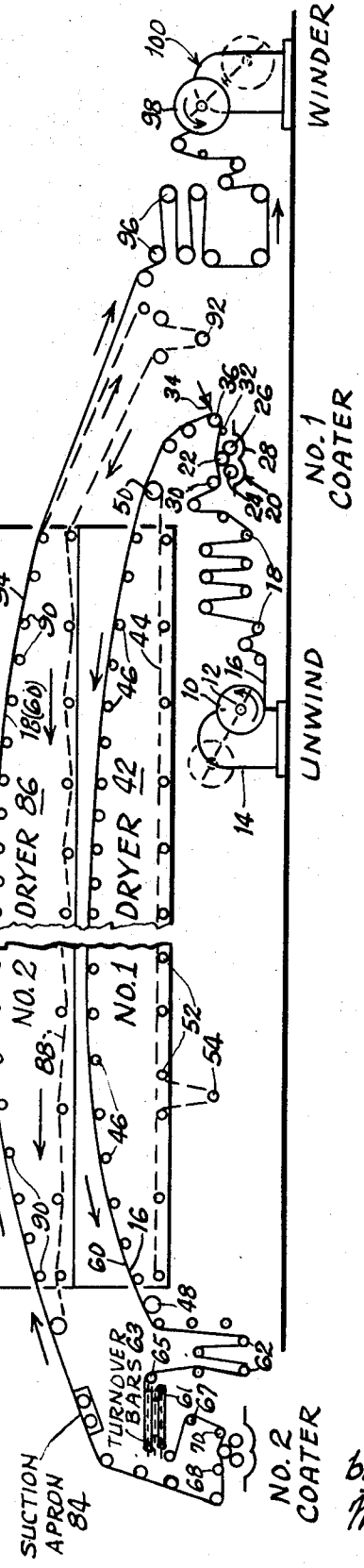
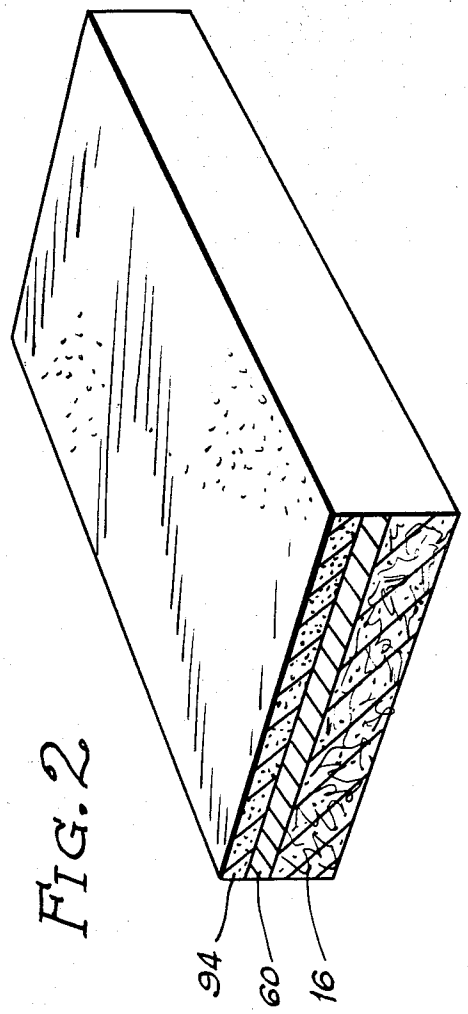


FIG. 2



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METHOD FOR THE MANUFACTURE OF DOUBLE COATED SHEETS WITH PRESSURE-RUPTURABLE MATERIALS

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Int. Cl. B41m 5/16
U.S. Cl. 117—36.9 2 Claims

ABSTRACT OF THE DISCLOSURE

Tandem coating of paper web on one side first with a coating of pressure-rupturable encapsulated materials and then with a coating of clay overlaying the coating of pressure-rupturable materials, wherein each coating, while wet with the coating composition, is doctored to meter the coating composition and to uniformly distribute the coating composition over the surface of the web.

This invention relates to the art of coated paper, and more particularly to the method for the fabrication of a manifold sheet having two separate coatings on one side of the sheet in which one of the coatings is formulated of a pressure sensitive material of the type described in the patents hereinafter set forth.

In the United States Patents Nos. 2,299,693; 2,374,862; 2,548,366; 2,712,507; 2,730,456; 2,730,457; 2,800,457; 2,929,736; 2,932,582; 3,020,171; 3,104,980; 3,129,103; and 3,455,721, description is made of a copy process and materials for use in the practice of same in which separate coatings are provided on suitable carrier sheets in which one of the coatings is formulated to contain a liquid reactant such as a colorless dye component dissolved in a liquid solvent and which is encapsulated in microscopic capsules uniformly distributed throughout the coating (hereinafter referred to as the emulsion coat), while the other coating is formulated of clay or other particulate substance which is adapted to react with the liquid in response to release from the capsules to form a colored image (hereinafter referred to as the mineral or clay coat). When the coating containing the encapsulated liquid is positioned in surface contact with the clay coating, no color develops until pressure is applied by pen, pencil, stylus, typewriter key, die impression or the like, or by heat to rupture the capsules in the imaged areas whereby the liquid released from the ruptured capsule wets out the adjacent receptive material in the clay coating to develop the image.

In accordance with one form of paper of the type described, often referred to in the art as carbonless copy paper, the paper is used in a manifold assembly in which the top sheet in the assembly is fabricated with only its underside coated with the emulsion coating, while the bottom sheet in the assembly is coated on its top side with only the clay coating. All of the sheets in between are coated on the underside with emulsion coating and on the top side with the clay or mineral coating in two side-coated sheets. Thus, an impression on the top sheet ruptures the capsules contained on the underside of each of the sheets whereby the encapsulated liquid thereby released wets out the adjacent clay coating to develop the image.

Because the micro-capsules are pressure sensitive and are capable of being ruptured in response to pressure of the magnitude encountered in mechanical nips of a paper machine, it has been the practice to make application of the microcapsular system as a separate operation applied

onto the previously fabricated paper base sheet. For this purpose, use has been made of a composition in which the micro-capsules are admixed with adhesive, lubricating pigment such as talc, and cellulosic fibers which operate to protect the capsules from premature rupture in the coating.

The described "off-the-machine coating" of the microcapsular system poses a number of requirements including (1) additional machinery for such separate off-the-machine coating; (2) additional floor space for such separate operations and equipment; (3) movement of paper from the paper making machine to the described separate coating operation in which packaging, shipping and labor represent additional costs; (4) additional waste resulting from a two-stage process, and (5) procurement of paper as a separate commodity with its attendant costs, etc.

In my copending applications Ser. No. 795,663, filed on Jan. 31, 1969, now U.S. Patent No. 3,632,378, and Ser. No. 834,572, filed on Mar. 26, 1969, now U.S. Patent No. 3,535,140, description is made of new and improved methods and apparatus for preparing two-sided coated paper sheets of the type described which represent significant improvements over the prior art. In accordance with the methods described in these copending applications, use is made of tandem coatings in an "off the paper machine" operation by which the emulsion coating and the clay coating are applied by separate stations in sequence on a single coating machine.

However, the methods as described in the aforementioned copending applications are adapted to form the mineral or clay coating and the emulsion on opposite sides of the paper web or sheet. Thus, they are not applicable to a type of coated paper sheet which is known to the art as "self-contained paper." The so-called "self-contained paper" is a variation of carbonless copy paper of the type described above in which both the emulsion coating and the clay coating are formed on the same side of the paper sheet with the emulsion coating being laid down prior to the clay coating. Thus, paper of this type can be used by placing it on the underside of a sheet of untreated paper whereby an impression made on the untreated paper causes rupture in the capsule coating of the treated paper whereby the fluid released thereby wets out the clay in the coating overlaying the emulsion coating on the treated sheet to develop the image.

It is an object of the present invention to provide a new and improved method for preparing self-contained paper of the type described in which the first coating is formed of a pressure sensitive material; in which two separate coatings can be carried out in a single continuous multiple coating process; and, in which the method can be carried out in a simple and efficient manner, with a minium amount of time, investment, labor, equipment and cost.

This and other objects and advantages of the invention will appear hereinafter, and, for purposes of illustration, but not of limitation, an embodiment of the invention is shown in the accompanying drawing in which:

FIG. 1 is a schematic elevational view of a coating method embodying the concepts of the invention;

FIG. 2 is an enlarged view, partially in section, of a double coated paper sheet produced in accordance with the method illustrated in FIG. 1.

Although the invention is addressed to the method and apparatus for the dual coating of paper base stock, the problem sought to be overcome by this invention arises primarily by reason of the unique characteristics of the compositions with which the base paper is coated.

Briefly described, the emulsion coating is formulated of an aqueous composition containing rupturable microscopic capsules of tanned gelatin containing a liquid color-

forming ingredient, such as a colorless dyestuff dissolved in an organic solvent. There may be included within the emulsion coating composition, a substantial amount (up to 50% by weight of the capsules) of a coarse, solid particulate material, such as kaolin clay and/or cellulose fibers suspended with the rupturable capsules and in which a small of water-soluble binder may be dissolved in the aqueous medium. For a more detailed description of the emulsion coating, reference may be made to the examples in U.S. Patent No. 2,711,375, and others of the patents heretofore set forth.

The clay coating comprises an aqueous system having an acid reacting mineral clay, such as attapulgite clay, or microfine solid particles of an oil-soluble, acid-reactant organic polymer, in finely divided form, suspended therein, with or without other fillers such as calcium carbonate, silica gel, satin white and the like, and a small amount of natural or resinous binder. For a more detailed description and formulation of the clay coating composition, reference may be made to the examples in the aforementioned patents, particularly No. 3,455,721.

Referring now to the concepts of the invention in a method and apparatus for the manufacture of self-contained sheets having dual coatings of the type described on the same side of the paper base sheet, the paper raw stock, such as 11-pound manifolding bond, is supplied in the form of rolls **10** mounted for free rotational movement on a spindle **12** supported on the unwind stand **14**. The web **16** of raw stock paper is passed from the roll **10** over a series of idler rollers and guide rollers **18** to a first coating station **20**.

The first coating station comprises an applicator roll **22** in communication with a transfer roll **24** and a metering roll **26**, the bottom portion of the transfer roll being immersed in a bath of the emulsion coating composition in pan **28**. The applicator roll **22** engages the bottom side of the paper web **16** as it passes between guide roll **30** and leveling roll **32** to apply an excess of the emulsion coating composition to the bottom side of the paper web. An amount of emulsion coating composition corresponding to a controlled excess above 4½ pounds per 3300 square feet is applied by the applicator and metering system at this first station.

From the first coating station **20**, the one side coated web is advanced directly to an air knife **34** which cooperates with the backing roll **36** to meter the coating to about 4½ pounds per 3300 square feet of the paper and to uniformly distribute the coating composition over the surface thereof.

From the first coating station, the paper web, which has been turned about the roller **36**, to position the coated side uppermost, is advanced through one section **42** of a drying oven maintained at a temperature of about 200° F. or higher while supported on an endless belt **44**. The upper run of the belt is supported on rollers **46** arranged in a substantially arcuate path through the dryer and, for this purpose, it is preferred to make use of a foraminous belt or a belt formed of a vapor permeable material to enable the escape of water vapor therethrough when released from the coating. The endless belt **44** turns about rollers **48** and **50** outside the dryer and the return run passes through the dryer section to maintain temperature while being supported on a bottom run of rollers **52** provided with a take-up roller **54** for maintaining the proper tension in the supporting belt.

The paper base **16** with the dried emulsion coating **60** on the top side thereof is passed from the drying oven **42** over a series of guide rollers and tensioning roller **62** and then over an assembly of turnover bars **61, 63** and **65**, which operate to turn over the continuous web whereby the top side containing the dried emulsion coating is on the underside of the sheet and ready for the second coating step. Any arrangement of commercially available turnover bars may be used in accordance with the practice of the invention. As is known by those skilled in the art, such turnover bars generally include an assembly of three rollers or bars, two of which are inclined with respect to horizontal and vertical axis.

From the turnover bars, the web having the treated emulsion coating on the underside thereof is passed over a roller **67** to the second coating station, which is constructed similarly to the first coating station in that it comprises an upper applicator roller **66** in accordance with the underside of the web as the web passes between leveling roller **68** and guide roll **70**. The applicator roller **66** is supported between a transfer roller **72** and a metering roller **74** which takes up coating composition from a bath in the coating pan **76** in which the bottom portion of the transfer roller is immersed. The applicator roller is adjusted to apply the clay coating composition to the underside of the web overlaying the dried emulsion coating composition to a coating weight in a controlled excess of about 4.5 pounds per 3300 square feet.

From the coating station **64**, the coated web is advanced to a second air knife **78** and over the roller **80** which again operates in combination to meter to about 4.5 pounds per 3300 square feet the amount of coating composition allowed to remain on the web and to distribute the clay coating overlaying the dried emulsion coating composition uniformly across the web.

From the air knife **78**, the web which has been double coated first with the emulsion coating and then with the clay coating overlaying the dried emulsion coating lowermost, is advanced over a suction apron **84** and then to an upper section **86** of the drying oven through which it is carried on the surface of a supporting endless belt **88** in a relaxed state.

The upper run of the belt is supported on longitudinally spaced-apart crosswise extending rollers **90** arranged in an arcuate path through the dryer. The belt continues to support the web for a short distance beyond the exit of the dryer. Thereafter, the belt turns downwardly and back about rollers which lead through the dryer to a take up roller **92** which is provided outside the dryer for adjusting the tension of the belt; as with the belt **44**, it is preferred to make use of a vapor permeable belt to enable the escape of vapors therethrough during passage through the dryer.

The web **16** containing the dried clay coating **94** overlaying the dried emulsion coating **60** is passed over a series of guide rollers and tension rollers **96** to a wind up roller **98** mounted on a winder stand **100** and powered to wind the coated web into the roller. Thus, the web is drawn through the coating apparatus and dryer, and reel tension is developed in the wind up roller section.

It has been found that when use is made of premetering and air knives in the processing of the applied coating composition, it becomes possible to apply smooth coatings and dispense with the application and drying of the emulsion coating composition as a separate operation in advance of the application and drying of the clay coat. Under such circumstances, it becomes possible to apply the separate coating compositions in sequence in a continuous operation on a continuously moving web thereby to obviate the necessity for making separate passes for each coating operation with a lapse of time between each coating application. Application of the clay coating composition in rapid sequence immediately following the application and drying of the emulsion coating composition reduces the need for protective additives in the emulsion composition which have been necessary to protect the capsule coated paper during the handling of rolls which were required in a two-stage process on separate machines. Immediate application of the clay coating composition over the freshly coated emulsion composition improves the bond between the two layers and thereby reduces the adhesive demand in the clay coating composition. Both these effects thus improve the efficiency of capsule usage.

While the concepts of this invention find their best use in a continuous double coating operation in a single coat-

ing pass, it will be understood that many of the advantages and improvements of this invention will be capable of achievement by first coating the web with the emulsion coating composition followed by drying in one pass and then coating the web with the clay coating composition and drying in a subsequent separate pass.

It will be further understood that numerous changes may be made in the details of formulation and operation, without departing from the spirit of the invention, especially as defined in the following claims.

I claim:

1. In the method of producing a double coated sheet having relatively uniform smooth coatings on one side of the sheet in which the sheet is first coated with an aqueous emulsion-containing pressure-rupturable capsule of a liquid color forming material and is then coated with an aqueous clay coating composition to form a clay coating overlaying the emulsion coating, the sequence of the steps of applying the emulsion coating to one side of a moving paper web, doctoring the applied coating while wet with an air knife to meter the coating and to uniformly distribute the coating composition over the side of the web, drying the emulsion coating while the coated web is supported in a relaxed state on a continuous conveyor surface with the emulsion side uppermost, coating the same side of the coated web with a clay coating composition to form a clay coating overlaying the dried emulsion coating, doctoring the clay coating while wet with an air knife to meter the coating and to uniformly distribute the clay coating composition over the web and then drying the clay coating.

2. The method as defined in claim 1 which includes the step of turning the paper web over after drying the emulsion coating and before application of the clay coating composition whereby the clay coating is applied to the same side of the paper web in one pass.

References Cited

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MURRAY KATZ, Primary Examiner

U.S. Cl. X.R.

117—64 R, 76 P