

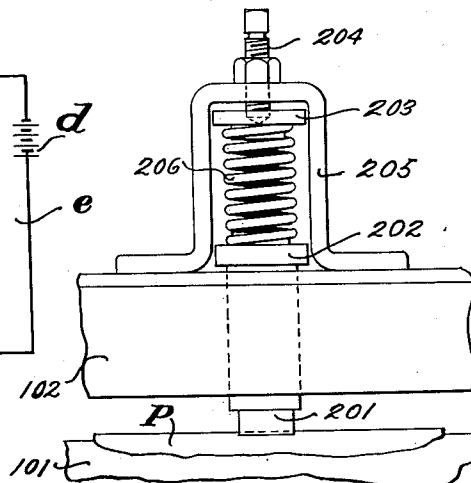
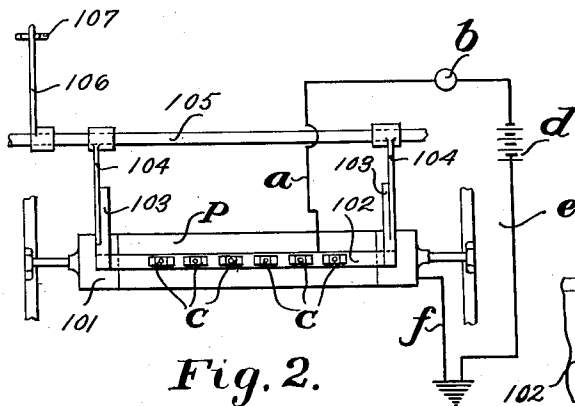
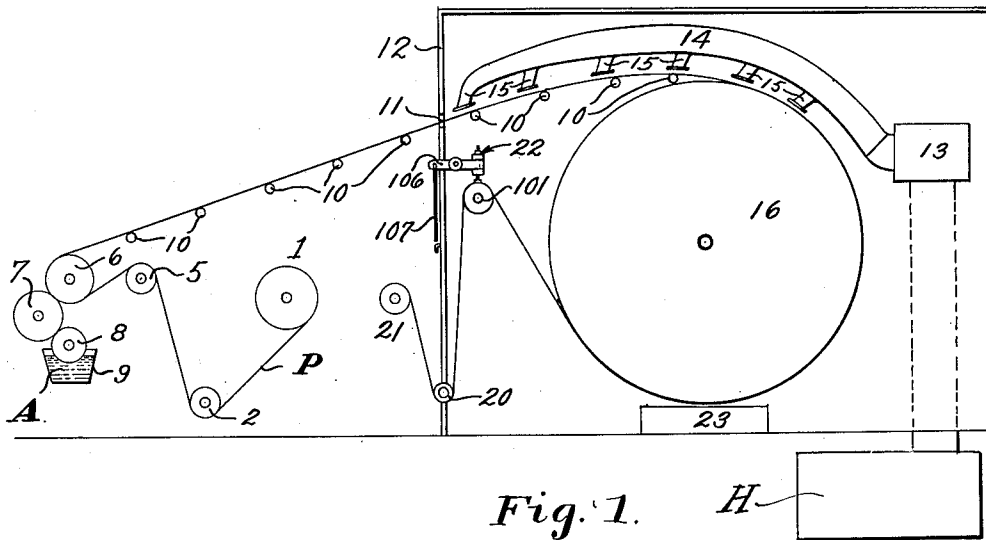
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GAUGING THICKNESS OF SURFACE COATING

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UNITED STATES PATENT OFFICE

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GAUGING THICKNESS OF SURFACE COATING

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This invention relates to the application of coatings to paper or other sheet material and has for its chief objects the maintenance of uniform thickness of such coatings and avoidance of waste by unnecessarily heavy coating. It is applicable to the manufacture of surface coated paper in particular; and permits the continuous measurement of the weight or thickness of the coating applied to a continuously moving web of paper in the form of an aqueous solution subsequently dried by heat.

In the manufacture of such paper in large quantity, economy of the coating material becomes important, and therefore the coating should be uniformly as thin as is consistent with the adequate performance of the functions of the product. With a given paper stock and coating material the minimum effective thickness of the coating when dried or set will be determined empirically, and the ascertained economical optimum adopted as the standard.

Apparatus illustrating the method of gauging the thickness of a set coating or paper sheet is shown in the drawings hereto annexed, in which,

Fig. 1 is a diagrammatic reproduction of such apparatus, in longitudinal elevation;

Fig. 2 is a plan view, partly diagrammatic, of the coat-thickness gauging instruments; and

Fig. 3 is a view in elevation, on relatively large scale, of an element of the gauging instrument.

Referring to Fig. 1 wherein is shown one illustrative embodiment of the genus of the invention; a roll of paper P, mounted at 1 to be unrolled, is led over a plurality of guiding and smoothing rolls 2 and 5 and passed between rolls 6 and 7, of which roll 7 applies a liquid solution of coating material to one surface of the paper. The coating solution is picked up from a supply A in a trough 9 by roll 8. This roll may be rotated in either direction, but that opposite to the rotation of roll 7 is preferred, as being better adapted to transfer a uniformly thick liquid film to the surface of roll 7, to be transferred to the paper at the nip between rolls 7 and 8. The

system of rolls 6, 7, 8, is provided with bearing adjustments by which the quantity of coating film per unit of paper area may be adjusted. Such adjusting devices being well known, are not shown in the drawings.

From roll 6, the coated paper is led over supporting rods 10, 10, through a slot 11 in the side of a drying chamber 12, thence over other supporting rods 10, 10 inside the drying chamber, over a roll 16, which serves to smooth out waves and crinkles in the coated paper, thence over roll 101, which is one member of the device for gauging the thickness of the set and dried coating, over guide roll 20 located in a slot in the side of the chamber, and thence to the winding up roll 21. Driving mechanism for such of the above mentioned rolls as require it, is provided in the well known manner, and need not be described.

The drying chamber 12 has an induct at 13 for heated drying air, and an educt at 23. An exhaust fan (not shown) connected with educt 23 will be provided, as well as an air heater H to raise the temperature of air before it enters the induct 13.

For effective initial application of heated drying air to the wet film of coating on paper P, a manifold pipe 14, receives the air entering at 13, and delivers it in blasts from nozzles 15, which have elongated apertures spanning the width of the paper web. The temperature, humidity, and volumetric rate of delivery of the drying air are so maintained that the film of coating material is practically set before it arrives at the gauging instruments generally designated at 22 in Fig. 1.

It is well known that, in the manufacture of paper or like material, the moisture content of the material at the end of the drying operation can be measured and controlled by measuring continuously the electrical conductivity of the material. I have discovered that, if a web of completed paper to which a coating of definite weight has been applied, as in the form of an aqueous solution of definite strength, be drawn at constant speed through a drying chamber in which constant driving conditions are maintained, (i. e. by

constant temperature, humidity and quantity of the air supplied to the chamber), the moisture content of the coated paper leaving this chamber will be constant, and therefore likewise its electrical conductivity. If, however, the quantity of coating material applied to the paper be changed, all the other conditions referred to remaining constant, electrical conductivity of the coated paper leaving the drying chamber will change to a new value the magnitude of which depends upon the variation in thickness of the coating alone. By maintaining the humidity of the drying air supplied to the chamber 12 approximately at a constant (which may be effected by any of the known air-tempering apparatus) and, as above stated, its temperature and rate of circulation through the drying chamber at constant values and by holding the speed of travel of the coated paper through the chamber also constant, the surface of the coating film on the paper web will be set before it reaches the gauging instruments, so that the thickness of the coating will be the only variable factor.

The thickness of the set and dried coating film is gauged by the instruments 22 due to resistance offered to the passage of an electric current by the coated paper the thickness of the paper itself being practically a constant. The differential of potential between terminals in the circuit of which the coated paper is to form a part should, of course, be effectively a constant.

One form of gauging instruments 22 is shown in Figs. 2 and 3. Over the guide roll 101 (of conductive material) there is mounted a metal bar 102 which carries a number of contact members C. Bar 102 is secured to arms 104 by means of non-conducting blocks 103 (as of fibre or hard vulcanite). Arms 104 are secured to a rock shaft 105 which is mounted in suitable bearings (not shown) and is provided with a control handle 107 on the radius arm 106 which projects out through a slot in the side of the drying chamber (see Fig. 1).

Bar 102 is connected electrically to a source of current *d*, by lead *a*, in which a current-indicator, conventionally shown at *b* is placed in the circuit. This indicator will preferably be of the recording type. The circuit is completed, as by leads *e* and *f*, to ground, respectively from the source *d* and the roll 101.

At intervals along the bar 102 the contact devices C are placed. One of these is shown in detail in Fig. 3, wherein a metal plunger 201 is mounted to slide in a hole drilled therefor in bar 102 in good electrical contact therewith, and to rest on the coated surface of paper web P as it passes over the roll 101. The plunger 201 has a non-circular spring seat 202, and a spring 206, bearing at its lower end on seat 202 and at its upper end on the annularly shouldered disc 203, is held under

compression which may be adjusted by the set screw 204 which is threaded into the yoke 205.

Under the maintained conditions above noted, all the variable factors affecting the resistance of the coated paper web except the thickness of the coating material have been eliminated, and, the resistance to passage of the electric current, of which the effective potential differential is a constant, by the coated paper web, which indicates the optimum thickness of the coating thereon having been empirically determined, observation of the readings of the indicator *b* will betray any departure, in either direction, from this optimum thickness on the part of the coating; appropriate adjustments of the coating appliances (such as rolls 6, 7, 8) and renewed observation of the current (or, conversely, resistance, indicator) will restore the coating to the determined optimum thickness in its set or dried condition, within such limits of departure as are practically or necessarily tolerable.

To recapitulate: The mode of gauging thickness of coating on a web, as of paper, (which serves as a guide to corrective adjustment of rate of application of coating solution) comprises coating such web with a film of coating solution, passing it at uniform rate through a current of heated drying air which is supplied at constant humidity, and at such temperature, and at such rate as to ensure setting or practically thorough drying of the coating before the web passes between the electrical contacts (paper-support and members contacting with the paper surface) and becomes part of the circuit in which said contacts are included, and indicating to observation the resistance offered by the coated web to passage of the circuit current.

I claim:

1. Method of applying a substantially uniform thickness of coating on sheet material such as paper which comprises applying a thickness of coating material to the sheet material, subjecting the coated sheet to constant drying conditions, passing a current of electricity through the coating material and sheet material at a point where the coating material is set and through a current resistance indicating device, and controlling the amount of coating applied so as to maintain the reading of the indicating device substantially constant.

2. Method of applying a substantially uniform thickness of a coating on sheet material such as paper, which comprises applying a film of liquid coating material to the surface of the sheet material, passing the thus coated sheet material through a drying chamber, introducing into and withdrawing from said chamber a current of preheated air having substantially constant humidity, at initial temperature and volumetric rate of supply and withdrawal adequate to eliminate mois-

ture carried by the coating material and sheet material and set the coating before the latter emerges from the drying chamber, passing a current of electricity through the coating material and sheet material at a point where the coating material is set, and through a current indicating device, and controlling the amount of coating applied so as to maintain the reading of the indicating device substantially constant.

3. Method of applying a substantially uniform thickness of a coating on sheet material such as paper, which comprises applying a film of liquid coating material to the surface of the sheet material, passing the thus coated sheet material through a drying chamber, introducing into and withdrawing from said chamber a current of preheated air having substantially constant humidity, at initial temperature and volumetric rate of supply and withdrawal adequate to eliminate moisture carried by the coating material and sheet material and set the coating before the latter emerges from the drying chamber, directing the incoming drying air as a blast directly against the wet coated surface of the sheet material, passing a current of electricity through the coating material and sheet material at a point where the coating material is set, and through a current indicating device, and controlling the amount of coating applied so as to maintain the reading of the indicating device substantially constant.

4. Apparatus for gauging the thickness of a coating on sheet material such as paper, comprising means to conduct a length of such material into, through, and out of a drying chamber, said drying chamber, provided with apertures for entrance and exit of the material, means to apply to a surface of the sheet material a film of liquid coating material, means to direct a blast of heated drying air upon the coated side of said sheet within the drying chamber and at initial temperature and volumetric rate of supply and withdrawal adequate to eliminate moisture carried by the coating and the sheet material and set the coating, means outside the drying chamber to maintain said drying air at substantially constant humidity, means to maintain circulation of drying air into and out of said chamber, and means to pass an electric current through the coated sheet material at a point in its course when the coating thereon has become set, and a current measuring instrument in the circuit.

Signed by me at Framingham, Massachusetts this 20th day of August, 1929.

ERNEST L. KALLANDER.