Sept. 20, 1966 F. D. BERGSTEIN ET AL 3,274,307

METHOD AND MEANS FOR CONTROLLING FOAMING OF CLAY COATING COMPOSITION DURING APPLICATION

Filed March 1, 1962 2 Sheets-Sheet 1

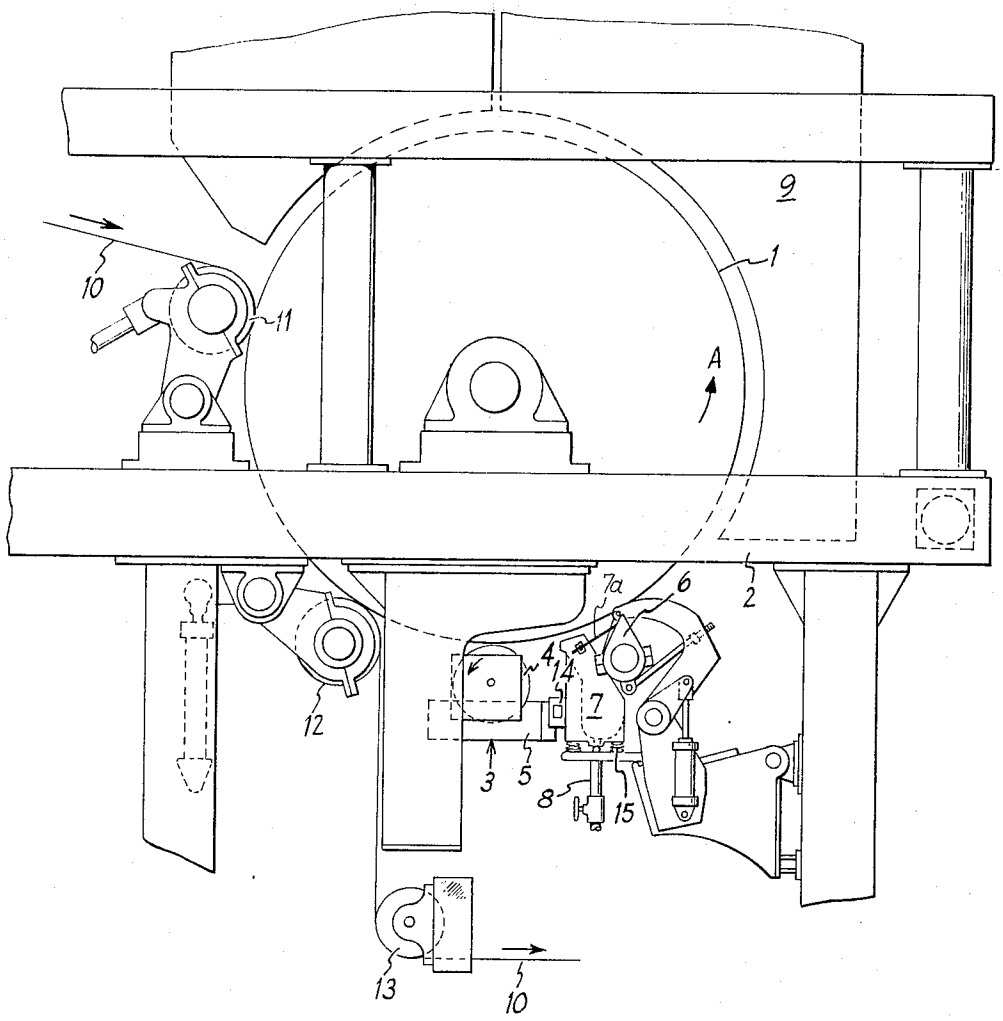

Fig. 1

INVENTOR.
FRANK D. BERGSTEIN,
ALFRED B. KLEINGERS, JR., AND
LEONARD BACK,

BY Young Quat, McNeille, Strasser & Foster

ATTORNEYS.

Sept. 20, 1966 F. D. BERGSTEIN ETAL 3,274,307

METHOD AND MEANS FOR CONTROLLING FOAMING OF CLAY COATING COMPOSITION DURING APPLICATION

Filed March 1, 1962 2 Sheets-Sheet 2

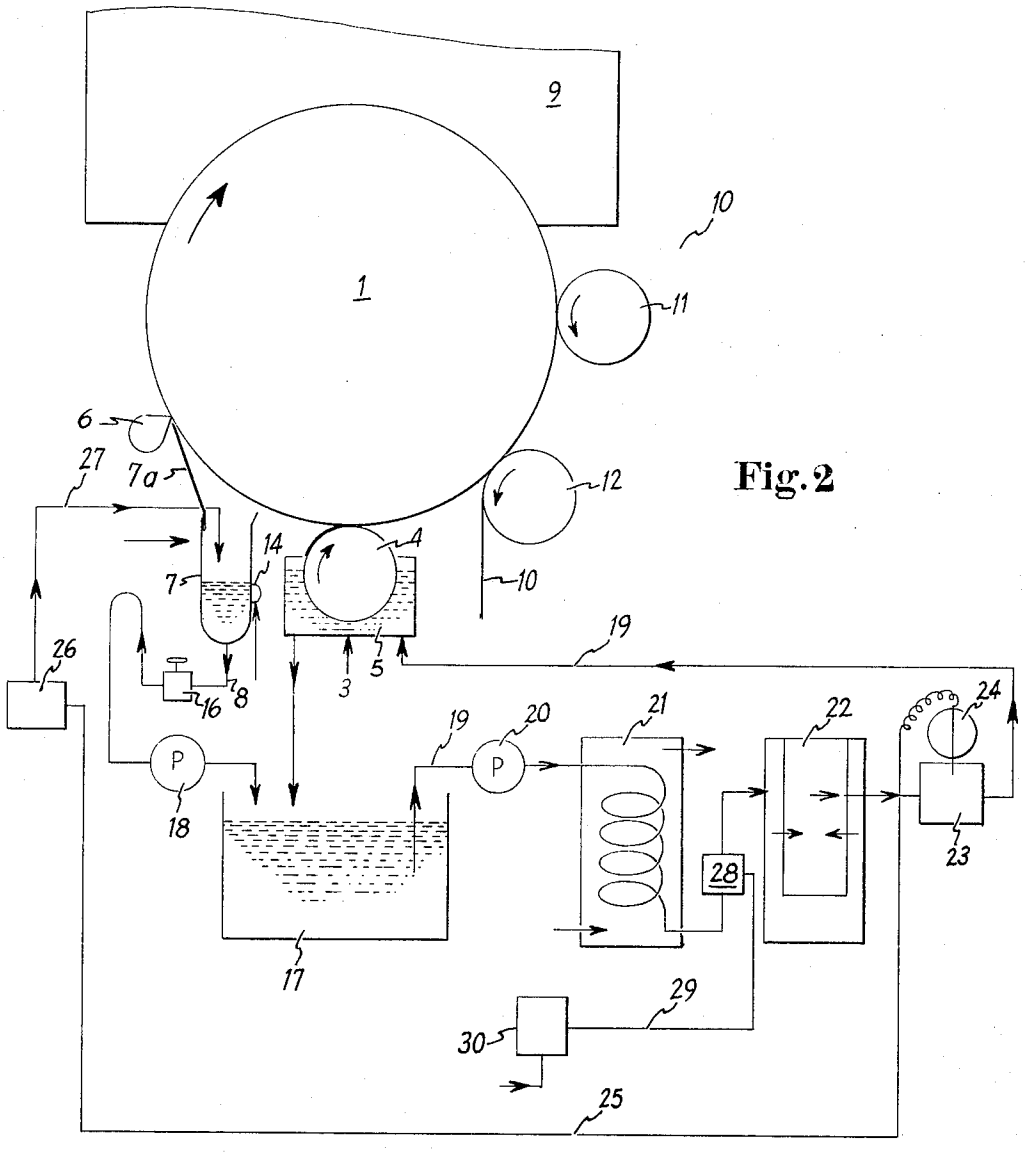

Fig. 2

INVENTOR.
FRANK D. BERGSTEIN,
ALFRED B. KLEINGERS, JR., AND
LEONARD BACK,
BY Youngblut, Melville, Hansen & Justen
ATTORNEYS.

United States Patent Office 3,274,307
Patented Sept. 20, 1966

3,274,307

METHOD AND MEANS FOR CONTROLLING FOAMING OF CLAY COATING COMPOSITION DURING APPLICATION

Frank D. Bergstein, Wyoming, and Alfred B. Kleingers, Jr., and Leonard Back, Middletown, Ohio, assignors to Bergstein Packaging Trust, Middletown, Ohio, a corporation of Ohio

Filed Mar. 1, 1962, Ser. No. 176,605
3 Claims. (Cl. 264—37)

This invention relates to the application of a layer or film of a fluid film forming material to a casting surface and has to do more particularly with the elimination of foam and entrained air bubbles from the casting composition during the casting operation.

The instant invention will find particular utility in conjunction with the type of cast coating operation taught in Bergstein Patent 2,934,467 issued April 26, 1960, and entitled Dry Gloss Pre-Cast Clay Laminated Paper and Method of Making It. In accordance with the teachings of this patent, a thin layer or film of mineral coating composition is applied by an applicator roll to a casting surface, such as a polished metal drum or endless belt, and dried in contact therewith, whereupon the adhesively coated surface of a web of paper or board is adhered to the exposed surface of the dry coating and the web utilized to strip the dried mineral layer from the casting surface. The resultant product is characterized by an essentially clay surface having a cast finish corresponding to the finish of the casting surface. For the most part, such technique is utilized in the production of cast coatings characterized by an extremely high gloss.

The presence of entrained air bubbles or foam in the aforementioned mineral coating composition at the time it is applied to the casting surface and dried thereagainst has a deleterious effect on the coating in that it cuts down the gloss and adversely affects the printability of the coated web. When viewed through a magnifying glass, the foam spots in the cast coating are seen to be in the nature of cavities or depressions.

The principal cause of foam and air entrainment lies in the practical necessity of recirculating and reusing excess coating composition doctored from the casting surface as an incident of the casting operation. The applicator roll initially applies the coating composition to the casting drum in an excessive amount, whereupon a doctoring means, preferably an air knife, acts to smooth and even the applied coating to the desired uniform thickness, which may be on the order of one mil. Consequently, a substantial quantity of the initially applied coating compositon is removed, and the still highly fluid material collected in an underlying blow-off pan from which it is returned to the supply tank for reuse. Considerable foam is generated during the doctoring operation, particularly where an air knife is employed, and consequently considerable foam and entrained air bubbles are present in the blow-off pan. Unless this foam is broken almost immediately, some of it will be carried through the drain from the blow-off pan and hence recirculated to the applicator roll. Even the initial admixing of the coating composition—which comprises a slurry composed of major proportion of mineral pigment, such as clay, titanium dioxide, calcium carbonate, or mixture thereof, and a minor proportion of a natural or synthetic binder, such as casein or a synthetic resin—produces some degree of air entrainment and foam, and while a fresh batch of coating composition is not nearly as heavily contaminated as recirculated material, it nonetheless may contain sufficient foam bubbles to noticeably affect the cast coating.

Accordingly, a principal object of the instant invention is the provision of apparatus and techniques for use in

conjunction with a casting device to effectively eliminate foam and entrained air from the casting composition during its application, recovery and recirculation.

A further object of the instant invention is the provision of a vibratory blow-off pan positioned to receive fluid casting composition doctored from the casting surface to which it was initially applied, such vibratory blow-off pan acting to rapidly dissipate foam and air bubbles in the recovered composition.

Still a further object of the instant invention is the provision of a recirculating system for the recovered composition which system incorporates means for automatically controlling both the viscosity and the temperature of the composition, it having been found that both the temperature and the viscosity of the composition are major factors in the elimination of foam and entrained air.

Still a further object of the instant invention is the provision of procedures by means of which the viscosity of a mineral coating composition can be carefully controlled, thereby providing the heaviest possible coating up to but just short of the point at which foam would be generated, such heavy coating being highly advantageous in that it provides for maximum opacity and gloss in the coating layer cast against the casting surface.

The foregoing, together with other objects of the instant invention which will appear hereinafter of which will be apparent to the skilled worker in the art upon reading this specification, are accomplished that construction and arrangement of parts and by those procedures of which exemplary embodiment shall now be described.

Reference is now made to the accompanying drawings wherein:

FIGURE 1 is a fragmentary side elevational view of a casting unit incorporating a vibratory blow-off pan in accordance with the instant invention.

FIGURE 2 is a schematic diagram illustrating the circulating system for the casting unit, which system incorporates both the vibratory blow-off pan and means for automatically controlling both the viscosity and temperature of the composition being cast.

Referring first to FIGURE 1 of the drawings which illusrtates an exemplary casting unit of the type to which the instant invention is particularly applicable, a revolving casting drum **1** is supported by a suitable machine frame **2** and, as the drum is rotated in the direction of the arrow A, a layer or film of casting composition is applied to the surface of the drum by means of an applicator **3**, which may conveniently comprise a coating roller **4** rotating in reverse direction to the drum **1** and dipping into a pan **5** containing the composition to be applied to the drum. Immediately following the application of a layer of the composition to the casting drum, excess material is doctored from the casting surface by means of an air knife **6** and the material so removed collected in the blow-off pan **7** which has a conduit **8** for returning the collected material for reuse. The smooth and uniform layer of composition remaining on the casting surface is then dried as the casting drum rotates beneath the dryer **9** through which currents of heated air are circulated to effect thorough and rapid drying of the cast layer.

If the cast layer is to be laminated to a supporting web, a web of backing material **10**, which usually comprises a continuous strip of paper or boxboard, is led into contact with the dried layer, as by passage around the roller **11** and hence juxtaposed to the outer or exposed surface of the cast layer. It will be understood that the backing material **10** will have been previously coated with a thin layer of adhesive which is tempered to a consistency such that, upon juxtaposition of the adhesive coated web to the layer on the drum, the layer will be intimately bonded to the web and yet the adhesive will not strike through the layer to wet or otherwise disrupt the surface thereof in

contact with the casting drum. The backing material is then utilized to strip the layer from the drum, the backing material passing around the roller **12** for this purpose, whereupon the coated web will be conveyed from the coater, as by means of guide roller **13**, the coated web being delivered to a roll winding stand or to a sheeter and stacker, not shown. If the cast layer is in the form of a non-fibrous film which is to be removed as such from the casting surface, it too may be stripped from the drum by passage around the roller **12**.

In the operation of the device just described, a considerable quantity of casting composition is removed by the air knife and this material cascades into the blow-off pan in a continuous stream, thereby generating a considerable quantity of foam. Such foam is generated not only by the cascading casting composition but also by the action of the air knife which, while of relatively low velocity, nonetheless acts to entrain air in the casting composition. Consequently, a considerable head of foam is built up in the blow-off pan which, unless rapidly dissipated, is carried through the conduit **8** and ultimately recirculated to the coating applicator **3**.

In accordance with the instant invention, it has been found that the foam in the blow-off pan can be rapidly dissipated by means of a vibrator **14** secured to the blow-off pan and operative to vibrate at high speed. For this purpose, it has been found that an air actuated vibrator capable of operating at from 2000–5000 vibrations per minute is highly effective. In order to permit free vibration of the blow-off pan, it is preferred to spring mount the pan, as by means of springs **15**. Alternatively, the spring mounting may comprise strips of spring metal suspending the blow-off pan from the machine frame.

It is also preferred to construct the blow-off pan so that it is relatively deep. Normally, a recovery pan of this character would be relatively shallow and provided with a large drain opening so that no appreciable quantity of material is retained in the pan. However, by making the pan narrow and deep, the foam-laden casting composition is held for a longer period of time and the foam is allowed to rise to the top of the pan. With the return conduit at the bottom of the pan, the casting composition is drained from the pan at the point farthest removed from the area of greatest foaming, which is at the surface of the composition in the pan. Preferably, a valve **16** will be interposed in the return conduit **8** so that the rate of flow from the pan may be adjusted to maintain the desired deep pool of material in the pan. Alternatively, return flow may be controlled by an elbow or loop in the return conduit **8**. It also has been found helpful to provide a baffle **7***a* extending upwardly from the blow-off pan **7** to a point immediately beneath the air-knife **6**. As the casting material is removed from the drum it will flow down the baffle in a thin flowing sheet; and since the baffle vibrates with the blow-off pan, the baffle acts to rapidly dissipate foam and air bubbles from the composition flowing thereover.

Referring now to FIGURE 2 of the drawings which schematically illustrates the circulating system for the casting composition, it will be seen that the return conduit **8** acts to return the composition from blow-off pan **7** to the storage tank **17**. If necessary a pump **18** may be interposed in the return conduit. The casting composition is delivered from the storage tank **17** to the applicator **3** by means of conduit **19** and pump **20**; and as an incident of such delivery, the composition is first passed through a heat exchanger **21** and a filter **22**. The purpose of the heat exchanger is to control the temperature of the composition which, while initially cool, nonetheless becomes heated during its recirculation. That is, when the composition is applied to the casting drum it becomes heated due to the fact that the drum itself is either heated internally or has absorbed considerable heat by reason of its passage beneath the drier **9**. In either event, the temperature of the composition in the circulating system will rapidly rise. Since it has been found that the quality of the cast layer and its freedom from foam and entrained air will vary depending upon its viscosity, which in turn is directly affected by the temperature of the composition, it becomes necessary to control both viscosity and temperature.

In accordance with the instant invention, the casting composition is fed through a small enclosed tank **23** containing a viscosity probe **24**, which may comprise a unit of the type wherein the probe acts as a transducer, the probe shearing the liquid being measured and measuring the damping effect or "viscous drag" of the liquid. A controller, which forms a part of the unit, translates the damping action of the liquid on the probe into useful meter readings and will act, as through a circuit **25**, to energize solenoid controlled metering valve **26** which serves to add water or solvent in controlled amounts to the blow-off pan **7** through conduit **27**. It has been found that more effective admixing of the added water or solvent is obtained by introducing it into the blow-off pan rather than into the storage tank. When introduced in the blow-off pan, the water or solvent materially aids defoaming by lowering the viscosity locally in the area where the foaming is the greatest. Alternatively, for some types of casting compositions, such as those which incorporate casein or protein binder, it is preferred to employ the type of viscosity measuring unit wherein density is determined by weighing a measured quantity of the composition.

The temperature of the casting composition is controlled by means of an automatic temperature controller **28** which acts through the circuit **29** and solenoid actuated valve **30** to control the flow of cooling water through heat exchanger **21**. Thus, the temperature of the composition is so controlled that it will be essentially uniform at the time the viscosity of the composition is measured. The viscosity probe **24** and temperature controller **28** thus coact to automatically control the consistency of the composition and will be calibrated accordingly. The setting of the controls will be determined in large measure by the nature of the casting composition and the properties desired in the layer being cast.

For example, where a mineral coating composition composed essentially of pigment and binder is being cast, it has been found that the more viscous the composition the better the gloss and opacity of the cast layer. However, as the viscosity of the composition is increased, its tendency to form and retain foam is also increased. Consequently, it becomes necessary to strike a balance by operating the system at a point just short of the foaming. It has also been found that as the solids content of a given composition is increased, the amount of aqueous fluid in the layer being cast decreases, which, in turn, means less drying of the cast layer and less total excess composition which must be doctored from the casting surface. It will be understood, of course, that neither the viscosity nor the solids content of the casting composition can be increased to a point where the free flow of the composition through the system is impaired, or to a point where the composition becomes difficult to apply to the casting surface and doctored into a smooth and even layer or film. In essence, however, by utilizing the controls of the instant invention, the quality of the casting composition may be materially enhanced by utilizing composition having higher solids content than were heretofore practical and yet the undesirable side effects of higher solids content, particularly foaming and air entrainment, are effectively eliminated.

It also may be pointed out that the application of a casting composition to a metallic casting surface does not permit the extensive use of chemical defoamers. A metallic casting surface does not "wet" well, the applied coating tending to draw up into beads if the surface tension of the composition is improper. Chemical defoamers have an adverse effect on the composition, acting to form

imperfections which are known in the art as "fish-eyes" or "orange-pealings" in the cast layer. Consequently, chemical defoamers cannot be tolerated in quantities sufficient to overcome foam; and the controls of the instant invention must be relied upon to control foaming.

Generally speaking, it has been found that for best results the viscosity of the casting composition should be held between 100 and 300 c.p.s. (centipoise seconds), the viscosities being determined on a Brookfield 20 r.p.m. viscosimeter using a 2 m. spindle. In maintaining the viscosities within the desired range, it is preferred to hold the temperature of the coating composition in the range of 70 to 100° F., with a temperature on the order of 90° F. particularly suited where emulsion binders, such as acrylic polymer resin emulsions or vinyl acetate emulsions, are employed. It has been found that higher temperatures tend to adversely affect the emulsions and hence are to be avoided.

Where the casting composition comprises a mineral coating composition composed of 70–90 parts of clay, calcium carbonate, titanium dioxide or mixtures thereof and the binder comprises 30–10 parts fine particle size vinyl acetate emulsion or an acrylic emulsion, with the pigment and binder dispersed in water to form a slurry containing about 50–65 percent solids, excellent results are achieved by maintaining the composition delivered to the coating unit at a temperature of about 90° F. and at a viscosity of about 104 c.p.s.

Similar considerationis apply where the casting composition comprises a film forming emulsion, such as a polyethylene emulsion, vinylidene chloride copolymer latex, and film forming styrene copolymer latex. All of these emulsions are highly foamable and require careful control during their application to a casting surface.

As should now be evident the recirculating system of the instant invention provides for an essentially automatic casting operation and at the same time permits the use of casting composition having higher solid content in the absence of undesirable foaming and air entrainment which would adversely affect the quality of the layer or film being cast.

Having thus described the invention in certain exemplary embodiments and with the understanding that modification may be made therein without departing from its spirit and purpose, what is desired to be secured and protected by Letters Patent is:

1. A method for removing foam and entrained air bubbles from a slurry of casting composition recovered as an incident of a casting operation, which method comprises continuously collecting the recovered slurry of casting composition in a vessel which is relatively deep as compared to its width, maintaining said vessel essentially filled with said casting composition, subjecting the vessel and the casting composition therein to vibration at a frequency on the order of from 2000 to 5000 vibrations per minute, and continuously withdrawing casting composition from the lowermost portion of said relatively deep vessel.

2. For use in a casting operation wherein a fluid casting composition is applied to a casting surface and the applied coating doctored to a predetermined thickness, a blow-off pan having an upwardly opening mouth for collecting excess casting composition doctored from the casting surface, resilient means mounting said blow-off pan so as to permit essentially free vibration thereof, a vibrator operating at a frequency of from 2000 to 5000 vibrations per minute mounted on said blow-off pan to effect rapid vibration thereof, whereby to dissipate foam and entrained air bubbles from casting composition collected in said blow-off pan, and means for withdrawing coating composition from the bottom of said blow-off pan at a predetermined rate of flow.

3. For use in a casting operation wherein a fluid casting composition is applied to a casting surface and the applied coating doctored to a predetermined thickness, a blow-off pan for collecting excess casting composition doctored from the casting surface, said blow-off pan having an upwardly opening mouth and being relatively deep as compared to its width, means resiliently mounting said blow-off pan so as to permit essentially free vibration thereof, a vibrator secured to said blow-off pan to directly vibrate said pan, whereby to rapidly dissipate foam and entrained air bubbles from casting composition collected in the said blow-off pan, means for withdrawing coating composition from the bottom of said blow-off pan at a predetermined rate of flow.

References Cited by the Examiner

UNITED STATES PATENTS

1,418,273	6/1922	Benjamin	118—429
2,168,972	8/1939	Carver.	
2,485,857	10/1949	Bower.	
2,556,954	6/1951	Zeigler et al.	
2,739,567	3/1956	Jones et al.	118—429
2,996,038	8/1961	Hunicke.	

ALEXANDER H. BRODMERKEL, *Primary Examiner.*

F. S. WHISENHUNT, *Assistant Examiner.*