

UNITED STATES PATENT OFFICE

2,676,118

CASTING SUPPORT AND PROCESS OF
MANUFACTURING SAME

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1

In one process for the manufacture of sheets of thermoplastic film-forming materials such as vinyl resins, the film-forming material in the form of a solution or dispersion is deposited on a supporting surface, dried thereon, heated to fuse the deposited material into a homogeneous film, cooled and stripped off. Ornamental sheets may be formed for instance by printing one or more designs in color on the supporting surface and then applying a complete coating of clear or colored solution. Such a process is disclosed in Patent No. 2,486,258.

An object of my invention is to provide a coated paper suitable for use as the support in the above described and similar processes and for other purposes.

Essential and desirable characteristics of the support are the following:

It should have a surface to which the resin coating will adhere when freshly applied so that, e. g. a colored pattern printed thereon will not slide or "skid" and become distorted and from which the resulting sheet will separate cleanly, it should be flexible and strong and capable of withstanding the tension and heat to which it is subjected in the coating and heating operations, it should not vary materially in length or width when subjected to variations in temperature and tension, it should be resistant to wrinkling and curling and it should be inexpensive and capable of being used repeatedly.

I have found that a highly suitable support having the desirable characteristics described above may be provided in the form of a coated paper web or sheet.

The coated paper in accordance with my invention preferably has a strong and fairly heavy body stock. An example of a suitable paper body stock is one formed of 60 percent of long fiber and 40 percent of short fiber, rosin sized in the beater, the sheet weighing about 95 pounds per ream (500 sheets 25 x 38 inches). Such a sheet has been found to have adequate tear resistance or tensile strength and resistance to curling and creasing. It will be understood, however, that although such a relatively heavy body stock is preferable for use in the process described above the invention is not limited thereto and embraces the use of body stocks of other weights and compositions.

The paper coating which provides the surface upon which the resin film is formed must provide a surface to which the wet resin coating will adhere but from which the dried and fused film will separate cleanly. The paper coating must also be flexible, smooth, strongly adherent to the body stock, sufficiently strong in itself

2

that it will not be pulled apart or pick when the resin coating is stripped off and free of porosity or cracks into which the resin coating may penetrate. I have found that a suitable paper coating is provided by first applying an inexpensive base coating consisting essentially of clay and crude soybean flour. I have used such a soybean flour which is sold under the name "Prosein" as the adhesive in the base coating. In making a coating composition of the soybean flour and clay, the soybean flour is dissolved or liquefied by the use of about 5 percent of caustic soda based on the weight of the flour. The weight of the base coating applied to the body stock may vary within a relatively large range. In this connection it is noted that I prefer to coat both sides of the body stock not only to the end that both sides may be used in the production of the resin film but also because paper coated on both sides has less tendency to curl.

A suitable range for the weight of the base coating is from 2 to 12 pounds dry weight per side per ream, a preferred weight of coating being about 6 pounds per side per ream, it being understood that depending upon the surface character of the paper body stock and the character of the base coating, a sufficient weight of coating must be applied to cover the fibers of the body stock and to give, after calendering, a level surface free of cracks and crevices.

Clay is used as the pigment or filler in the base coating because it is inexpensive and finely divided and gives a strong level coating which is free of imperfections but the clay may be substituted wholly or in part by other finely divided inert pigments such as blanc fixe, talc, satin white, etc.

The soybean flour is used in the base coating because it is inexpensive and gives a smooth and sufficiently strong coating but it may be substituted wholly or in part by other adhesives such as milk casein, soybean protein, glue, starch, etc. bearing in mind that the coating must be sufficiently adherent to the paper body stock and sufficiently strong and flexible to resist the pull involved in stripping the resin film from the paper. In substituting other adhesives for the soybean flour it is to be borne in mind also that soybean flour is only about half active adhesive and half inert material. Thus in substituting the soybean flour by casein one would use only half the quantity of casein.

In using soybean flour the ratio thereof to filler or pigment (clay) may vary within a considerable range, e. g. from 0.5 to 3 parts by weight of clay to 1 part by weight of the soybean flour, a ratio of at least 1 part of clay to 1 part of soy-

bean flour usually being preferred, with a ratio as high as 3 to 1 being very satisfactory in certain cases. In general, the base coating is one having a relatively high adhesive content, i. e. a coating which is strong and strongly adherent to the paper body stock. The base coating must be sufficiently hydrophilic that the aqueous top coating will wet and adhere to it.

The characteristics of the top coating are important. Most important of these characteristics are that the top coating must be sufficiently adherent to the base coating to resist separation when the resin film is stripped off, it must be sufficiently strong in itself to prevent separation or picking, it must be capable of being wetted by and of holding the wet resin coating and it must be impenetrable by and capable of separating cleanly from the dried and baked resin coating. Since the resin coating generally is in the form of a greasy ink the top coating must be receptive thereto.

I have found in producing the top coating that it is necessary to use a pigment or filler such as clay in the coating in order to give the surface sufficient adherence to the wet or fluid resin coating. Finely divided clay is the preferred filler but may be substituted wholly or in part by other finely divided fillers such as blanc fixe.

As the adhesive for the top coating I have found methyl cellulose to be most satisfactory.

A third essential ingredient of the top coating is a humectant such as ethylene glycol, diethylene glycol, glycerine, propylene glycol, sorbitol, urea, urea nitrate, etc. Although it has been determined to be essential to use a humectant in the top coating composition in order to produce a finished surface from which the resin film may be separated satisfactorily it is not known precisely how or why the humectant contributes to this result. It appears that the humectant is essential in the production of a surface having the desired properties but that it may not be essential in the finished coating because it appears that all or substantially all of the humectant may be lost from the top coating when the latter is dried and supercalendered. In the case of glycols only a small residual quantity amounting to no more than a trace may remain in the finished top coating and may or may not affect the surface characteristics of the coating whereas in the case of glycerine all or a very substantial quantity remains in the finished coating and is at least not detrimental. It is my present opinion that the humectant is essential in the production of the desired top coating surface but that it has little or no effect on the properties of the finished coating and may be either present or absent in the final product in actual use. It is my opinion that the humectant in the coating as applied to the paper serves to prevent the paper from curling before calendering and to prevent cracking during calendering and probably also to promote a greater degree of flow of the coating during calendering and consequently the production of a more level and closed-up (impermeable) surface.

The proportions of filler, preferably a fine grade of paper coating clay, methyl cellulose and humectant, preferably diethylene glycol, in the top coating are variable as follows. The weight of clay in the coating composition may vary with respect to the weight of the methyl cellulose from 0.2 to 2 parts by weight of clay to 1 part by weight of the methyl cellulose but I have found that a weight of the methyl cellulose at least equal to the weight of the clay generally is preferred and that

the optimum ratio is about 1 to 1. The amount of humectant in the top coating composition as applied also may vary with respect to the weight of methyl cellulose therein from 0.2 to 1 part by weight of diethylene glycol to 1 part by weight of methyl cellulose. Here again a ratio in the neighborhood of 1 to 1 gives best results. The preferred top coating composition as applied therefore contains equal parts by weight of methyl cellulose, clay and diethylene glycol.

The weight of top coating applied to the paper, disregarding the volatile vehicle (water) but including the humectant, part or all of which may be lost in finishing the coating, may vary from about 3.5 to 10.5 pounds per side per ream. With the composition containing equal parts by weight of clay, methyl cellulose and diethylene glycol, the range is from 3.5 to 7.5 and with a composition containing 2 parts by weight of clay to 1 part by weight of methyl cellulose and 1 part by weight of diethylene glycol the range is 6.5 to 10.5 pounds per side per ream.

In manufacturing the coated paper product a better product can be produced by calendering the paper base stock since this contributes to the production of a final level surface but the improvement obtained by calendering the paper stock is not generally sufficient to warrant the expense involved and is therefore generally omitted.

The base coating and the top coating are both carefully supercalendered in a moist or damp state so as to produce the maximum smoothing and levelling of the final surface.

Summarizing the foregoing, the preferred procedure and materials are as follows:

(a) A paper base stock of about 95 pounds per ream, not supercalendered;

(b) A base coating consisting essentially of 1 part by weight of clay and 1 part by weight of soybean flour applied to the paper at a solids content of about 35 percent and at the rate of about 6 pounds dry weight per side per ream and supercalendered moist; and

(c) A top coating consisting essentially as applied of equal parts by weight of clay, methyl cellulose and diethylene glycol at the rate of about 4 pounds (dry weight) per side per ream and supercalendered moist.

In the preparation of the top coating a suitable procedure is as follows. The methyl cellulose is wetted out with hot water because, although methyl cellulose is not soluble in hot water it is more readily wetted by hot water than by cold water. The resulting mixture of methyl cellulose and hot water is then diluted with cold water containing an anti-foaming agent such as butanol, the total amount of water used being sufficient to give an 8 to 10 percent solution of the methyl cellulose. Clay dispersed in water (65 percent solids) is then stirred into the methyl cellulose solution and finally the diethylene glycol is added and mixed by stirring.

Illustrative specific examples of the base and top coatings are as follows:

Base coats

A.

- 4000 pounds of water at 180° F.
- 900 pounds of soybean flour
- 45 pounds of caustic soda (NaOH)
- 4000 pounds cold water
- 1386 pounds of clay slurry (65 percent solids)
- 5½ pounds tri-butyl phosphate (defoamer)

5
B

960 gallons of water
900 pounds of soybean flour
45 pounds of caustic soda
2700 pounds of clay slurry (65 percent solids)
5½ pounds tri-butyl phosphate

C

960 gallons of water
900 pounds of soybean flour
45 pounds of caustic soda
4100 pounds of clay slurry (65 percent solids)
5½ pounds tri-butyl phosphate

Top coats

A

140 gallons water at 150° F.
150 pounds methyl cellulose
3 gallons butanol
245 gallons cold water
150 pounds diethylene glycol
1 pound tri-butyl phosphate
231 pounds clay slurry (65 percent solids)
½ gallon butanol

B

140 gallons water at 150° F.
150 pounds methyl cellulose
3½ gallons butanol
245 gallons cold water
150 pounds ethylene glycol
1 pound tri-butyl phosphate
116 pounds clay slurry (65 percent solids)

C

140 gallons water at 160° F.
150 pounds methyl cellulose
3½ gallons butanol
245 gallons cold water
130 pounds glycerine
1 pound tri-butyl phosphate
460 pounds clay slurry (65 percent solids)

In making coating compositions of the ingredients listed above, the ingredients may simply be introduced into a container in the order in which they are listed with agitation.

I claim:

1. Process for the production of a casting support for the production of sheets of thermoplastic film-forming materials which comprises applying to a paper body stock a base coating of an aqueous coating composition consisting essentially of from about 1 to about 6 parts by weight of pigment and about 1 part by weight of hydrophilic adhesive, said coating amounting to from about 2 to about 12 pounds of solids per side per ream of body stock, at least partially drying said coating and supercalendering the at least partially dried coating, applying to said base coating a top coating of an aqueous coating composition consisting essentially of from about 0.2 to about 2 parts by weight of pigment, from about 0.2 to about 1 part by weight of organic humectant and about 1 part by weight of methyl cellulose, said top coating amounting to from about 3.5 to about 10.5 pounds of solids including humectant per side per ream, at least partially drying said top coating and supercalendering said at least partially dried top coating.

2. Process as defined in claim 1 in which the adhesive of the base coating is soybean flour and the weight ratio thereof to pigment in said base coating is about 1 part of soybean flour to from about 0.5 to about 3 parts of pigment.

6

3. Process as defined in claim 1 in which the adhesive in the base coating is soya bean flour and the pigment is clay and the weight ratio thereof is about 1 to 1.

4. Process as defined in claim 1 in which the pigment in the base coating is clay and the adhesive is soybean flour and the weight of said coating is about 6 pounds per side per ream.

5. Process as defined in claim 1 in which the weight ratio of the pigment, humectant and methyl cellulose in the top coating is about 1 to 1 to 1.

6. Process as defined in claim 1 in which the weight ratio of pigment, humectant and methyl cellulose in the top coating is about 1 to 1 to 1 and the weight of said coating is about 4 pounds per side per ream.

7. Process as defined in claim 1 in which the paper body stock has a weight of about 95 pounds per ream, the base coating consists essentially of about 1 part by weight of clay and about 1 part by weight of soybean flour and about 6 pounds thereof per side per ream is applied to the body stock, the top coating consists essentially of about 1 part by weight of clay, about 1 part by weight of methyl cellulose and about 1 part by weight of diethylene glycol and about 4 pounds thereof per side per ream is applied to the base coating and both the base coating and the top coating are partially dried and supercalendered in the moist state.

8. A casting support for the production of sheets of film-forming thermoplastic materials comprising a paper body stock, from about 2 to about 12 pounds per side per ream of a supercalendered base coating consisting essentially of from about 1 to about 6 parts by weight of pigment and about 1 part by weight of hydrophilic adhesive and from about 3.5 to about 10.5 pounds per side per ream of a supercalendered top coating comprising from about 0.2 to about 2 parts by weight of pigment, and about 1 part by weight of methyl cellulose, produced by the process defined in claim 1.

9. A casting support as defined in claim 8 in which the adhesive in the base coating is soybean flour and the weight ratio thereof to pigment is about 1 part by weight of the soybean flour to from about 0.5 to about 3 parts by weight of pigment.

10. A casting support as defined in claim 8 in which the adhesive in the base coating is soybean flour, the pigment is clay and the weight ratio thereof is about 1 to 1.

11. A casting support as defined in claim 8 in which the pigment in the base coating is clay, the adhesive is soybean flour and the weight of said coating is about 6 pounds per side per ream.

12. A casting support as defined in claim 8 in which the weight ratio of the pigment and methyl cellulose in the top coating is about 1 to 1.

13. A casting support as defined in claim 8 in which the weight ratio of pigment and methyl cellulose in the top coating is about 1 to 1 and the weight of said coating is about 4 pounds per side per ream.

14. A casting support as defined in claim 8 in which the paper body stock has a weight of about 95 pounds per ream, the base coating consists essentially of about 1 part by weight of clay to 1 part by weight of soybean flour and the weight thereof is about 6 pounds per side per ream,

the top coating comprises about 1 part by weight of clay and about 1 part by weight of methyl cellulose and the weight thereof is about 4 pounds per side per ream.

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5

10

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