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H. E. VAN DERHOEF

2,308,034

FILM FORMING APPARATUS

Filed April 7, 1941

FIG. 1

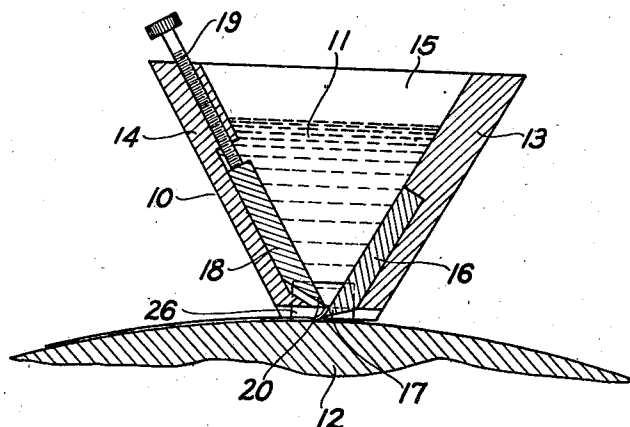


FIG. 2

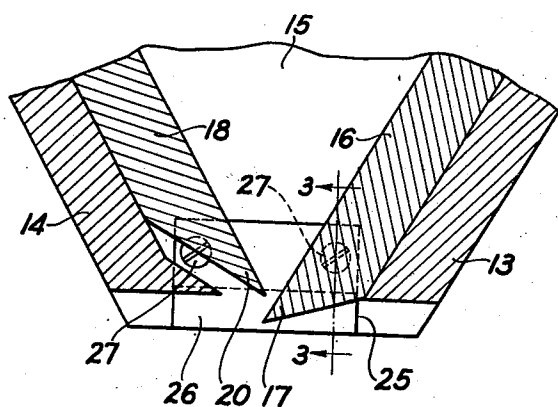
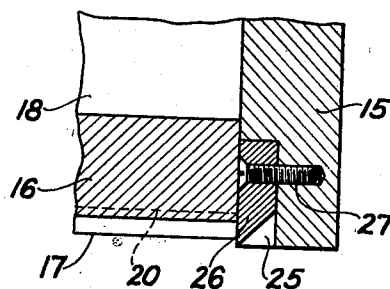


FIG. 3



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FILM FORMING APPARATUS

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7 Claims. (Cl. 18—15)

The present invention relates to hoppers for distributing a film forming solution, such as cellulosic solutions, to form a continuous sheet or film, and more particularly to a new blade arrangement for such hoppers which improves the uniformity of the sheet distributed by the same.

It has been common practice for some time in the art of forming thin sheeting and film base to spread a thin coating of a desired material, generally a solution of cellulosic ester such as cellulose acetate in a suitable solvent, and generally referred to as a dope, onto a heated surface and cause the solvent to evaporate therefrom. The method usually employed consists of feeding the solution, or dope, from an appropriate feeding device onto the polished metallic surface of a slowly rotating wheel or drum. The solvent evaporates from film more or less progressively as the wheel turns. In less than a complete revolution of the wheel sufficient solvent has been removed from the film to permit it to be stripped from the surface of the wheel and conveyed to a wind-up or carried over other rolls or drums for further curing treatment.

The device usually employed for feeding the solution, or dope, to the coating wheel comprises a V-shaped hopper provided with spaced apart blades mounted at an angle to one another forming a discharge slot at the apex of the V. Usually one or both of these blades is adjustable with respect to the other so as to provide a means for controlling the thickness of the dope stream and, therefore, the sheeting formed. It has previously been found that serious difficulties often arise from the tendency of the cellulose ester solution to form slugs, or encrustations, on the edges of the blades, which tend to give rise to uneven coating and the formation of streaks in the finished product which render it unfit for use. Many elaborate precautions have been undertaken, and arrangements have been provided, to overcome this slugging on the ends of the discharge blades to overcome the disadvantage set out above.

In the past there has always been a great deal of difficulty created in the edges of the wet dope flowing onto the casting surface due to slugs which tend to form on the bottom edges of the end walls of the hopper at the blade ends. The slugs so formed change the thickness of the edges of the stream of dope, and also at times create a hooked condition at the edge of the sheet which, when partially cured and while being stripped from the surface of the casting wheel, provide a starting point for tears. While

the previously suggested means for preventing slugging in the discharge slots in hoppers of this type have been employed they have proven ineffective in preventing slugging at the bottom of the end walls of the hopper probably because the construction of hoppers previously used have been very susceptible to slugging at this point.

Therefore, the primary object of the present invention is to improve the discharge slot of V-shaped hoppers to insure a discharge of a film of dope therefrom which has smooth edges of a uniform thickness. Another object is to improve the bottom ends of the end walls of the hopper to prevent the formation of slugs at the ends of the discharge slot. A further object is to modify the hopper blade arrangement in such a way that the change can be readily made on existing hoppers with no trouble at all. Yet another object is to bevel the bottom edges of the end walls of the hopper in the vicinity of the discharge slot so as to provide a line contact between the edges of the stream passing through said slot and the bottom of said end walls which form the ends of the discharge slot. And still another object is to provide the end walls of existing hoppers with a recess in the vicinity of the discharge end of the blades, and fix an end plate in each of said recesses in abutment with the ends of said blades, the lower end of said end plate being beveled away from the face thereof directed toward the discharge slot to provide a line contact between the lower end of the plate and the edge of the stream of dope passing over the same.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its methods of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments when read in connection with the accompanying drawing in which:

Fig. 1 is a sectional view of a complete hopper embodying the present invention, and showing it associated with a surface of a wheel onto which the film dope is adapted to be distributed thereby,

Fig. 2 is an enlarged sectional view of just the discharge end of the hopper,

Fig. 3 is a sectional view taken substantially on line 3—3 of Fig. 2.

Like reference characters refer to corresponding parts throughout the drawing.

Referring to the drawing, the numeral 10 designates a V-shaped hopper broadly of well-

known construction adapted to contain and feed a cellulosic solution or dope 11 which, for example, may be a solution of cellulose nitrate or acetate in a suitable solvent, such as acetone or other liquid, to the surface of the casting wheel or drum 12. This feeding device may hereinafter be conveniently referred to as a "dope hopper," the cellulosic solution as "dope," and the wheel or drum as the "coating wheel," since these terms are customarily employed in the art. The hopper may be adjustably mounted, or suspended, over the wheel by means, not shown, in such a manner that it may be lowered to, or raised from, the coating surface as occasion may require.

The hopper 10 as shown comprises a V-shaped trough including two inclined side walls 13 and 14 joined at their ends by end walls 15. The discharge blade 16 may be set into a recess in the lower end of the side wall 13 so that its beveled discharge end 17 extends through an opening in the bottom of the trough. Cooperating with a blade 16 is a blade 18 extending into a recess in the other side wall 14 and provided with a plurality of adjusting screws 19 by which the discharge end 20 may be moved toward or away from the blade 15 for regulating the thickness of the stream of dope which flows from the hopper onto the coating surface 12. The discharge ends of the blades are beveled, as shown, to provide a line contact between the edges of the blades and the stream of dope flowing thereover without wetting an area greater than that of the very edge of the blade for the purpose of reducing the tendency of the dope to form slugs on the ends of the blades. The blades 16 and 18 are of such width that they abut the inside faces of the end walls 15 of the hopper. The ends of the blades and the inside surface of the end walls of the hopper are machined to form a substantially liquid-tight joint, and it will be appreciated that the end walls of the hopper form the ends of the discharge slot and are contacted by the edges of the dope stream passing through the discharge slot.

Hoppers constructed as set forth above are well known in the art and no feature thereof set forth up to this point constitutes any part of the present invention except insofar as they cooperate with the improvements hereinafter fully set forth and constituting the present invention. In hoppers of the prior art the end walls have been substantially thick, e. g., 1/2-inch, and have terminated at their lower ends in a square edge. Inasmuch as the lower ends of the end walls of the hopper define the ends of the discharge slots, and the edges of the dope stream pass thereover and from the lower edge thereof, these end walls in effect constitute discharge blades for the edges of the dope stream. I have found that due to the fact that the lower ends of the end walls were square and of substantial thickness, the dope flowing off the right angle edge tends to flow along the horizontal thickness of the bottom edges of the end walls rather than flowing cleanly off of the edge. This dope flowing along the horizontal thickness of the bottom edges of the end walls forms slugs, or encrustations, which create a change in thickness of the edges of the dope stream, and also at times create a hooked condition on the edges of the stream which when dry, and while being stripped from the coating surface, provide a starting point for tears. The square edge on the discharge ends of the end walls is so susceptible to slugging that the elabo-

rate precautions heretofore provided for eliminating slugging on the ends of the discharge blades, such as encasing the area of the blades in a solvent vapor, treating the discharge ends of the blades with solvent, etc., has failed to overcome slugging at this point.

To overcome this deficiency in dope hoppers of the type set forth, and to eliminate a great amount of waste in sheet material caused by this condition, I have provided the simple improvement outlined below. This improvement, while simple in nature, overcomes a deficiency which has been inherent for many years in dope hoppers of the type set forth, and which deficiency has caused a great amount of waste in the sheet material formed by such a hopper.

I have found that if the bottom edge of the end walls of the hopper is beveled away from the face thereof constituting the ends of the discharge slots to provide a substantially sharp edge at the end of the discharge slot for the dope to flow off of, that the above slugging difficulty at the ends of the discharge slot can be eliminated or effectively reduced. This will eliminate the square horizontal edge at the bottom of the end walls of the hopper over which the edges of the dope stream tended to flow in a horizontal direction. It will be readily understood that the bottom of the end walls of the hopper need only be beveled at that portion adapted to form the end of the discharge slot, or that portion adapted to be abutted by the discharge ends of the hopper blades 13 and 14. However, in the fabrication of a new hopper it would probably be just as easy to bevel the entire length of the bottom edge of the end walls of the hopper as it would to bevel only a limited length in the center of the same.

For the purpose of illustrating the present invention I have shown the improvement constituting the present invention made in an existing hopper just to show how easy it can be incorporated in such a hopper. That area of the lower end of each end wall 15 of the hopper which is to be abutted by the discharge ends 17 and 20 of the blades 16 and 18, respectively, is provided with a recess 25. Into each of these recesses there is fitted on end plate 26, the lower end of which is beveled as shown in Fig. 3. These end plates are of such size as to completely fill the recess in the end wall as to all dimensions, and is fixed in said recess by a screw 27. The longer straight face of the end plates, therefore, form, in effect, discharge blades for the edge of the dope stream, the discharge end of which is sharp and prevents the slugging caused by dope flowing horizontally over the square ends of the end walls of the hopper as was previously the case. It will be obvious that the size of the end plates 26 will depend upon the amount of adjustment which the blades are capable of, because the discharge end of the blades must at all times abut the face of the end plates.

As clearly shown in the drawing, the bottom of the end walls 15 of the hopper and the lower end of the end plates should extend slightly below the discharge ends of the blades 16 and 18. The bottom of the end walls should extend below the discharge ends of the blades so that if for any reason the hopper is accidentally lowered too close to the casting surface 12, the bottoms of the end walls will hit this surface first and prevent the blades from contacting the surface clear across the same. The discharge ends of the end plates should extend below the discharge ends

of the blades to prevent the edges of the stream of dope from squirting out sideways upon leaving the discharge slot, and for the purpose of maintaining a uniform edge on the stream of dope during passage of the same from the discharge ends of the blades to the coating surface.

While I have shown my improvement in dope hoppers applied to a hopper having discharge blades separate from the side walls of the hopper, it will be readily understood that the idea of beveling the bottom edge of the end walls of the hopper, as shown, and for the purpose set forth, could be used in a hopper in which the side walls of the hoppers themselves constituted a discharge slot of a given width.

The operation and purpose of the improvement constituting the present invention will be obvious by reference to the drawing and the foregoing description of the same. Although this improvement appears to be very simple, and more or less obvious after once being pointed out, the fact that it solves a problem which has confronted those in the coating art using dope hoppers of the type set forth for many years cannot be ignored. The fact that this improvement can be readily adapted to existing dope hoppers with very little trouble and expense widens the range of its usefulness so that it can be applied to any dope hopper of the type set forth which is now in use.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not be restricted except insofar as is necessitated by the spirit of the appended claims.

Having thus described my invention, what I claim is new and desire to secure by Letters Patent of the United States is:

1. A hopper for feeding a flowable cellulosic solution to a moving sheet forming element adjacent thereto, comprising two side walls inclined toward one another, the lower ends of said side walls spaced apart at their lower ends to provide a discharge slot of a given width, two end walls abutting opposite ends of said side walls and extending to the discharge ends of the same to define the length of the discharge slot, the outer side of each lower edge of said end walls being bevelled to provide a knife edge for contact with the edges of the stream where the latter flows out of the slot, the lower edge of each of said end walls beveled substantially to a point to provide a line contact between the discharge ends of the end walls and the edges of the stream of solution passing through the discharge slot.

2. A hopper for feeding a flowable cellulosic solution to a moving sheet forming element adjacent thereto, comprising two side walls, an end wall in abutment with each end of said side walls and forming a liquid tight enclosure therewith open at the bottom, a discharge blade adjustably mounted on each of said side walls, said blades inclined relative to one another so that the vertex of the angle formed thereby will be in alignment with the opening in the bottom of said enclosure, means for adjusting said blades relative to one another to provide a discharge slot of a desired width between the adjacent ends thereof, end plates fixed to said end walls in abutment with the opposite ends of said discharge blades, each of said end plates having a plane surface abutting and encompassing the opposite ends of the discharge ends of said blades to define the length of said discharge slot, the

outer side of each lower edge of said end plates being beveled to provide a knife edge without destroying said plane surface for the purpose of providing a substantial line contact between the discharge ends of said end plates and the edges of the stream of solution passing through the discharge slot.

3. A hopper for feeding a flowable cellulosic solution to a moving sheet forming element adjacent thereto, comprising two side walls, an end wall of substantial thickness in abutment with each end of said side walls and forming a liquid tight enclosure therewith open at the bottom, a discharge blade adjustable on each of said side walls and abutting said end walls, said blades inclined to one another so that the vertex of the angle formed thereby is in alignment with the opening in the bottom of said enclosure, means for adjusting said blades relative to one another to provide a discharge slot of a desired width between the adjacent ends thereof, the length of which slot is determined by said end walls, the outer side of each lower edge of said end walls being beveled to provide a knife edge for contact with the edges of the stream of solution passing through the discharge slot for the purpose of preventing slugging of the solution at these points.

4. A hopper for feeding a flowable cellulosic solution to a moving sheet forming element adjacent thereto, comprising two side walls, an end wall of substantial thickness in abutment with each end of said side walls and forming a liquid tight enclosure therewith open at the bottom, a discharge blade adjustable on each of said side walls and abutting said end walls, said blades inclined to one another so that the vertex of the angle formed thereby is in alignment with the opening in the bottom of said enclosure, means for adjusting said blades relative to one another to provide a discharge slot of a desired width between the adjacent ends thereof, the length of which slot is determined by said end walls, the outer side of the bottom edge of that portion of the end walls abutting the discharge ends of said blades being beveled rearwardly from the face of said walls constituting the end of the discharge slot to provide a knife edge for contact with the edges of the stream of solution passing through the discharge slot for the purpose of preventing slugging of the solution at this point.

5. A hopper for feeding a flowable cellulosic solution to a moving sheet forming element adjacent thereto, comprising two side walls, an end wall of substantial thickness in abutment with each end of said side walls and forming a liquid tight enclosure therewith open at the bottom, a discharge blade adjustable on each of said side walls and abutting said end walls, said blades inclined to one another so that the vertex of the angle formed thereby is in alignment with the opening in the bottom of said enclosure, means for adjusting said blades relative to one another to provide a discharge slot of a desired width between the adjacent ends thereof, the length of which slot is determined by said end walls, that portion of the end walls encompassing the discharge ends of said blades provided with a recess, an end plate fixed to each end wall in said recess therein, each of said end plates having a straight face abutting the ends of the discharge ends of said blades forming ends for said discharge slot, the outer side of each lower edge of said end plates being beveled to provide a knife edge for

the purpose of preventing slugging of the solution at these points.

6. A hopper of the type described comprising a V-shaped trough including inclined side walls and vertical end walls, the lower ends of said side walls spaced apart to provide an elongated opening, a pair of discharge blades mounted on each of said side walls at an angle to one another and having their opposite ends in abutment with said end walls, means for adjusting said blades with respect to one another to provide a variable width discharge slot the length of said trough, the outer side of each bottom edge of said end walls engaging the discharge ends of said blades being beveled to provide a knife edge from which the edges of a stream of dope may flow without forming slugs.

7. A hopper of the type described comprising a V-shaped trough including inclined side walls and vertical end walls, the lower ends of said side walls spaced apart to provide an elongated

opening, a pair of discharge blades mounted on each of said side walls at an angle to one another and having their opposite ends in abutment with said end walls, means for adjusting said blades with respect to one another to provide a variable width discharge slot the length of said trough, the bottom edge of the lower portion of each end wall abutted by the discharge ends of said blades extending slightly below the ends of said blades and recessed, an end plate fitted into each of said recesses and having one face in abutment with the each of said discharge blades whereby these plates constitute discharge blades for the edges of a stream of dope flowing from the hopper, the outer side of each lower edge of each of said end plates extending slightly below the ends of said discharge blades being beveled to provide a knife edge from which the edges of a dope stream may pass without slugging.

HENRY E. VAN DERHOEF.

CERTIFICATE OF CORRECTION.

Patent No. 2,308,034.

January 12, 1943.

HENRY E. VAN DERHOEF.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 52, claim 1, beginning with the words "the lower edge" strike out all to and including "slot" in line 56, same claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 9th day of March, A. D. 1943.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.