APPARATUS FOR MAKING PICTORIAL PARALLAX PANORAMAGRAM UNITS

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ABSTRACT

Apparatus for making pictorial parallax panoramogram units wherein a coating roll, a pressure roll and a forming roll are mounted in parallel relationship to form a pair of spaced-apart nips, the first such nip being formed between the coating roll and the pressure roll and the second such nip being formed between the pressure roll and the forming roll. The coating roll is heated and a metering means cooperates therewith to form a predetermined thickness of plastic material which is fed to the first nip. A backing sheet is fed by suitable means through the first and second nips, and at the first nip, the metered layer of plastic is applied to the backing sheet. The forming roll is chilled so that as the backing sheet with the plastic thereon passes through the second nip, the plastic material is set to conform to the configuration of the surface of the forming roll.

3 Claims. 8 Drawing Figures
APPARATUS FOR MAKING PICTORIAL PARALLAX PANORAMAGRAM UNITS

This application is a division of our copending application, Ser. No. 202,930, filed May 14, 1962, and is entitled to the priority date thereof.

This invention relates broadly to optical display units, and is particularly concerned with the provision of optical display units incorporating lenticular screens. Such display units are generically known in the art as "parallax panorama gram units."

SPECIFIC METHOD OBJECTIVES

To provide practical and commercial methods of producing the products according to the preferred embodiments, a method is used which provides for applying a coating directly to an image-carrying layer, and then embossing the coating to form the same into a lenticular optical screen. The coating is applied as a fluid flowable viscous material which is subsequently set to afford permanency in form and flexibility in use without affecting the characteristics of the image-carrying layer. The coating is free of any plasticizer so as to eliminate allergy or bleeding problems or the like when applied to the base layer. The method includes steps affording application of the coating in a controlled thickness to ensure uniformity in the ultimate screen, and the utilization of a minimum of material. The plastic material is applied in time sequence with the movement of the image-carrying base.

It is to be understood that the invention of this application lies in the provision of apparatus adapted to carry out such method so as to produce the desired products. Thus, with respect to the preferred embodiment of the apparatus, specific objects of the invention include the following: (a) the provision of an automatic apparatus adapted to perform the methods and processes hereinabove; (b) the provision of such an apparatus which includes means for automatically timing a sequential processing operation in accordance with the method of the preferred embodiment herein; (c) the provision of such an apparatus which is applicable to the formation of lenticular screen pictorial parallax panoramagram units, as well as to general coating techniques; (d) the provision of such an apparatus wherein the base layer being coated is passed about rollers for purposes of having the coating applied thereto; (e) the provision of such an apparatus which incorporates a grooved embossing roller for purposes of forming the applied coating into a lenticular screen; (f) the provision of such an apparatus which includes a reservoir for holding and heating plastic to be applied to the base layer, and means for opening and closing the reservoir in timed relation to the movement of a base layer traveling thereunder; (g) the provision of such a basic apparatus which permits adjustment in the thickness of the coating being applied; (h) the provision of such an apparatus which includes means cooperating with the roller means thereof to ensure uniformity in coating, as well as uniformity in formation of the coating into a lenticular screen; (i) the provision of such an apparatus which can be operated over extended periods of time for commercial production, and without shutdown.

In accordance with the basic aspects hereinabove, a pictorial parallax panoramagram unit comprises a flexible optical display. The display includes a lenticular image layer and a lenticular screen having a base face and a lenticulated forward face. The image layer is fixed in direct contact with the base face of the screen, and in alignment with the lenticles defined by the forward face thereof. Preferably, the focal point of the lenticles of the screen lie at least substantially in the plane of the image layer which affords the best optical clarity with a planar rear face adjacent the image layer. The screen has a maximum thickness of between 0.005 and 0.025 inches.

In accordance with the preferred embodiment hereinabove, the unit is manufactured by applying a flowable coating of the plastic, preferably a polymer of an ethenically unsaturated hydrocarbon, in a viscous state onto a lined image layer preferably in sheet form, and thereafter embossing the coating into the form of lenticles properly aligned with the lineations on the image layer. The plastic is preferably such that it has a melt temperature of between 275° and 350° F., and a coating viscosity of between 10 and 200 poises. Moreover, the chill temperature of such plastic is such that it permits the application of the plastic and subsequent forming operations at about the same time allowing for setting as the plastic is engaged by a forming embossing-type roller. Preferably, the embossing roller is chilled to properly set the plastic, but after setting the plastic, maintains its flexible characteristics, and affords a screen having a flexibility of between 0.1 and 2.0 × 10⁶ p.s.i.

The apparatus for producing a unit in accordance with the aforesaid preferred embodiment includes a series of rollers adapted to carry out the method steps, as well as a controllable reservoir for depositing the plastic on the image layer as the image layer passes thereunder. Preferably, the apparatus also includes sequentially operated gripping means and a vacuum type pickup feed. Additionally, the preferred form of apparatus includes gear-operated timing means to insure proper sequential operation.

The above basic aspects of the preferred embodiment hereinabove and preferred modification hereinabove, as well as other important features of the invention, will be better comprehended, and the invention as a whole will be better understood, when consideration is given to the following detailed description thereof. Such description refers to the annexed drawings, presenting preferred and illustrative embodiments of the invention. In the drawings:

FIG. 1 is a fragmental enlarged perspective view of a pictorial parallax panoramagram unit constructed in accordance with the preferred embodiment hereof;

FIG. 2 is a side schematic view of a preferred processing assembly utilized to produce the type of products with which the invention is primarily concerned;

FIG. 3 is a schematic side view presenting structural aspects of the devices hereof to be used with the assembly of FIG. 2;

FIG. 4 is a perspective view of a preferred form of plastic discharge coating means incorporated in the system of FIG. 3; and

FIG. 5 is a transverse sectional view of the coating means shown in FIG. 4.

If reference is not made to FIG. 1, it will be seen that such FIGURE presents a pictorial parallax panoramagram unit or optical display generally designated by the numeral 2. Such unit or display comprises a lined image layer 4 and a lenticular screen 6 fixed directly thereover. The lenticular screen 6 has a base face 8 and a lenticulated forward face 10. The image layer 4 is fixed in direct contact with the base face 8 of the screen 6, free of any adhesive interposed between the screen 6 and image layer 4. The lenticular screen 6, or more particularly, the lenticulated face 10 thereof, comprises a series of semicylindrical or partially cylindrical curves forming the forward face of elongated lens elements generally designated by numeral 12. Each of the lens elements, as shown, comprises a simple lens of the type having a circularly curved, forward face, and a planar rear face. The focal point of the lenses 12 of the screen lies at least substantially in the plane of the base thereof, or in the plane of the image carried by the image layer 4.

The image layer is applied to a base sheet 30 (FIG. 2) and the lenticular screen is formed thereover in accordance with the preferred embodiments hereof. As shown in FIG. 2, a pair of feed rollers 40 are suitably positioned to feed the base sheet to and past the stations where the subsequent operations will be performed. The first operation is that of depositing, on the base sheet 30 a coating. For this purpose, disposed at the first operation station is an extruder 42 which feeds a depositing trough 44 having a movable wall 46. Disposed directly under and in vertical alignment with the outlet 48 of the trough 44 is a coating cylinder 50. This coating cylinder merely comprises a roller having a smooth surface, and carrying means for
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3. gripping thereon the base sheet 30. Disposed laterally, and supported for rotation on an axis disposed vertically above, the coating cylinder, is an ironing cylinder 52. This ironing cylinder preferably has a smooth chrome-plated circular surface 54. The ironing cylinder 52 is so positioned that it forms with the coating cylinder 50 a nib passageway 56.

According to the invention, the sheet 30 is fed between the feed rollers 40 and under the depositing trough 44. As the sheet passes under the depositing trough 44, a plastic coating 60 is deposited thereon. For this purpose, the movable side 46 of the trough 44 is raised to open the outlet 45, and allow the plastic material to flow under gravitational action from the trough and onto the surface of the sheet 30. The printed top surface 34 of sheet 30 faces the trough so that such surface which substantially forms the plastic composition.

The trough 44, quite naturally, is provided with suitable means to raise or maintain the temperature therein so that the plastic to be released has the proper viscosity.

Such viscosity permits the ready disposition of the plastic material on the upper face 34 of the sheet 30 as the sheet 30 is engaged by or gripped by the coating cylinder 50, and supports a substrate during its movement through the trough 44. The rear wall 47 of trough 44 is stationary and provided with a lower tip opening 49 which is disposed a distance ft above the face 34 of the sheet 30. This distance corresponds to the thickness of the film as applied, and varies between 0.004 and 0.0245 inches depending on the ultimate screen thickness desired. The tip 49 may be regarded as an initial smoothing tip, because the coating is subsequently ironed by the ironing cylinder.

As the sheet 30 passes under the trough 44, the same is moved continually by the coating cylinder 50 past the nib passageway 56. In this passageway, the coating, as applied to the face 34 of sheet 30, is smoothed so as to be regular and uniform throughout the entire area thereof. The spacing between the ironing cylinder and the coating cylinder is equal to substantially the thickness of the ultimate product, or alternately, the distance between the ironing cylinder on the face 34 of the sheet 30 is equal to dr. Thus, during the initial operations of depositing a coating of predetermined thickness onto the forward face of the base sheet 30, and ironing such surface whereby it is uniform throughout its area, there is existent a coated base sheet. The coating is planar on both faces, i.e., the facing face 34 of sheet 30 and the forward face of the coating which is spaced therefrom. During this stage of the process, the coating is still sufficiently viscous to permit subsequent formation thereof, and at the same time, the viscosity thereof is sufficient to maintain the coating sufficiently stable to permit passage of the coated unit to a subsequent operation immediately below. It will be understood that these conditions are realized by having the proper melt temperature, viscosity, and set temperature relationships established. In other words, the plastic composition, aside from its optical characteristics, need have a melt temperature above ambient temperature, and a setting temperature substantially no greater than ambient temperature, and preferably slightly less than ambient temperature, and a viscosity between such temperatures which permits the ready disposition thereof as a coating, and a smoothing thereof, as well as the formation thereof.

The semifinished unit comprising the base sheet 30, and the coating 60 applied thereon, has been supported during previous operations with the base sheet 30 adjacent the coating cylinder 50. However, as such semifinished unit is moved to a position within the nib passageway 56 between the coating cylinder 50 and the embossing cylinder 70, it is pressed thereagainst in the nib passageway 80. Due to the viscosity and tackiness of the plastic, and the relative movement between the coating cylinder 50 and the embossing cylinder 70. The semifinished unit is transferred from the coating cylinder to the embossing cylinder with the coating 60 in engagement with the periphery of the embossing cylinder.

The embossing cylinder carries the groove 72 on the periphery thereof, and by virtue of the pressure exerted between the coating cylinder 50 and the embossing cylinder 70, in the nib passageway 80, the coating 60 is formed into a plurality of ribs—in the grooves 72 serving to shape the coating into such form.

In order to achieve the desired end result the coating 60 has a thickness prior to reaching the embossing cylinder of slightly less than the maximum thickness of the finished lenticular screen formed on the base sheet 30. This differential in thickness is comparatively small, as will be appreciated by reference to the ranges set forth above, but this differential in thickness allows for compression of the plastic coating into the paper as element 39 described above. Specifically, due to the formation into the lenticular structure, while the coating becomes thicker, the volume is redistributed. Thus, the initial coating is applied so as to have a volume corresponding substantially to the ultimate volume of the lenticular screen after formation into lenticular elements by the embossing cylinder.

For purposes of carrying out the method described above in connection with FIG. 2, certain preferred apparatus embodiments hereof are incorporated in the assembly for selectively applying the coating to the base layer 30. This phase of the invention is presented in FIGS. 3-5, inclusive. In FIG. 3, as in FIG. 2, the numeral 50 designates the coating roller, the numeral 52 designates the ironing cylinder, and the numeral 74 designates the embossing cylinder.

The trough 540 utilized for purposes of depositing a flowable viscous plastic in the manner prescribed in connection with FIG. 2, preferably is constructed as shown in detail in FIG. 5. In this figure, the numeral 47 designates the rear wall of the trough, and the numeral 46 designates the forward wall thereof. The wall 46, is fixed in relation to the wall 47 whereby the base ends of the walls define therebetween the lower edge of the trough, an opening 49 of predetermined width, preferably of the order of 40 thousandths of an inch. In order to close the opening 49, the wall 46 is not movable as prescribed in connection with FIG. 2, and instead, an auxiliary movable wall 500 is incorporated. The wall 500 has a lower knife edge portion 502 which is adapted to move in abutting and contacting relation with the lower end 504 (corresponding to edge 49, FIG. 2) of the rear wall 47 and in contacting relation to the lower edge 506 of the fixed forward wall 46. Lower end 504 of wall 47 is disposed vertically below edge 506 of wall 47 thereby forming an inclined outlet passage.

The wall 500, as shown in FIG. 4, is slidable within inclined recesses such as 510 formed in the end walls 512 of the trough frame whereby the wall 500 is mounted for reciprocating movement along an inclined axis extending parallel to the plane thereof, and the incline of the outlet passage 49. In this manner, the wall 500 can be raised or moved upwardly in the direction of the arrow 516, thereby moving the lower or tip end 502 of the wall 500 to a position where the trailing edge thereof is approaching the opening 49, then the wall 500 is lowered to its original position in blocking relation to the opening 49, thereby stopping the flow of plastic from the trough 540.

The plastic within the trough may possess properties whereby when the trough is heated, the same is flowable under gravitational force onto the face of the base layer 30. However, in certain instances, due to the properties of the plastic, it may be desirable to force the same under pressure through the opening 49, and in this instance, pressure can be applied within the inlet tube 252 of trough 540 to force plastic therein into the trough and out through the opening 49 at the base thereof. As conventional, and as suggested above, the deposit...
ing trough should be heated to maintain the plastic in a molten and sufficiently flowable state for the depositing of the plastic in either manner described above.

It had been found that the provision of the movable auxiliary wall 500 yields certain advantages. In particular, if the wall 46 is movable as suggested in connection with FIG. 2, then the force required to cause movement thereof is dependent upon the adhesive force exerted by the plastic within the trough thereon. The movable wall 500 is not subjected to the total adhesive-type force of the plastic, but instead, is only subjected to the force thereof in a limited area adjacent the opening 49. Thus, with the auxiliary wall, less force is required for movement thereof and substantially simpler means can be incorporated for selectively causing the necessary adjustment in position of the wall. Moreover, with the arrangement of FIGS. 3–5, opening and closing of the trough can be more closely controlled both from the time standpoint and the material depositing standpoint, i.e., closing can be obtained instantaneously to prevent excess plastic deposit on a base layer.

Various types of systems can be utilized to automatically achieve the selective movement of the wall 500 with passage of base layers under trough 540. Any such means, however, must operate in times sequence with movement of the base layer 30 relative to the outlet of the trough 540. This times relation can be obtained from movement of any of the rollers incorporated in the coating and embossing system, or from the particular feed arrangement utilized to sequentially move sheets into processing position on the coating roller 50. For purposes of illustration, in FIG. 3, the shaft 530 of coating cylinder 50 is shown as carrying a sliding plate adjustable cam arrangement 532. Such cam arrangement is conventional and includes a pair of juxtaposed plates having projecting cam portions 534 and 536. The plates are rotatably slidable relative to one another about the shaft 530 whereby the length of the cam surface formed by the respective cam projections 534 and 536, can be adjusted as desired.

For the purposes of understanding the operation of the system of FIG. 3, assume that the cam arrangement 532 is adjusted with the projections in the relative positions shown in such Figure. Further, assume that an electromechanical control arrangement is operatively associated with the cams to cause selective movement of the wall 500.

In the illustration of FIG. 3, the electromechanical control arrangement includes a microswitch 538 electrically connected with a solenoid 541. The solenoid is disposed to operate a linkage 542 pivotal about a fixed pivot shaft 544. The right end of the linkage 542 is pivotally connected to the movable wall 500 by means of a conventional pivot connection 50. The left end of the linkage 542, as shown, is in engaging contact with an operating plunger 546 of the solenoid 541.

The microswitch 538 merely serves as a switching means to connect the coil of the solenoid 541 with a source of power through the line 550. Solenoid 544 is of conventional design having the plunger element 546 downwardly extendable upon energization of the solenoid coil, whereby to exert a downward force on the left end of the linkage 542 as shown.

Thus, when the microswitch 538 is operated by the cam assembly 532, the solenoid 541 is energized and the linkage 542 is pivoted counterclockwise about the pivot shaft 544. This results in raising the movable wall 500 and opening the passageway 49 through the base of the trough means 540.

In order to provide for automatic return of the wall 500 to its initial closing position, a spring means such as designated by the numeral 552, is fixed at one of its ends to the wall 500 and the other of its ends to the fixed end wall of the trough adjacent thereto. Preferably, two such springs 552 are provided so as to bias the movable wall 500 and eliminate binding of the wall in the recesses 510 mounting the same for sliding movement. Return spring arrangements of this general type are conventional and the details as to the connection thereof between the end wall and the movable wall can be made in any suitable manner.

It will be noted from the above that the time of opening of the trough 540 is controlled by the length of the coating face formed by the cam projections 534 and 536. Since this length can be adjusted by virtue of the tip of cam assembly incorporated, and since the cam assembly itself can be set in proper timed sequence with movement of the base sheets 30 over the coating roller 50, the opening and closing of the trough 540 can be controlled so as to start disposition of the plastic immediately inward of the leading edge of the base sheet 30 and so as to stop the disposition of the plastic immediately inward of the trailing edge thereof or immediately after the trailing edge of the most rearward image section on the base sheet 30.

Bearing in mind the manner in which automatic timed sequential plastic depositing can be achieved with the apparatus provided, there is but one additional consideration of particular importance, and this relates to the control of the coating thickness. By reference to FIG. 5, it will be noted that the movable wall 500 can be moved to positions where the openings of the trough is as great as the width of the passageway 49, or only as great as some portion thereof. In other words, the opening at the base of the trough 540 can be controlled by selective movement of the wall 500. In turn, since the wall 500 is movable under the action of the linkage 542, limiting the degree of pivoting of the linkage about the shaft 544, serves to control the extent of upward movement of the wall 500. Thus, preferably, a stop means such as generally designated by the numeral 560 in FIG. 3 is incorporated. Such stop means incorporates a fixed support 562 and an adjustable abutment screw 564 threadably engaged within the support 562. The tip 566 of the screw 564 limits downward movement of the left end of the linkage 542 as shown, and thus moving the screw to a position where the tip 566 is closer to the linkage 542, as shown, serves to decrease the opening of the trough 40, whereas adjusting the screw where the tip 566 is moved further from the left end of the linkage 542, permits wider opening of the trough 540. It will be understood that while the abutment mean 560 has been shown as cooperating with the left end of the linkage, the same could cooperate with an abutment carried by the wall 500, or with the right end of the linkage 542 as shown. Moreover, an adjustment means on the solenoid controlling the movement of the plunger therein would serve the same purpose. The important point to understand is that some means is provided for selectively adjusting the movement of the wall 500 so as to in turn permit adjustment of the degree of opening of the trough 540.

CONCLUSION

After reading the foregoing detailed description of the illustrative and preferred embodiments of the instant invention, it should be apparent that the objects of this specification have been successfully achieved.

Accordingly, what is claimed is:

1. An apparatus for making a composite laminate of flexible lenticular screen and backing sheet, said apparatus comprising a heated coating roll, actuable means for metering a uniform layer of predetermined thickness of a melted plastic in advance of said coating roll, a pressure roll disposed in spaced parallel relationship to said coating roll to form a first nip spaced a finite distance from the location where said metering means deposits said uniform layer onto said coating roll, a chilled forming roll disposed in spaced parallel relationship to said pressure roll to form a second nip spaced a finite distance from said first nip, the surface of said forming roll providing an embossing surface formed in accordance with the desired lenticular screen, and means responsive to movement of one of said rolls to actuate said means for metering, whereby when a backing sheet is fed through said first nip, a coating of said plastic of predetermined thickness is applied to said backing sheet at said first nip, and when said backing sheet is thereafter fed with said plastic thereon through said second nip, a lenticular configuration is embossed in the surface of said plastic, said chilled forming roll serving to sufficiently set
the embossed plastic to cause the same to maintain its lenticular configuration.

2. In combination with apparatus for selectively depositing a plastic coating on a series of base layers, plastic-depositing means comprising a trough having an elongate outlet passage therein and selectively operable means for opening and closing said passage, roller means for conveying a base layer under said outlet passage, and means for selectively operating said means for opening and closing said passage in timed relation to movement of said roller means and thereby movement of a base layer past said outlet passage.

3. The combination defined in claim 2 wherein said trough comprises a frame including a pair of fixed wall members having base ends defining an inclined outlet passage between base ends thereof, and wherein said means for opening and closing said passage comprises an auxiliary wall member mounted in said frame and reciprocal along an inclined axis at least substantially parallel to said passage.

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