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APPARATUS FOR SMOOTHING THERMOPLASTIC COATING MATERIALS

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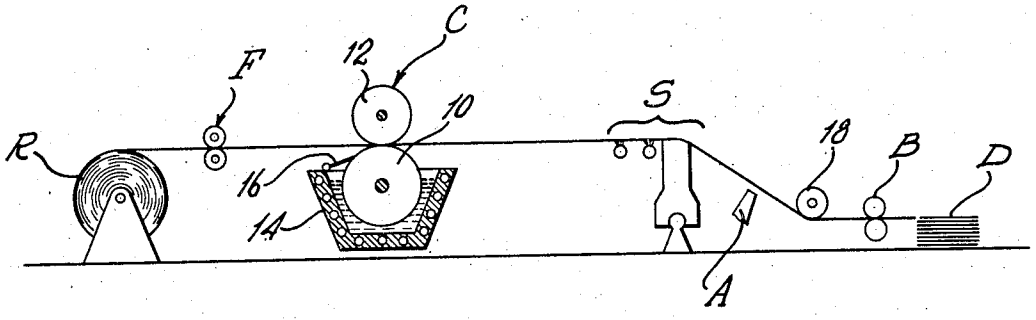


Fig. 1.

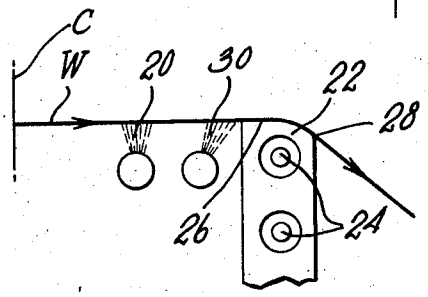


Fig. 2.

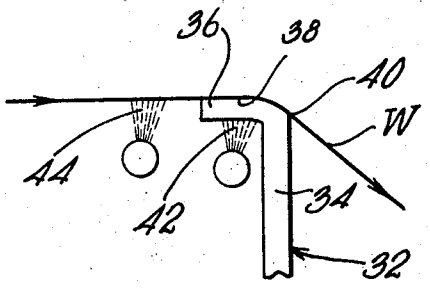


Fig. 3.

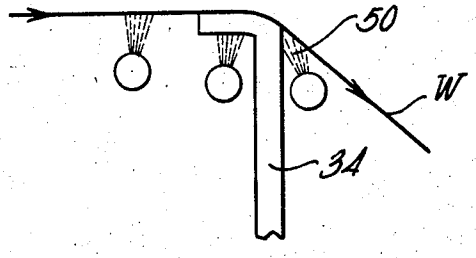


Fig. 4.

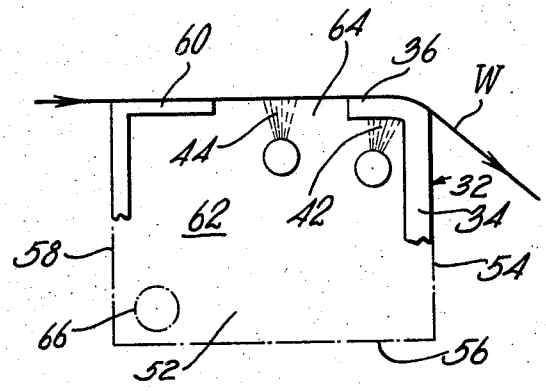


Fig. 5.

INVENTOR
ARTHUR M. WICKWIRE, JR.
BY Francis H. Lee
ATTORNEY

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APPARATUS FOR SMOOTHING THERMOPLASTIC COATING MATERIALS

Arthur M. Wickwire, Jr., Mountain Lakes, N. J., assignor to Interchemical Corporation, New York, N. Y., a corporation of Ohio

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2 Claims. (Cl. 91—53)

This invention relates to the smoothing of thermoplastic or hot melt coating materials and aims to provide an improved apparatus for smoothing coating materials of this character which have comparatively high melting points and high viscosities when molten. The invention is particularly useful in the smoothing of hot melt coating materials applied to a moving web of paper or like material with a rotogravure cylinder having a knurled or etched screen surface.

Because of the fact that the rotogravure method of applying coating and marking materials provides an accurate control of the amount of material applied and consequently an accurate regulation of the ultimate thickness of the applying film, such method is now being widely used in industry for both hot melt and lacquer coating. Some of the hot melt coating materials having desirable properties for special uses have high melting points and the molten materials are rather viscous. This causes difficulties in applying such materials to a web traveling at comparatively high speed, particularly when a glossy smooth film is desired. Various means have been suggested for smoothing such coating materials after application; and most of these have involved the use of some sort of a heated smoothing bar or shoe. While many of the suggested smoothing methods and apparatus are now being satisfactorily used, they do not function efficiently at high speeds. This is probably due to the fact that proper smoothing requires the coating material to be re-melted at least on the outside surface, and the control and supply of sufficient heat for this purpose is troublesome.

I have discovered that effective heating and smoothing of the applied hot melt coating materials having high melting points or high viscosities when molten may be accomplished by means of high temperature gas flames applied directly upon the coated surface and to the smoothing bar.

In accordance with my invention, the web is first passed through a gravure coating unit which results in applying the coating to the web surface in a multiplicity of regularly spaced uniform small dots or quantities. The thus coated surface of the web, moving at high speed, is then heated by means of one or more high temperature flames which are placed rather close to the coating unit and act to preheat the small dots of coating material and melt at least the outside surfaces thereof; and immediately after this flame preheating, the coated and preheated surface is passed over a smoothing bar which may itself be heated by means of gas flames. If desired, an enclosure may be constructed around the smoothing bar and the burners allowing a space through which the flames may be applied to the web. Then a suitable suction duct or exhaust may be connected to the enclosure for removing any unburned gases from the region of the web and preventing their escape into the room where the apparatus is situated.

Such preheating the web permits satisfactory smoothing of hot melt coatings at web speeds as high as about 350 feet per minute for the viscous materials having high melting points, and at speeds as high as about 700 feet per minute for materials having comparatively low melting points. Because of the ease with which the amount of heat supplied with gas burners may be adjusted, the heat may be altered readily for various types of coating materials and various speeds of operation.

The above and other features and objects of my invention will become apparent upon consideration of the following detailed description, and the accompanying drawing, in which:

Fig. 1 is a diagrammatic side elevational view, partly in section, of a complete coating apparatus in which the apparatus features of my invention have been embodied and with which my improved method of smoothing may be practiced;

Fig. 2 is a diagrammatic transverse sectional view, on a somewhat larger scale, showing the preheating of the applied coating with high temperature gas flames and subsequent smoothing with conventional smoothing equipment as illustrated in Fig. 1;

Fig. 3 is a diagrammatic transverse vertical sectional view showing the preheating of the web with gas flames and the heating of the smoothing bar with gas flames;

Fig. 4 is a diagrammatic view similar to Fig. 3 showing the use of an additional gas flame after smoothing; and

Fig. 5 is a diagrammatic view similar to Fig. 3 showing one manner of enclosing the smoothing apparatus so that the gases and products of combustion of the burners may be removed from the region of the web and apparatus.

As shown in Fig. 1, a web W of paper or other material to be coated is fed by means of feed rollers F from a supply roller R to a rotogravure coating unit C which includes a gravure coating roller 10 and a cooperating resilient impression

cylinder 12. As is usual in such constructions, the coating roller 10, which may be internally heated, rotates in a bath of the molten hot melt coating material contained within a heated fountain housing 14; and excess coating material is removed from the surface by means of a doctor blade 16 so that the coating material is applied in the proper regulated quantities to the lower surface of the web W. After passing through the coating unit C, the web W is led over a smoothing apparatus S which acts to level out and redistribute the small dots of material applied by the gravure coating roller 10 so as to produce a smooth and uniform film. This film may be subsequently cooled and set in any desired manner, as by means of an air blast supplied from a nozzle A. The web W then passes beneath a guide roller 18 and through a cutting apparatus B where it is cut into sheets of the desired size which are delivered to a delivery apparatus D. The smoothing apparatus S embodies the principles of my invention and, although it is shown as used in conjunction with a gravure coating apparatus C and a rotary cutting apparatus B, it will be understood that its use is not restricted to such apparatus but it may be used generally in conjunction with various types of coating apparatus and with a conventional rewind, if desired.

One form of smoothing bar that has been used effectively with hot melt coating materials applied with a gravure cylinder is disclosed in Bert C. Miller Patent No. 2,189,738, dated February 6, 1940. According to this patent, hot melt coatings applied with a gravure or other type of coating roller may be effectively smoothed by passing them over an electrically heated smoothing bar having a smooth curved web contacting surface terminating in a sharp edge over which the web may pass at an angle. The action of this smoothing bar on the applied coating material is such that a smooth and uniform film is produced during the passage of the web over the bar. In operation of such equipment, it has been observed that the relatively cool web and coating material exert a noticeable cooling effect on the heated smoothing surface so that, unless unusually strong heating elements are used in the bar, difficulties in smoothing will result. This is particularly true if the web is operated at high speed; and at speeds of 200 feet per minute or over, for coating materials having high melting points, the difficulties encountered in electric heating have been almost unsurmountable or the expense of supplying sufficient heat electrically renders the apparatus uneconomical and impractical.

In Fig. 2, I have shown one form of construction of the smoothing apparatus S which effectively eliminates the difficulties encountered in prior apparatus and permits the entire coating and smoothing operation to be carried out at greatly increased speed even though the coating materials have high melting points. As shown, this form of apparatus comprises a first burner for applying a high temperature gas flame 20 to the web W substantially immediately after its leaving the coating apparatus C and a conventional smoothing bar 22. This smoothing bar may be of the type disclosed in Miller Patent No. 2,189,738 referred to above and is heated by means of electric strip heaters or resistance elements 24 mounted in suitable openings provided in the bar. Said bar has an upper curved web contacting surface 26 and a sharp edge 28 over which the web passes during the smoothing operation. As a further means of heating the web before it reaches the smoothing bar 22, a second burner for producing a high temperature flame 30 may be directed into the angular space between the web and the forward edge of the smoothing bar 22. The burners employed for producing the high temperature flames 20 and 30 may be of any desired construction, such, for example, as the elongated ribbon flame burners disclosed in F. O. Hess Patent No. 2,228,114, dated January 7, 1941. In the use of these burners, gas and air are premixed in proper proportions for combustion and then pumped under pressure to the burner, which is constructed with a ceramic combustion space that becomes heated and provides a source of radiant heat. The gas and air mixture may be adjusted so that as the gas reaches the burner it may be ignited without the necessity of supplying any additional oxygen for combustion. With such burners, it is possible to produce temperatures of about 2000° F.

It will be apparent that these high temperatures would be sufficient to burn the coating material and the web if the web is stopped above the burners. However, when the web is moving at speeds of about 350 feet per minute, the burners merely act to raise the temperature of the applied coating material rapidly to a point at which it may be properly smoothed. That is, they cause the outer surface of the applied coating material to be melted immediately before it contacts the curved surface 26 of the smoothing bar 22. Then, as the web passes over said curved surface and the sharp edge 28, the coating will be effectively smoothed. This method of preheating the applied coating material adds enough heat to the web to prevent its exerting too great a cooling action on the smoothing bar so that the ordinary resistance elements 24 of the smoothing bar will, in most cases, function satisfactorily even at the increased speeds.

Due to the fact that it takes time for the heat to travel through the smoothing bar and there is a rapid withdrawal of heat caused by the contact of the web with the curved surface, even though the coating is preheated, there are certain speeds of operation and types of coating materials where the use of electrical heating in the smoothing bar may become uneconomical. In Fig. 3, I have shown a modified form of smoothing bar 32 for smoothing the coating material applied to the web W. This modification completely eliminates the use of electrical heating. As indicated, the smoothing bar 32 comprises a substantially vertical section leg 34 having a horizontal smoothing section 36 formed at the upper end thereof and projecting outwardly so as to provide an angular space between the two sections 34 and 36. The smoothing section 36 is provided with a curved smoothing surface 38 and a sharp edge 40 over which the web is passed and is similar to the smoothing bar 22 in this respect. However, rather than being heated by electric resistance elements, the smoothing bar 32 is heated by means of a high temperature flame 42 which is used in addition to a preheating flame 44 for the coating material. Thus, in this form of construction, the applied coating material is preheated by means of the flame 44 and then passed over the smoothing surface 38 which is heated by means of the high temperature flame 42. Both of the flames 42 and 44 may be supplied from any desired type of burner, such as that disclosed in the Hess patent referred to above. Because of the high

heats that can be obtained with such burners, there appears to be no limit on the speed that may be obtained with this combination of elements.

While the construction shown in Fig. 3, and particularly the smoothing bar **32** thereof, results in the production of a smooth and glossy surface in the applied coating material regardless of the speed at which the web is traveling, it often happens that minute scratches or ridges form in the surface as it cools after passing over the sharp edge **40**. These may be caused by the presence of dust or other foreign matter which may contact the coating somewhere bewteen the point where it is applied and the sharp edge **40**. To remove any such minute scratches that may be present in the otherwise smooth surface, I have provided, in the apparatus shown diagrammatically in Fig. 4, a third high temperature gas flame **50** which is directed into the angular space between the vertical leg **34** and the web W of the Fig. 3 construction. The heat of this flame causes the outer skin or surface of the coating material to be melted slightly so that there will be sufficient flow therein to take out the scratches.

Although the types of burners that I prefer to employ for the production of the high temperature gas flames usually do not result in the generation of any noxious gases during combustion, it may nevertheless be desirable to provide an enclosure for the smoothing bar and the burners used for the gas flames. In Fig. 5, I have shown the smoothing bar **32** mounted on a housing **52**. This housing **52** is actually formed in part by the smoothing bar **32** which has the vertical leg **34** thereof connected to a side wall **54** of the housing. Said housing also includes a bottom wall **56**, a forward side wall **58**, a top wall or cover **60** and suitable end walls **62**. The top wall **60** extends inwardly from the side wall **58** to a point adjacent the forward edge of the smoothing section **36** and thus provides a space **64** through which the flame **44** may project and contact the coated surface. The burners for producing the flames **44** and **42** may be mounted within the housing **52** and a suitable exhaust conduit **66** connected thereto for removing the gaseous products of combustion from the region of the apparatus and from the room in which the apparatus is situated.

Although I have described certain preferred forms of apparatus, it will nevertheless be understood that various changes may be made in the construction, and certain features thereof may be employed without others, without departing from my invention or sacrificing any of its advantages.

What I claim is:

1. Apparatus for smoothing a thermoplastic coating material which has been applied upon one surface of a traveling web, comprising the combination of means for applying a high temperature flame directly upon the coated surface, means for smoothing the thus heated coated surface, and means for applying a second high temperature flame upon the smoothed coated surface immediately after it leaves such smoothing means.

2. Apparatus for smoothing a thermoplastic coating material which has been applied upon one surface of a traveling web, comprising the combination of means for applying a high temperature flame directly upon the coated surface, a smoothing bar having a smooth curved metal web contacting surface on the upper side thereof positioned adjacent such flame applying means, means for applying a high temperature flame to the lower side of said smoothing bar so as to heat said smooth curved metal surface to an elevated temperature, and means for applying a high temperature flame to the coated surface of the traveling web after it leaves said smoothing bar.

ARTHUR M. WICKWIRE, JR.