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Sorenson

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[54] **ADHESIVE CURING DEVICE**

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[52] **U.S. Cl.** **34/121,** 34/126, 118/60, 156/322, 156/499, 165/89, 165/90, 165/96

[51] **Int. Cl.** **F26b 13/18**

[58] **Field of Search**......156/547, 555, 324, 322, 320, 156/498, 499; 34/115, 119, 121, 126; 118/60; 165/89, 90, 96; 117/119.6, 62

[56] **References Cited**

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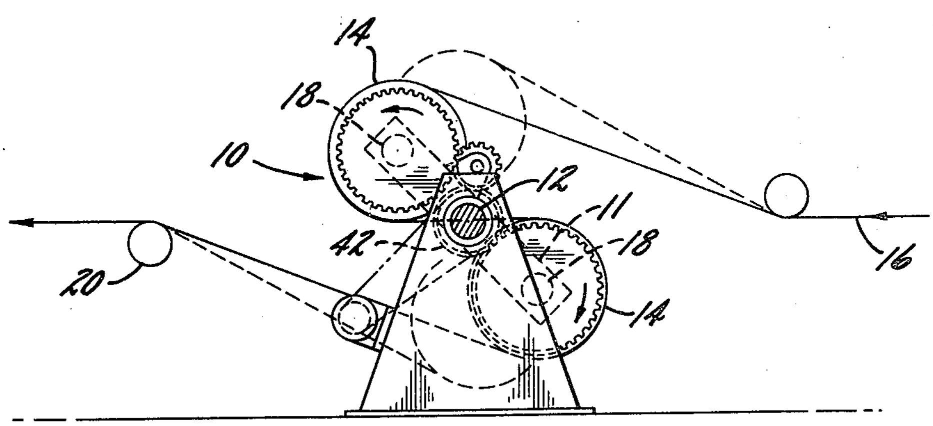
[57] **ABSTRACT**

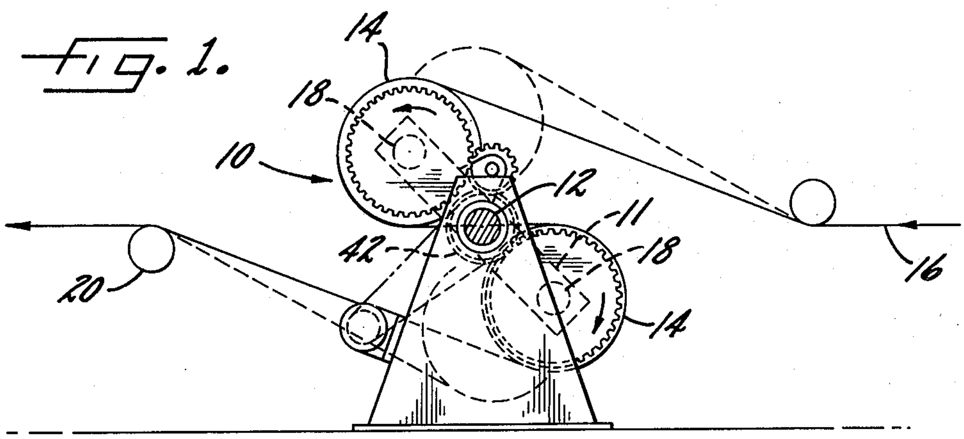
A device for controlling the heating and thus the degree of cure of an adhesive on the surface of a web by utilizing two heated, rotatable drums movably mounted on a turret. By rotating the turret, the contact time between the web and the surface of the heated drums is varied thereby altering the heat transferred to, and therefore the cure state of, the adhesive.

1 Claim, 3 Drawing Figures



PATENTED OCT 3 1972 3,694,927

Fig. 1.



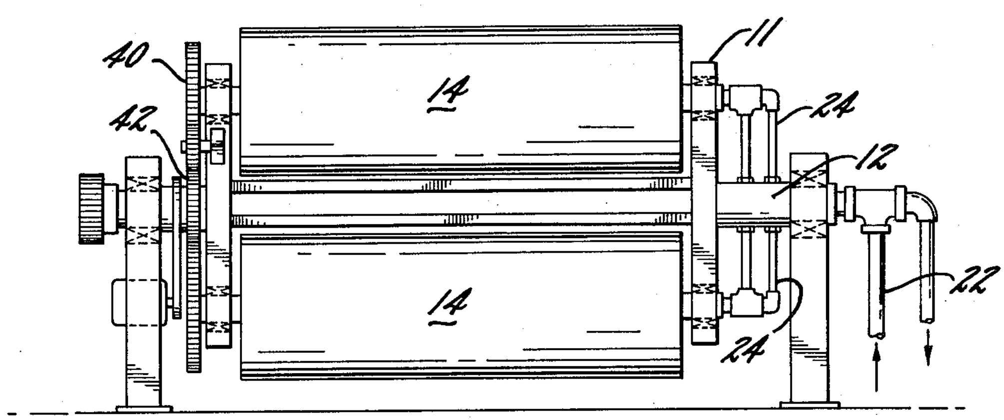


Fig. 2.

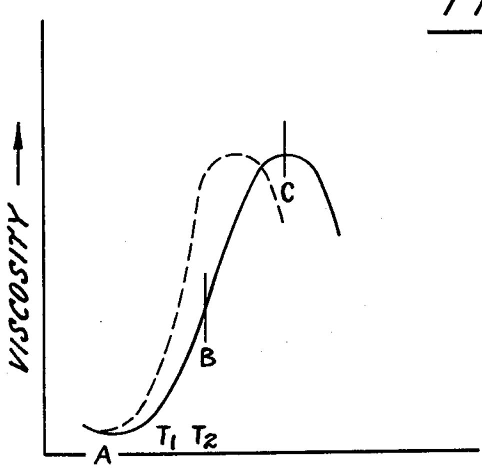


Fig. 3.

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ADHESIVE CURING DEVICE

DESCRIPTION OF THE INVENTION

This invention relates generally to method and apparatus for heating adhesive compositions on a moving web. In the context of my invention, the term "web" includes all films, scrims, or sheets capable of being passed in contact with drum surfaces. More particularly, my invention concerns controlling the final condition of an adhesive on a moving web independent of changes in processing speed, heating temperature, or the like.

For many applications it is desired to apply an adhesive to a travelling web and to heat or otherwise cure the adhesive to some degree to promote bonding. In the context of this invention, the term "cure" includes any change in the physical properties of the adhesive resulting from the application of heat. For example, a plastisol adhesive may be warmed to form a continuous film or heated to a state of a viscous, tacky mass. Alternatively elastomeric adhesive may be either tacky or fully set depending upon the degree to which they have been treated.

A common means for raising the temperature of an adhesive carried on a web is to pass the web around a heated drum so that the adhesive contacts at least a portion of the drum's surface. Alternatively, the side of the web opposing the adhesive bearing side may be placed in contact with the drum's surface and the temperature of the adhesive material raised by conduction through the web.

In these and other similar situations a problem frequently arises when it becomes necessary, for mechanical or other reasons, to change the speed at which the web may be moving. Inasmuch as the drum temperature remains essentially constant, a decrease (or increase) in web speed causes a corresponding extension (or shortening) of the time at which the web is in contact with the drum and, consequently, overheating (or underheating) of the adhesive. A result of such a change often is an unsatisfactory cured adhesive and wasted product.

In other cases the speed at which a machine may be operated is governed by the cure state of the adhesive. Faster and more efficient operation would be possible but for the fact that the adhesive would be "green" or insufficiently cured. By providing a way to accommodate increased speeds while maintaining desired heating of the adhesive, this problem may be overcome.

In still another mode of operation where the speed and roll temperature are maintained constant, it may be desirable to either change the adhesive composition or vary its degree of cure. Heretofore such a requirement would have forced a corresponding alteration in speed or roll temperature.

It is an object of the present invention to provide means for controlling the heating of such adhesives whereby compensation may be made for changes in web speed.

Related to this object, it is further an aim of the present invention to reduce the amount of waste or substandard production resulting from changes in web speed.

It is yet another object of the present invention to allow increased web speeds in those situations where the adhesive cure state is a factor which limits web velocity.

A related object is to provide for changes in adhesive cure state or composition without necessitating corresponding alterations in web speed or roll temperature.

It is apparent that the present invention has other utility than has been specifically mentioned in the preceding paragraphs. For example one or more events may cause a reduction in the temperature of the heated drum. Ordinarily this would be expected to force a reduction in web speed in order to maintain adhesive cure. The present invention may be utilized to increase the contact time with the heated surface without changing web speed--or at least with a reduced change being necessary.

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings, in which:

FIG. 1 is a side view of the turret structure of the invention showing two possible positions of the heated drums;

FIG. 2 is a front view of the same structure; and

FIG. 3 is a graph showing the rate of change of viscosity with temperature for two general types of plastisol adhesives.

While the invention will be described in connection with a preferred embodiment, it will be understood that I do not intend to limit the invention to that embodiment. On the contrary, I intend to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.

Turning first to FIG. 1 there is shown a turret **10** including a beam **11** pivotable about axis **12** and rolls **14** at the ends of the beam, at least one of the rolls being heated. A sheet or web **16** carrying a plastisol adhesive on one or both of its surfaces is passed over the rolls **14** which are rotating in opposite directions about axis **18**. Rolls **14** are heated to promote curing of the adhesive, and either or both rolls may be driven by motors (not shown), or they may be mounted so as to be freely rotatable if desired. From the rolls **14** the web or sheet is passed over a guide roll **20** for further processing.

In accordance with one aspect of the invention, when the web **16** speed decreases and it is desired to decrease the final temperature of the web and thus the final degree of cure of the adhesive, turret **10** is rotated clockwise, for example, to the alternate position indicated by broken lines in FIG. 1. From FIG. 1 it can be seen that, by repositioning rolls **14** as indicated, the contact between the sheet **16** and the surface of heated rolls **14** is reduced, thus decreasing the time during which web **16** is in contact with the rolls **14**, the amount of heat transferred to the web, and the state of cure of the adhesive. Similarly, should the web **16** speed remain constant and either the drum **14** temperature increase or the adhesive require less heat, the same rotation of the turret **10** tends to maintain the final temperature-cure condition of the adhesive at a predetermined condition. Conversely should more heat be required, the turret **10** may be rotated counterclockwise.

FIG. 2 presents a front view of the apparatus shown in FIG. 1. In addition there is shown in FIG. 2 a preferred arrangement for heating rolls **14**. Steam from a source (not shown) enters through single port **22** and is fed through conduits **24** to rolls **14**. These conduits move with the turret and avoid the necessity for using any flexible piping which would otherwise be required to feed each roll separately. Condensate removal is effected by a conventional condensate syphon, omitted from the drawing for reasons of clarity.

The relative angle of the rolls with respect to the direction of web travel may be controlled through the use of known power transmission and locking systems. For example, as shown, worm gear reducer **40** may be utilized in combination with pinion **42**. This arrangement is self-locking, and each revolution of the worm advances the gear a number of teeth proportional to the number of threads on the worm in the appropriate direction. Alternatively the controls may be automated so as to allow remote operation of the turret.

FIG. **3** generally illustrates the viscosity behavior of plastisol adhesives as a function of temperature. These adhesives are extensively used as binders between cellulose wadding and nonwoven reinforcements such as the scrims described in Hirschy U.S. Pat. No. 2,841,202 or the drafted webs described in Sokolowski U.S. Pat. No. 3,327,708. The combination has a fabric-like feel and is inexpensive when compared with fabrics for which it is a substitute.

As is evidenced from FIG. **3**, the viscosity of the plastisol represented by the solid line increases as the temperature is increased from a point A up to a point C. Thereafter the viscosity decreases as temperature increases. Point C is designated as the fusion point of the plastisol and, as described in TAPPI 50, 70A–84A, fusion corresponds to that state in which the plastisol exists as a continuous plastic phase. Prior to fusion, the plastisol is either a two-phase system of resin particles distributed in plasticizer (termed the fluid state and designated as the region A to B in FIG. **3**) or discontinuous resin particles swelled with plasticizer (termed the gel state and designated as the region B to C in FIG. **3**).

Ordinarily gelling occurs at about 140°–220° F. with the plastisol having a viscosity of about $10^4 - 10^5$ centipoise. Fusion occurs at about 280°– 350° F. at a viscosity of $10^6 - 10^7$ centipoise. The gel point for a particular plastisol can be determined by the hot bench test method described in "Plastic Technology" Oct. 1960, pages 43–47.

The dotted line in FIG. **3** illustrates the viscosity temperature characteristics of another plastisol. As is evident, this plastisol fuses faster than the one previously described, i.e. fusion can be obtained with a smaller temperature increase. Plasticizer selection can be used to establish an appropriate fusion rate. Examples of suitable plastisols include vinyl chloride polymers or copolymers and organic phthalate, sebacate, adipate, or phosphate esters as plasticizers. In addition, useful plastisols can contain solvents or thinners in amounts up to about 20 percent.

With respect to the present discussion, it is important to note that, for a given film or web speed and roll temperature, the present invention may be used to select an operating point on the curves shown in FIG. **3**. Furthermore this invention may be used to accommodate properties which vary between different plastisols as exemplified in FIG. **3**. By adjusting the surface contact between the sheet or film and the heated rolls according to the present invention so that the temperature reached is that marked T_1, a degree of cure for the adhesive represented by the broken line can be obtained which is similar to that obtained at T_2 with the adhesive which is represented by the solid line in FIG. **3**.

Having described the invention in terms of several applications other uses and embodiments will suggest themselves to one skilled in this art. It is intended that this invention embrace all such uses and embodiments falling within the scope of the claim which follows.

I claim:

1. Apparatus for controlled heating of an adhesive on a moving web including

two heatable drums rotatably mounted on a turret so that opposite sides of said web sequentially pass into contact with the surface of the respective drums and heat is transferred from at least one drum to the adhesive, and

means for rotating the turret whereby on rotation of the turret the amount of contact between both of the drums and the web may be simultaneously varied.

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