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## (54) Improved apparatus and method for applying a viscous liquid to a material surface

(57) An adhesive or other viscous liquid applicator apparatus utilizes a cylindrical glue roll (45) and a reverse acting notched metering or doctor blade (47) which forms, from an initial liquid layer on the roll, a series of laterally spaced liquid beads of metered size. The beads are subsequently spread to form a liquid layer for transfer to a web or other surface by a flexible spreader tongue (51). A glue film control system and glue film width control are also disclosed.

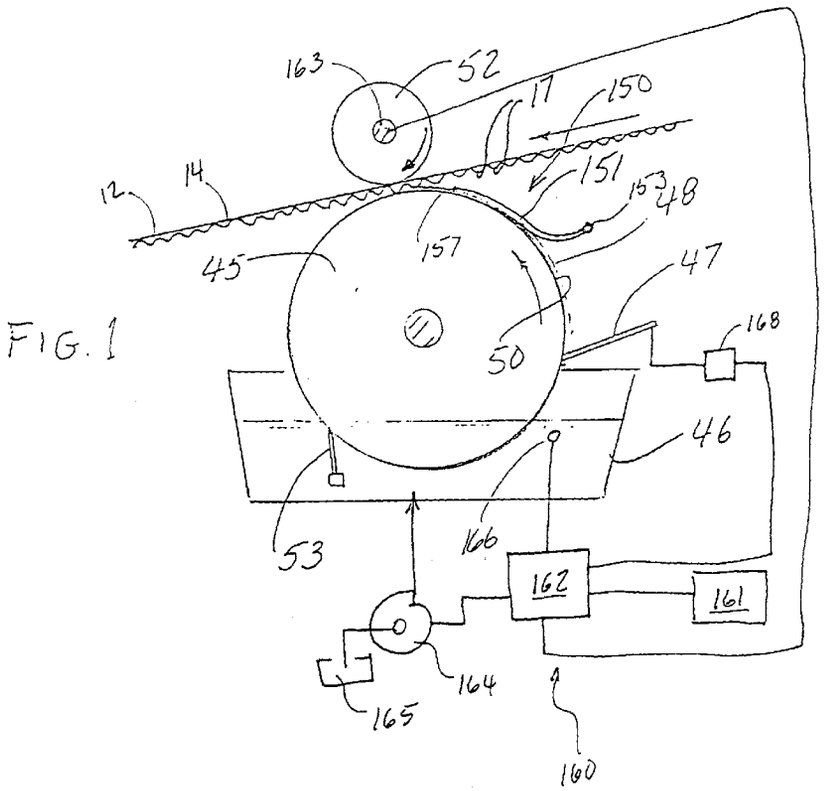


FIG. 1

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## Description

The present invention pertains to viscous liquid applying apparatus useful in applying a wide variety of liquid adhesives to web, sheet materials, or other surfaces. The apparatus and related method are particularly useful in the manufacture of corrugated paperboard products.

In accordance with the present invention, an applicator apparatus for applying a liquid adhesive or other viscous liquid to a moving material surface comprises a supply of adhesive, a cylindrical applicator roll rotatably mounted to bring an outer surface portion into operative communication with the supply of adhesive, a metering doctor blade positioned to engage the outer surface of the applicator roll downstream of the adhesive supply, the metering blade being provided with a roll-engaging edge defined by a series of spaced notches separated by straight edge portions, such that the notches form a series of spaced parallel beads of adhesive along the roll outer surface and the edge portions wipe the adhesive from the roll surface between the beads, and means downstream of the metering blade for spreading the adhesive beads laterally across the roll surface and for moving the surface to be coated generally tangentially along and in contact with the roll surface in the direction of rotation to transfer the adhesive to the surface. The metering blade is preferably mounted with the edge oriented in the upstream direction to provide a reverse angle of attack.

The means for spreading the adhesive beads comprises a flexible tongue which lies on and is resiliently biased against the surface of the roll downstream of the doctor blade and spreads the beads into an even and uniform film. A film control system utilizes microprocessor control to monitor the amount of glue consumed, compare the amount with the known amount of glue to be applied to the paper and the paper speed, and controls the amount of glue supplied to the glue pan, where a level sensor monitors the amount of glue actually being transferred. Glue pan level data can be processed to vary the attack angle of the doctor blade, thereby varying the glue film thickness and thus the amount of glue applied to the paper.

The film control system may also be utilized with a chambered doctor blade or a manifold glue supply system, using the same basic strategy and feedback control.

The invention also includes an adjustable glue layer width control which is operable to scrape glue layers from opposite lateral edge portions of the roll where no glue is desired, either because of changes in web width or the width of the glue layer desired to be applied to the web.

FIG. 1 is a side elevation view of an adhesive applicator apparatus of the present invention shown applying adhesive to a single face corrugated paperboard web, including a schematic representation of the glue film control system.

FIG. 2 is a side elevation of an adhesive applicator of an alternate embodiment utilizing a chambered doctor blade arrangement.

FIG. 3 is an enlarged side elevation of an adjustable glue roll wiper system utilized in the FIG. 2 embodiment to adjust the width of the glue layer to accommodate variations in web width.

FIG. 4 is a sectional detail taken on line 4-4 of FIG. 3.

The adhesive applicator apparatus of Fig. 1 is shown specifically for gluing the flute tips of a single face web 14, for example, just prior to applying the liner to form a double face web in a double backer. In this embodiment, a glue roll 45 is rotatably supported above a glue pan 46, so that the lower portion of the roll rotates into and picks up glue from the pan. A reverse acting doctor blade 47 of the type described in U.S. Patent No. 5,628,868 is positioned to form glue beads on the roll surface 50, which beads are subsequently spread to form a continuous layer by contact with a downstream flexible spreader tongue 51. The single face web 14 is moved generally tangentially over the glue roll 45 where the flute tips 17 contact and pick up laterally extending lines of adhesive from the layer on the roll surface 50. A backing roll 52 is preferably positioned against the liner side 12 of the web in a position set to accommodate the thickness of the web and the amount of glue to be transferred from the roll to the flute tips 17. Glue which is not transferred to the web and remains on the roll surface 50 may be scraped therefrom by a reverse acting scraper blade 53 so that fresh glue is applied to the surface of the roll as it enters the reservoir or glue pan 46. The scraper blade 53 may be submerged in the liquid glue, as shown, so the glue is returned directly to the supply in the pan.

A spreader assembly 150 includes the spreader tongue 151 which engages the beads of adhesive and spreads them into a thin uniform layer. The area under the tongue 151 is subjected to varying amounts of downward force, depending on the thickness of the film at a particular point, so that the equilibrium point is a perfectly even and uniform film.

The tongue is formed of a flexible sheet material, most preferably a plastic material having a thickness in the range of about .005 to .120 inch (.13 to 3.05 mm). The tongue is sufficiently long so that it wraps, via its inherent flexibility, around the roll surface 50 for a significant distance, for example, about 12 inches or 30 cm. If a longer tongue is utilized, it is believed that no improvement in the uniformity of the glue film results and more power is required to drive the roll. It is also important that the downstream end of the tongue 151 is formed with a sharp corner 157 to ensure a smooth deposition of the thin film. The tongue is supported by a rod 153 or any other suitable means. The tongue 151 achieves uniform coating thickness because any portion of the coating that extends above any other portion un-

der the tongue is immediately subject to a downward force normal to the tongue which, in turn, causes material to flow sideways, always toward a more uniform surface condition.

The amount of glue transferred to the web 14 is controlled by a film control system 160, operated by a control unit 162, which may be a portion of digital computer or other control means 161 employed to control the entire system. The amount of glue that should be applied to the web 14 is a constant amount per unit of paper contact area, and the control system utilizes that known quantity, along with the speed of the web moving over the roll 45 as determined by speed sensor 163 on the backing roll 52, to calculate the amount of glue that should be consumed per unit of time. That quantity is then input to the control unit 162, which in turn commands a constant volume pump 164 to provide that amount of glue to the glue pan 46 from glue reservoir 165. Control unit 162 also employs a level sensor 166 to determine the level of glue in the glue pan 46 (which provides an indication of whether the system is in fact transferring the desired amount of glue to the web 14). The control unit 162 uses the level information to vary the angle of attack of the notched doctor blade 47, via blade position monitor and control 168, to vary the glue bead thickness and thus the amount of glue applied to the web.

In the glue applicator 60 shown in FIG. 2, a chambered doctor blade 61 is utilized. The chambered doctor blade includes a reverse acting notched doctor blade 62 similar to the doctor blade 47 of the FIG. 1 embodiment. Notched doctor blade 62 is mounted at a fixed angle and may include relatively larger holes than blade 47 previously described. The inlet to the chamber is closed by a forward running flexible doctor blade 63 which seals the chamber, but allows the glue remaining on the glue roll 64 to re-enter the doctor blade chamber 65 by passing under the flexible rubber blade 63.

Fresh glue is pumped into the chamber 65 by a variable volume pump 66 withdrawing glue from a reservoir 67. The pump is operated to supply glue to the chamber at a rate equal to that desired in terms of a constant amount per unit paper contact area (e.g. pounds of glue per 1,000 square feet of paper processed) or a similarly appropriate value. Added to the doctor blade chamber 65 is the recirculated glue passing beneath the flexible rubber tongue 63 which is mixed with the fresh glue supplied from the reservoir 67. Because the notched reverse acting doctor blade 62 is mounted in a fixed position, an increase in the level of glue in the chamber 65 will result in an increase in the pressure head therein and, as a result, more glue will be forced past the notches in the doctor blade 62. Downstream of the chamber doctor blade, the glue beads are spread with the use of a flexible tongue 151 which may be identical to that described with respect to the FIG. 1 embodiment.

Utilizing a feedback film control system similar to system 160 described with respect to FIG. 1, the glue level in the chamber 65 is monitored to provide the appropriate control signals to operate the metering pump 66 to maintain the flow through the notched doctor blade 62 to maintain the desired film to be applied to the single face web 68 or other web being coated.

Referring to FIGS. 3 and 4, one of the problems with metering-type glue rolls 64 of the type described above is that it is difficult, cumbersome or messy to control the width in the cross machine direction of the glue layer to be applied, either because less than the full width of the web 68 is desired to be coated or because a narrower web is being run. In either event, the glue layer outside the width desired to be applied is typically removed by the use of glue dams. In accordance with this invention, the glue layer is applied to the full width of the roll 64 and an adjustable reverse operating doctor blade 70, positioned just upstream of the application point to the web 68, is utilized to scrape the glue layer from the portion of the roll 64 where no glue is desired and to return the glue to the system for reuse. The flexible wiper blade 70 is utilized with an identical blade mounted at the opposite axial end of the glue roll 64, both of which operate identically. The wiper blade 70 is fed laterally across the roll surface from a blade source 71 to contact the portion of the roll surface where it is desired to wipe the roll clean and remove all the glue. The blade 70 runs in a track 72 in a glue collection trough 73 and is biased into contact with the surface of the roll with an appropriate biasing leaf spring 74 or the like.

The film control system 160 described hereinabove utilizes strategy which may be applied to control the film thickness in a manifold-type glue supply system as well. In such a system, the metering supply pump would be operated, as previously described, to deliver glue at the desired output rate to a delivery manifold located adjacent the rotating glue roll from the surface of which all glue had previously been removed. The metered volume of glue is delivered to the roll surface directly upstream of the flexible rubber smoothing blade or tongue where it is smoothed into a uniform layer and delivered for direct application to the web. Any glue that is not used, either because it was not picked up by the web or because it was removed by the width control system (FIGS. 3 and 4), would be returned to a reservoir which also contains the new feed stock glue. By monitoring the level of the glue in the reservoir, the comparison may be made between the calculated amount being pumped to the manifold and the amount actually being utilized. The appropriate feedback control signal may then be utilized to vary the pump speed to adjust the amount fed into the manifold. In the case of applying glue to the flute tips of a single face corrugated web 68, as shown in FIG. 2, as an example, an increase in the amount of glue supplied to the manifold will result in an increase in the thickness of the glue layer applied to the roll 64. This in turn would increase the pickup rate by the flute tips of the corrugated single face web traveling over the surface of the glue roll 64.

## Claims

1. An apparatus for applying a thin film of a liquid adhesive to a moving web of material, said apparatus comprising:

   an adhesive supply reservoir;
   a rotatable cylindrical applicator roll;
   means for supplying adhesive from the reservoir to the surface of the rotating applicator roll at a rate of supply calculated to provide an adhesive film of a desired thickness on the moving web;
   a flexible spreader tongue overlying a portion of the roll surface for spreading the adhesive to form a uniform layer of adhesive on the roll surface over substantially its full width;
   adjustable wiper blade means for scraping the adhesive from roll surface portions extending axially inwardly from opposite roll ends to leave therebetween an adhesive layer of a selected width;
   means for moving the web into generally tangential contact with the adhesive layer to transfer to the web a film of said selected width;
   means for supplying the reservoir with a make-up amount of adhesive equal to the rate of supply and returning to the reservoir adhesive not transferred to the web; and,
   means for adjusting the rate of supply to maintain an equilibrium state in the volume of adhesive in the reservoir.

2. An apparatus for spreading a volume of a viscous liquid being carried on the surface of a rotating cylindrical applicator roll into a thin liquid film of uniform thickness, said apparatus comprising:

   a flexible spreader tongue overlying a portion of the roll surface and having a contact portion in contact with the liquid and terminating in a downstream edge; and,
   a tongue support mounting the tongue in a stationary position over the roll with the tongue extending downstream with respect to the direction of roll rotation to said downstream edge.

3. The apparatus as set forth in claim 2 wherein said tongue has a width corresponding generally to the axial length of the roll.

4. The apparatus as set forth in claim 2 wherein said tongue comprises a plastic sheet having a uniform thickness in the range of about .15 mm to about 3 mm.

5. The apparatus as set forth in claim 2 wherein said tongue has a length of at least about 30 cm.

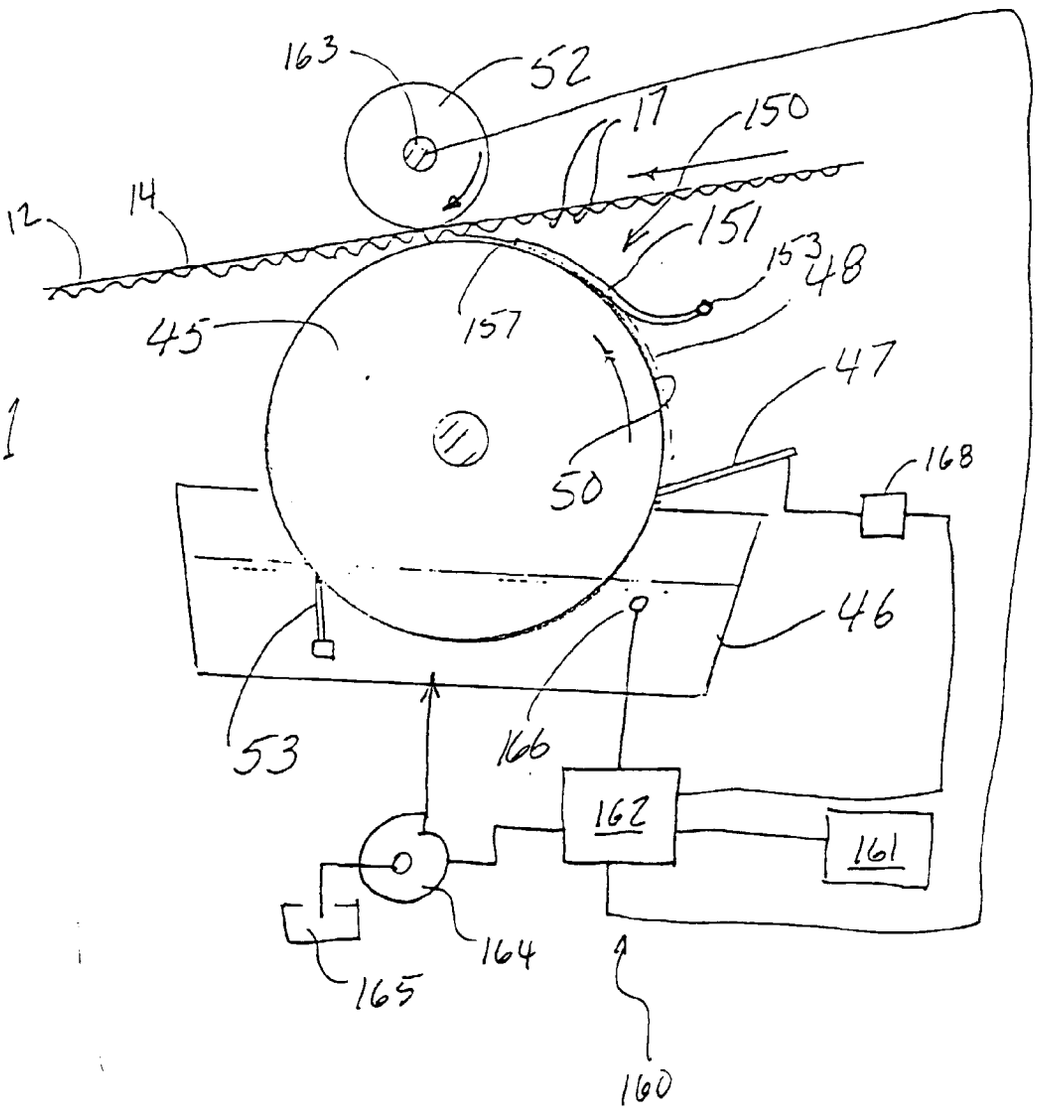
6. A method for controlling the thickness of a glue film applied to a web comprising the steps of:

   (1) calculating the rate of supply of liquid glue necessary to provide a glue film of a desired thickness on a moving web;
   (2) supplying glue from a reservoir at the calculated rate of supply to the surface of a rotating applicator roll;
   (3) spreading the glue to form a uniform layer of glue on the roll surface;
   (4) moving the web into generally tangential contact with the glue layer on the roll to transfer the glue film to the web;
   (5) supplying the reservoir with a make-up amount of glue equal to the rate of supply and returning to the reservoir glue not transferred to the web; and,
   (6) adjusting the rate of supply to maintain an equilibrium state in the volume of glue in the reservoir.

7. An apparatus for providing a glue layer of selected width on a rotatable cylindrical glue applicator roll comprising:

   means for spreading a substantially full width layer of glue on the roll surface during rotation thereof;
   a pair of axially adjustable wiper blades adapted to move along and in contact with the roll surface from opposite axial ends on a line parallel to the roll axis; and,
   means for positioning said wiper blades in spaced relation to scrap the glue from roll surface portions extending axially inwardly from the opposite roll ends and to leave therebetween said glue layer of selected width.

FIG. 1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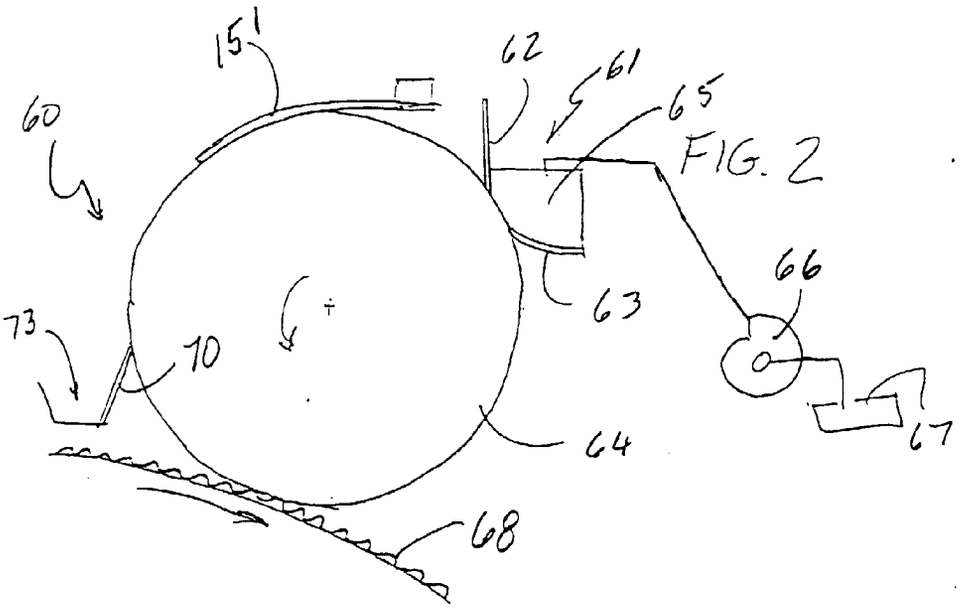


FIG. 2

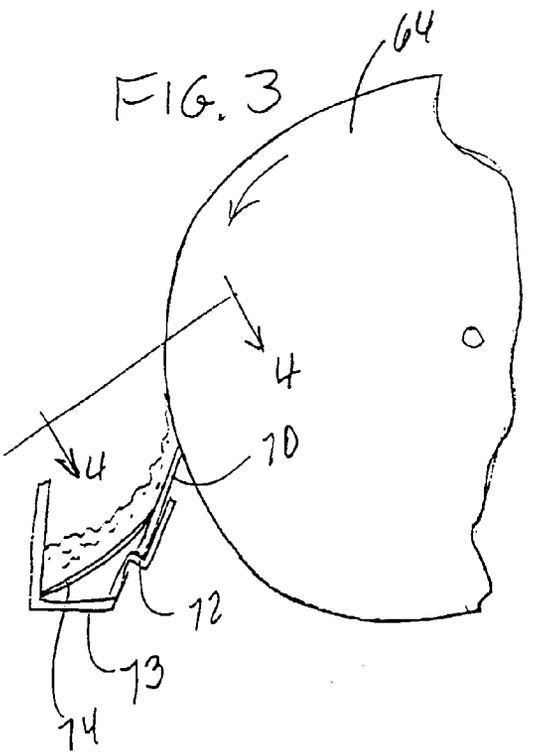


FIG. 3

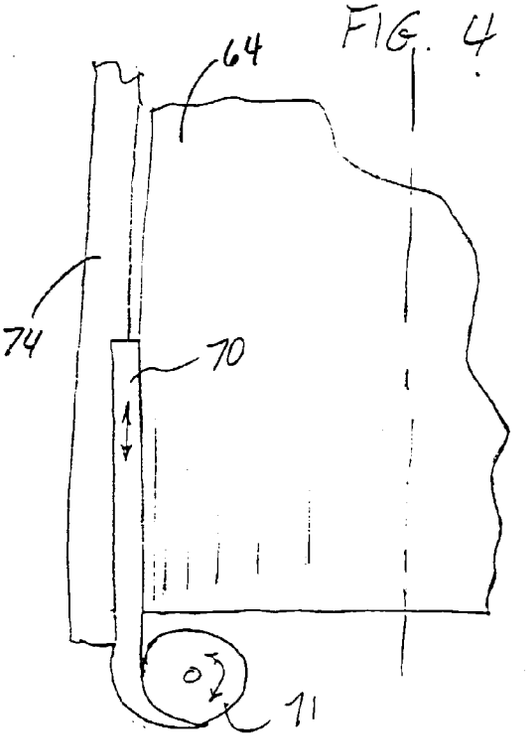


FIG. 4