Oct. 1, 1968 W. A. WOOTTEN 3,404,025

METHOD AND APPARATUS FOR COATING A SHEET OR WEB

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Fig. 1

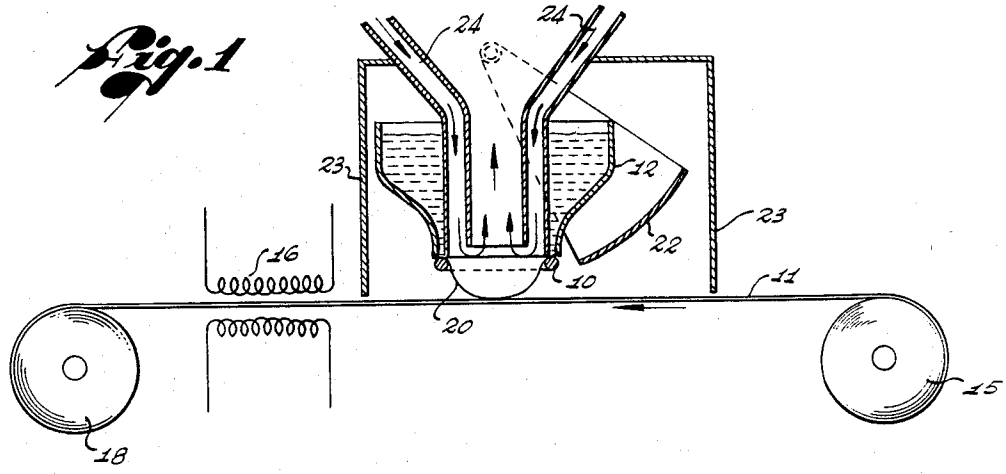


Fig. 2

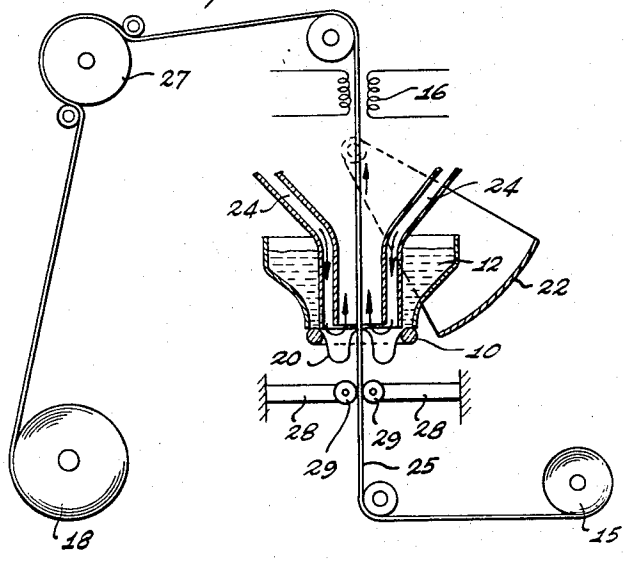


Fig. 4

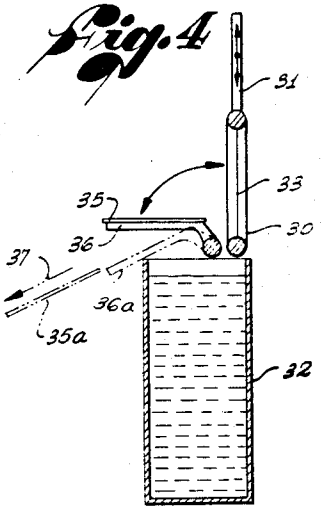
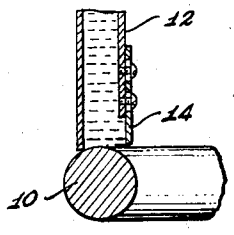


Fig. 3



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METHOD AND APPARATUS FOR COATING A SHEET OR WEB

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ABSTRACT OF THE DISCLOSURE

A continuous web or a discrete sheet of paper or the like can be quickly and easily coated with a plastic material by forming a thin film of the plastic across a loop and depositing the film from the loop onto the web or sheet. One or both sides of the web or sheet can be coated as desired.

The present invention relates generally to a method and apparatus for coating a blank, sheet, web, or other article, especially when the coating material is a plastic, a solution, an emulsion, or any other liquid that tends to form bubbles and foam.

As an example of the class of materials with which the present invention is particularly concerned, polyvinylidene chloride in aqueous emulsion is used to coat paper stock. During the handling of the coating material, it tends to form bubbles and to foam. As a result, it is very difficult to form a thin coating or film of the material and apply it to the article to be coated, particularly when the article is a web or the like moving at a substantial speed.

There are other materials having this same characteristic of tending to entrain air during the process of handling and consequently they present problems in applying a coating in a thin, uniform layer. The bubbles do not break readily; and the more stable the foam thus produced, the greater the difficulty in handling and applying the coating material. When the bubbles persist after the coating material is applied to the article, subsequent breaking of the bubbles results in small discontinuities in the coating, often referred to as "pinholing." It is obvious that when the purpose of the coating applied to a paper web or the like is to render it impervious to water or vapor, the existence of these discontinuities, even though small and infrequent, renders the coating substantially worthless since the breaks in the coating serve to pass the moisture or vapor and they enlarge as time goes on.

Thus it is a general object of the present invention to provide an improved method and apparatus for successfully handling and applying thin coatings to an article of liquid materials which inherently have the capability of forming a more or less stabilized foam. Such materials are commonly referred to in the industry as film formers.

More specifically, it is an object of the invention to develop method and apparatus for applying in thin, continuous films a coating of such film forming materials in a manner to eliminate discontinuities or pinholing.

It is also an object of the present invention to provide a coating machine of novel design which is greatly simplified in construction and in the number of moving parts, making the machine particularly easy to clean to effect removal of the coating material.

The above and other objects of the present invention are achieved according to a novel process that involves establishing a wet, air-borne film of the coating material across an open loop and then depositing the film on the article to be coated. The relative movement between the film and the article to be coated differs with various factors, including the character of the article. In the case of a continuous web, the traveling web may either pass at

one side of the open loop, in which case the film is deposited on an adjacent face of the web, or the web may pass through the loop, allowing the film to be deposited on both sides of the web. Both of these arrangements are particularly adapted to continuous methods of coating a traveling web. In the case of a small sheet or blank to be coated on one side, the process involved is similar to a batch process in which the sheet or blank is moved against the film formed and held on the open loop.

Apparatus required to carry out the coating process may be of any type suitable for the purpose and, in general, comprises an open loop, means supplying coating material to the loop, means for establishing a film of said coating material across the loop, and means for transferring the film to the article to be coated.

How the above and other objects of the present invention are attained will be more readiy understood by reference to the following description and the annexed drawing, in which:

FIG. 1 is a diagram representing in elevation one form of apparatus adapted to effect continuous coating of a web on one side only;

FIG. 2 is a diagram representing in elevation a variational form of apparatus adapted to effect coating on both sides of a traveling web;

FIG. 3 is a fragmentary section of the loop and means for supplying coating material thereto; and

FIG. 4 is a diagram representing in elevation apparatus for carrying out a batch-type process in which a series of blanks are coated on one face, one at a time.

Referring now to the dawing, and more particularly to FIG. 1, there is indicated at **10** an open loop which has a continuous periphery but is open centrally, as will become apparent. Loop **10** is normally elongated in one direction in order to extend entirely across the width of web **11** which is to be coated.

A reservoir **12** holds a supply of liquid emulsified polyvinylidene chloride, or any other liquid coating material, which is to be applied to the upper face of web **11**. Coating materials for this purpose are usually solutions of a plastic in a volatile solvent or a water emulsion, but the invention is not necessarily limited thereto. Reservoir **12** feeds by gravity to the upper edge of loop **10** and has a narrow discharge opening adjacent the loop and extending around substantially the full loop in order to supply coating material to the upper edge of the loop. As shown in FIG. 3, the width of the discharge orifice from reservoir **12** may be controlled, as by an adjustable gate **14** which is raised and lowered, by means not shown, to control the rate of outflow of the coating material to correspond to the rate of deposit on the traveling web.

Web **11** is delivered from a supply roll **15** and passes in a generally horizontal direction at one side of and below loop **10**. After passing the loop, the web passes drying means of any suitable design, as indicated at **16**. Typically such drying means may be electric heating elements or radiators which heat the web and the applied coat to dry and harden the coat. After passing heater **16**, the web is wound on a rewind roll **18**.

In order to establish the film **20** initially across the open loop, there is provided a plate-like member **22** which is swingingly or slidingly mounted so that it can move from the full line position of FIG. 1 to the dotted line position shown underneath loop **10**. In this latter position, liquid coating material flowing out of reservoir **12** flows across the loop and onto film-forming plate **22**. The film-forming plate accumulates enough of the liquid to establish an air-borne film of the liquid coating material extending from side to side across the open loop **10**. Some relative vertical movement between the loop and the film starting plate may take place in order to raise plate **22** close to

the loop initially to form the film. Once the film is established across the loop, plate **22** swings or slides to one side, and possibly down, in order to remove it from underneath loop **10**; and in the process of withdrawing the plate, film **20** is deposited upon the upper face of traveling web **11**. Once in contact with web **11**, the wet film adheres thereto and tends to be deposited upon the web continuously as it moves underneath the loop, thereby removing the film from the loop. However, the continuous supply of coating material to the loop replenishes the film at a rate sufficient to maintain the film intact across the loop, thus maintaining a continuous film in contact with the traveling web.

Moving at a substantial speed, web **11** tends by friction to move air with it, thus creating a substantial wind moving in the direction of the web. In order to isolate film **20** from this wind, shields **23** are provided at one or both sides of loop **10** in a position to block the wind from reaching film **20** and thus blowing it off the loop.

In order to help control the position of the film and, to the extent necessary, to displace the film downwardly off of loop **10** and onto the web **11**, means are provided for directing a gentle stream of air against the upper side of the film. As typical of such means, there is provided adjacent each of the longer sides of loop **10** a long, narrow air duct **24** which terminates a short distance above loop **10**. The air blown down through the two ducts **24** strikes the upper face of film **20** and is then deflected upwardly, leaving through the space between the two air ducts **24**. The temperature and humidity of the air stream are regulated to assist or retard drying of the film and the applied coating, as may be desired.

When it is desired to coat opposite faces of the web instead of one side only, the process may be modified to accomplish simultaneous coating of opposite sides of the web, using the apparatus illustrated in FIG. 2. This apparatus is constructed as previously described, except for the changes which will now be mentioned. In this case, the web is routed to provide a run of the web that is traveling substantially vertically. This allows the vertical run of web **25** to pass upwardly through open loop **10**. In this position, web **25** divides film **20** in such a manner that the web in effect passes through the film and consequently the film is in contact with and coats both of the opposite faces of the web. As before, the web is heated, as by suitable heating means at **16**, in order to set and harden the coating on the web, after which the web may pass over chilling roll **27** to further harden the coating before the coated web is wound up on rewind roll **18**.

Since the upward travel of web **25** tends to pull coating film **20** upwardly with it, the air ducts **24** are located as before to direct a gentle stream of air against the upper side of the web in order to control its shape and location. At this position, the stream of air is flowing counter to the direction of travel of the web and thus stabilizes the web against the tendency to move with the traveling web.

Since both sides of the web are being coated by film **20**, it is desirable to shield the film against the wind created by the traveling web by means which are disposed at both sides of the web. While any suitable apparatus for this purpose may be used, it is preferred to provide a pair of oppositely extending shielding arms **28**, disposed one at each side of web **25**, each arm terminating in a roller **29** which lightly bears against the web. The pair of rollers **29** completely block off wind created by friction with the web and offer maximum shielding of the film.

The present process is equally adapted to coating single sheets or cut blanks, particularly when they are to be coated only on one side. A typical situation of this character is a cardboard blank which has been cut in a manner to enable a box to be made from the blank, but which is still in a flattened condition. Such a blank can be coated according to the present invention, using apparatus as illustrated diagrammatically in FIG. 4.

Referring to FIG. 4, it will be seen that the apparatus involves an open loop **30** disposed in a generally vertical plane. Loop **30** is attached to support **31** by means by which the loop can be reciprocated vertically. Below loop **30** is reservoir **32** containing a supply of liquid coating material. By lowering loop **30** and immersing it in the body of coating material in tank **32**, a film is formed across the open loop, as at **33**. This liquid film is established across the loop by dipping the loop into the reservoir and will maintain itself for a time as an airborne film across the loop as the loop is raised out of the tank.

A blank **35** to be coated is placed on table **36** at one side of the loop, the table being pivotally mounted so that by swinging the table about its mount, the blank is brought into contact with the web and one face of the blank is coated. The table is next then lowered below its starting position to some such position as indicated at **36***a* and the coated blank **35***a* is slid off the table as indicated by arrow **37**. After this, the table returns to its starting position to receive another blank which is coated in the same manner.

Thus it will be seen that the present invention is adapted to batch treatment as opposed to continuous coating, in which case a film is repeatedly formed across an open loop, each film being deposited upon an article to be coated.

From the foregoing description, it will be understood that various changes in the details of the method and apparatus constituting the present invention may be made by persons skilled in the art without departing from the spirit and scope of the present invention. Accordingly, it is to be understood that the foregoing description is considered as being illustrative of, rather than limitative upon, the invention as defined by the appended claims.

I claim:

1. The method of coating an article that comprises:
establishing a film of liquid coating material across an open loop; and
passing the article to be coated through the loop to deposit the film on the article.

2. The continuous method of coating a sheet-like web that comprises the steps of:
establishing an air-borne film of liquid coating material across an open loop;
moving the web to be coated over a path in close proximity to the loop and in position to receive the film on the moving web;
directing a stream of gas against one side of the film to control the position of the film and continuously exhausting said gas from said one side of the film; and
continuously supplying material to the loop to replace the deposited film at the loop.

3. The continuous method as in claim **2** in which the film is deposited on one face of the web.

4. The continuous method as in claim **2** in which the web is passed through the loop and the film is deposited on opposite faces of the web.

5. The continuous method as in claim **2** in which the coated web is next heated to dry and harden the coating.

6. The method of continuously coating a surface on a continuous web that comprises the steps of:
establishing a film of liquid coating material across an open loop having an open side lying substantially in a plane;
disposing the web with said surface to be coated facing and closely adjacent the loop and moving the web past the loop in a substantially straight path parallel to the plane of the open side of the loop; and
continuously supplying material to the loop to replace film deposited on the web.

7. The method according to claim **6** which also includes the step of directing a stream of air generally perpendicular to the web and against the film to deflect the film against the web.

8. The continuous method of coating a sheet-like web that comprises the steps of:

establishing an air-borne film of liquid coating material across an open loop;

moving the web to be coated in a generally vertical path through the loop and depositing the film on the moving web;

directing a stream of air against the film on the loop in a direction counter to the direction of web movement to control the deposition of the film; and

continuously supplying material to the loop to replace the deposited film at the loop.

9. The continuous method of coating a sheet-like web that comprises the steps of:

establishing an air-borne film of liquid coating material across an open loop;

moving the web to be coated through the loop and the film and depositing the film on opposite faces of the moving web; and

continuously supplying material to the loop to replace the deposited film at the loop.

10. Apparatus for coating a traveling web, comprising:

an open loop having an open side lying in a substantially horizontal plane;

means continuously supplying liquid coating material to the loop;

means for establishing a film of said liquid coating material across the loop; and

means for moving the web continuously past the loop in a generally horizontal direction below and parallel to the plane of said loop and at a position closely adjacent to said loop to receive the film from the loop.

11. Apparatus as in claim 10 which also includes means directing a stream of air against the upper face of the film deflecting the film down onto the web and means

continuously exhausting said air from the space adjoining the upper face of the film.

12. Apparatus for coating a traveling web, comprising:

an open loop;

means continuously supplying liquid coating material to the loop;

means for establishing a film of said liquid coating material across the loop; and

means for moving the web continuously past the loop at a position to receive the film from the loop, the last-mentioned means including means directing the web over a generally vertical path through the loop to coat opposite faces of the web.

13. Apparatus as in claim 12 which also includes means at each side of the web directing a stream of air against the film.

14. Apparatus for coating a sheet-like blank, comprising:

an open loop;

a reservoir containing liquid material for coating the blank;

means for dipping the loop in the reservoir to form thereon a film of said liquid coating material; and

means for moving the blank against the film on the loop to coat the advancing face of the blank.

15. Apparatus as in claim 14 in which the last-mentioned means comprises a pivotally mounted arm at one side of the loop and swinging the blank against the film.

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