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[54] COATING DOCTOR APPARATUS

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Related U.S. Application Data

[63] Continuation of Ser. No. 28,741, April 15, 1970, abandoned.

[52] **U.S. Cl.** **118/63**

[51] **Int. Cl.** **B05c 11/06**

[58] **Field of Search** ..... 118/63, 21; 15/306 A; 117/102 L; 34/152, 160

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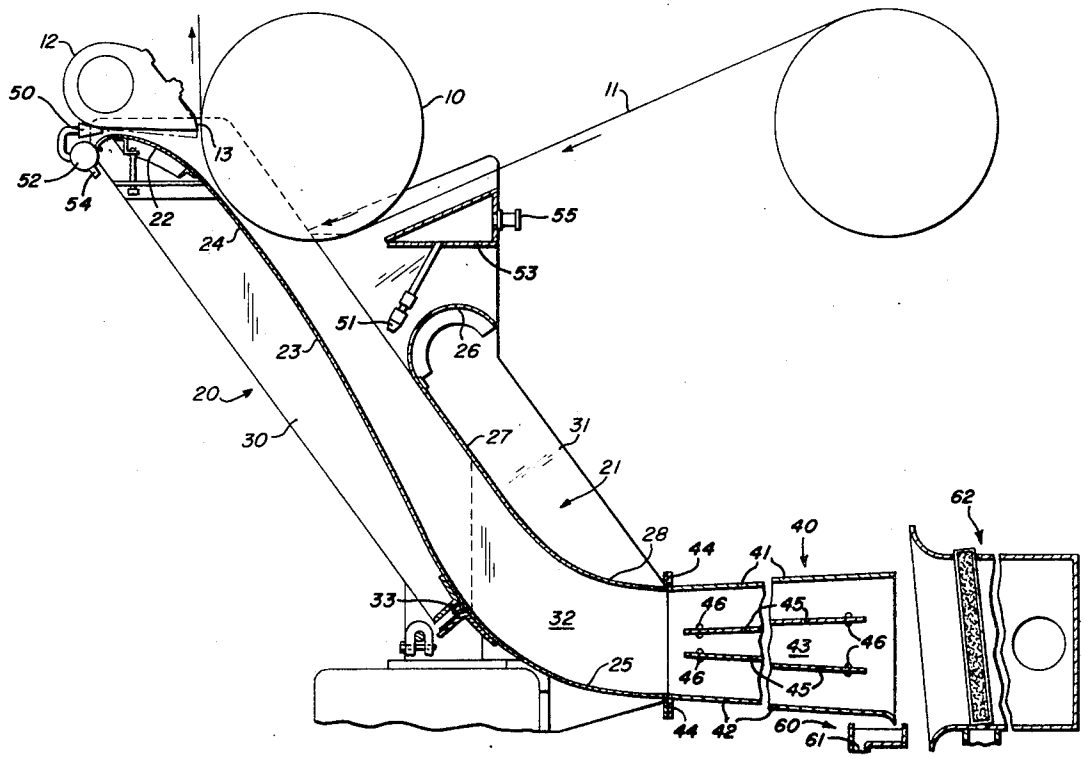
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[57] **ABSTRACT**

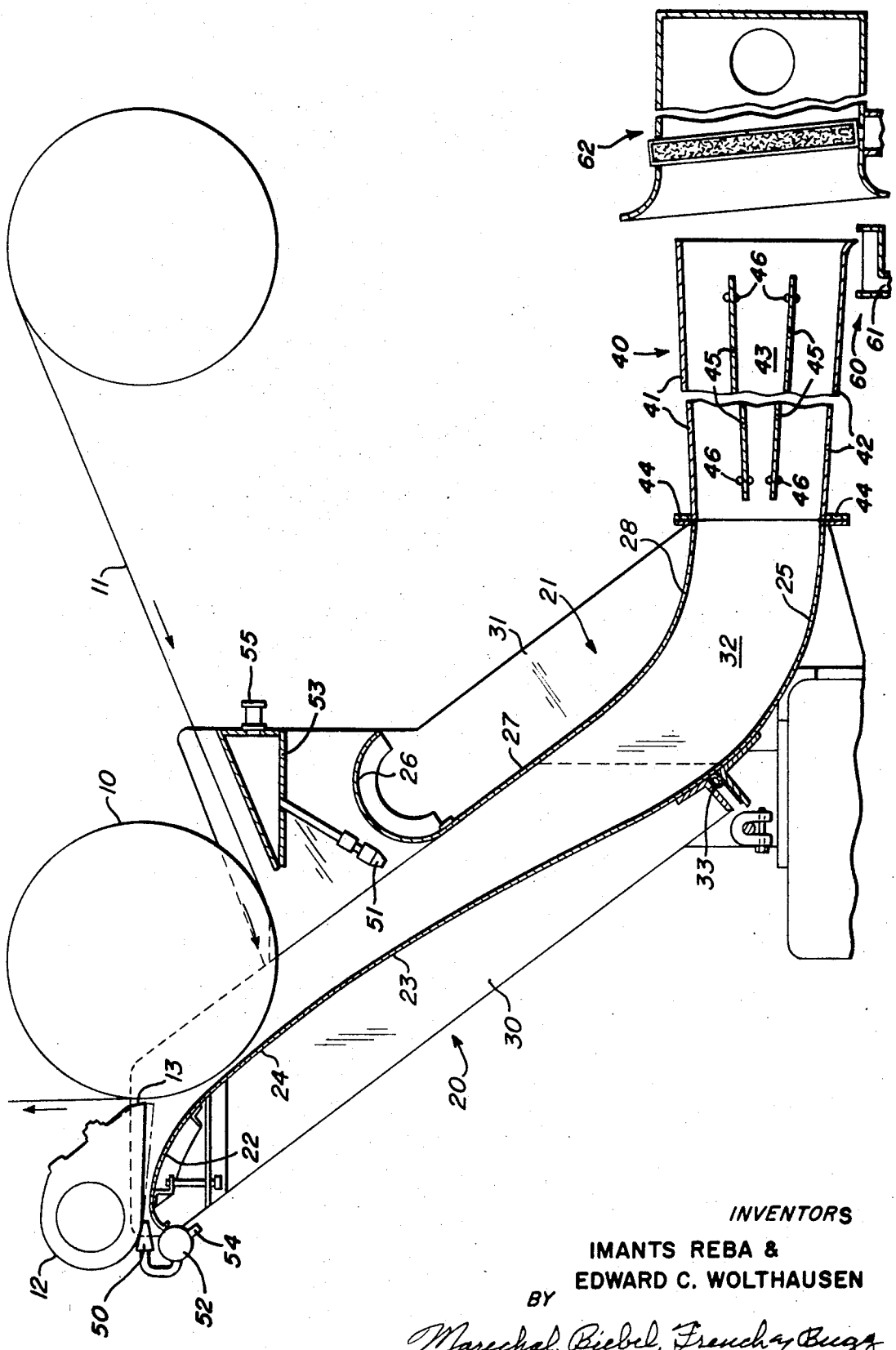
In coating doctor apparatus in which an air doctor is used to remove coating from a freshly coated web trained about a backing roll, internal baffles are eliminated and the contours of the coating return chamber are designed using flow control principles so that strong vortices and attendant misting are avoided in the coating return chamber, while at the same time subambient pressures generated along the curved surfaces of the chamber cause strong entrainment of air through the spaces between the edges of the coating chamber and the backing roll and air doctor and prevent coating material from escaping from the coating system.

11 Claims, 1 Drawing Figure



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COATING DOCTOR APPARATUS

This application is a continuation of Ser. No. 28,741, filed Apr. 15, 1970, now abandoned.

BACKGROUND OF THE INVENTION

Coating systems which utilize an air knife to doctor excess coating from a continuous web have found wide spread use in the industry as a result of the many advantages offered by this type of doctoring system over those using doctor rods, scrapers and the like. Despite the many advantages of the air knife type of doctoring system, one well recognized disadvantage of such systems is the difficulty in preventing the doctored coating from escaping from the coating system. This not only constitutes a health hazard but may also cause malfunctioning of the coater components and other machinery in the area by settling out on them.

Various remedies have been proposed as a solution to this problem. Generally they have taken the form of enclosing the doctoring area with a coating return chamber with the edges of the coating return chamber positioned as closely as possible to the air doctor and the backing roll to provide as air tight an enclosure as possible. Additionally, baffles are used within the coating return chamber to deflect coating removed by the air doctor down into the chamber, from whence it is withdrawn, usually through the use of vacuum pumps or the like.

It will be apparent, however, that there is a practical limit to the extent to which the edges of the coating return chamber and the baffles may be placed in proximity to the backing roll and the air doctor blade. Additionally, it has been found that by placing the baffles very close to the backing roll, which they must to be effective, a secondary atomization of the coating is caused, resulting in a mist which coats the air doctor's underside and also tends to escape through the gap between the air doctor and the return chamber wall.

It has also been found that existing coating return chamber geometry induces strong vortex flows which cause misting, foaming, precipitation, and drying of the coating material, and the intensity of these vortex flows within the coating return chamber actually increases with increasing baffle effectiveness.

SUMMARY OF THE INVENTION

A coating doctoring system according to the present invention eliminates the necessity of baffles or the like and the positioning of both edges of the coating return chamber in close proximity to the backing roll and air doctor. In fact, one of the upper edges of the coating return chamber is purposely spaced from the backing roll since the design of the coating return chamber, based upon flow control principles, results in a strong entrainment of air between the edges of the coating return chamber and the backing roll which prevents the escape of coating mist from the system.

At the same time, the elimination of baffles in the coating return chamber and the particular shape of the return chamber itself minimize misting caused by secondary atomization and the generation of vortices within the chamber.

Additionally, the shape of one of the chamber walls is such that the coating removed tends to attach to this wall, from which it is collected for recirculation.

It will also be seen that atomizing nozzles may be utilized to spray a fine mist of water into the coating chamber to precipitate coating particles and permit their ready removal from the system along with the liquid coating attached to one wall of the coating return chamber.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE shows a coating doctoring system according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As seen in the drawing, the coating doctoring system includes a backing roll **10**, about which is trained a freshly coated web **11**, the latter being carried by the backing roll **10** in the direction indicated by the arrows past an air doctor **12**. The air doctor has an outlet **13** through which is ejected a high velocity jet of air to remove excess coating carried by the web **11**, and means, not shown, may be provided for varying the position of the air doctor from its solid line position to that shown in dotted lines in the drawing.

Positioned beneath the air doctor and backing roll is a coating return chamber, the main components of which are a flow control wall **20** and a shroud **21**. The flow control wall **20** includes a convexly curved inlet end **22** and a convexly curved throat section **23** joined to the inlet section by a planar section **24**, while the shroud **21** consists of a curved entry end **26** and a substantially planar throat section **27**. Additionally, both the flow control wall and shroud may be provided with concavely curved terminal portions **25** and **28**, respectively, which, by gently turning the air flow through the coating return chamber, conserve space but still maintain a uniform air stream through the system.

The flow control wall and shroud are provided with side plates, as at **30** and **31**, and end walls, one of which is shown at **32**, extend between the flow control wall and shroud to complete the enclosure. It will also be seen that portions of side plates **31** extend upwardly to enclose a portion of the web and backing roll to prevent air flow into the system from the sides. Additionally, wall **20** may be provided with a hinge **33** to permit the upper part of the wall to be pivoted downwardly for ready access to the interior of the coating return chamber for cleaning, maintenance, and the like.

It will be noted that the planar section **24** forms, with the opposed surface of the backing roll **10**, a narrow slot, on the order of approximately ⅜ inch, through which the air stream passes as a high velocity jet. It will also be noted that the radius of curvature of section **23** is appreciably greater than that of the backing roll **10**. In a physical phenomenon known as the Coanda Effect a tendency exists for a high velocity flow from a narrow slot to attach itself to a curved surface. Further observation indicates that where this flow is between a pair of curved surfaces, the flow will attach to the surface having the greatest radius of curvature. Thus, by creating a high velocity jet by means of the planar section **24** and positioning the curved section **23** with a radius of curvature appreciably greater than that of backing roll **10** immediately downstream of the section **24**, coating carried by the air flow from the air doctor will tend to

attach itself to the flow control wall surface rather than reattach itself to the curved surface of the web trained about the backing roll upstream of the point of coating removal.

It will be apparent from the drawing that the inlet end of the shroud **21** is spaced an appreciable distance from the backing roll **10** and in an installation this distance was set at approximately 4 inches. This is contrary to conventional coating return chamber construction in that in conventional construction both walls of the coating return chamber are positioned as closely as possible to the backing roll and air doctor blade to prevent the escape of coating mist. In the present system, however, the geometry of the coating return chamber is such as to create a strong entrainment of air between both the flow control wall **20** and the bottom of the air doctor blade **12** and the backing roll **10** and the entry end of the shroud and the backing roll.

As noted above, conventional coating return chamber design in which the walls of the chamber are positioned in close proximity to the backing roll and air doctor blade tends to create vortices within the coating return chamber which in turn generate coating mist. In the coating return chamber of the present invention, however, it will be seen that the flow control wall **20** and shroud **21** extend downwardly away from the backing roll in gently diverging relationship. It will also be noted that the inlet end of the shroud is spaced from the backing roll a distance at least equal to and preferably greater than the minimum spacing between the deflection wall **20** and the shroud **21**. These two design features result in a smooth flow of air through the two inlets into the coating return chamber adjacent the inlet end **22** of the flow control wall and the entry end **26** of the shroud, thence through the throat section of the coating return chamber and outwardly through the diffuser section **40**.

Diffuser section **40** includes diverging upper and lower walls **41** and **42**, side walls, one of which is shown at **43**, and flanges **44**, which are secured to complementary flanges on the terminal portions of the flow control wall, shroud and side walls **32**. Vanes **45** extend transversely of the diffuser section and are provided with threaded studs, not shown, which extend through slots **46** in the walls **43** and are secured therein by nuts, also not shown, to permit some vertical adjustment of the vanes.

The diffuser section performs several important functions in the coating doctor system. Thus, since the cross sectional area of the diffuser increases in the downstream direction the velocity of the fluid flow at this point is appreciably, but not abruptly, reduced. Additionally, the use of vanes in the diffuser gives a more uniform velocity profile at the exit end thereof. As a result, if for some reason a back pressure is inadvertently created at the diffuser exit it will have a decreased effect on upstream air flow.

Although the elimination of baffles and the avoidance of strong vortices within the chamber prevent the generation of coating mist by either of these two factors, there will nonetheless be some coating mist generated by the impingement of the air jet upon the coated web, particularly when operating at high speeds. While most of the mist so generated combines with the rejected liquid coating at the narrow slot formed by the flow control wall and the backing roll, some mist is entrained in the air flow. Reduction of this mist may be accomplished by spraying moisture into the chamber. Thus, atomizing nozzles **50** and **51** are positioned adjacent the inlet end **22** of the flow control wall and the entry end **26** of the shroud. Nozzle **50** is supplied by means of a manifold **52** and nozzle **51** by means of a manifold **53**, with both manifolds being connected to a suitable source of liquid by means of conduits **54** and **55**, respectively. Water issuing from the nozzles **50** and **51** emerges as an extremely fine spray, capturing any coating particles and then falling to the wall **20** with the liquid coating removed from the coated web **11**.

Immediately beneath the exit end of the diffuser a sump **60** having a downwardly depending drain **61** is positioned to receive liquid coating attached to wall **42**. If desired, a filter chamber **62** may be positioned in spaced relationship to the exit end of the diffuser to receive exhaust air along with some ambient air.

It will thus be seen that the present invention, while eliminating the need for baffles and positioning both edges of the coating return chamber walls in extremely close proximity to the air doctor and backing roll, provides greatly improved removal of the doctored coating from the doctoring area.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Coating apparatus comprising:

a. a backing roll adapted to carry a coated web in a downstream direction,

b. an air doctor blade having portions including a bottom wall portion defining an outlet positioned adjacent said backing roll to direct a jet of air in an upstream direction against a coated web carried in a downstream direction by said backing roll,

c. a flow control wall having an inlet end positioned adjacent said bottom wall,

d. said flow control wall extending from said bottom wall in an upstream direction to a point opposite and in closely spaced relationship to said backing roll,

e. said flow control wall and said backing roll defining a narrow slot at said point,

f. said flow control wall extending from said slot downwardly and in said upstream direction in a curve having a radius of curvature greater than the radius of said backing roll, and

g. a shroud extending in spaced, opposed relationship to said flow control wall and having an entry end positioned upstream of said inlet end of said flow control wall,

h. said entry end of said shroud being spaced from said backing roll a distance substantially greater than the spacing between said flow control wall and said backing roll at said point.

2. The apparatus of claim **1** wherein:

a. said shroud and said flow control wall extending in downwardly diverging relationship to each other.

3. The apparatus of claim **2** wherein:

a. the spacing between said entry end and said backing roll is approximately equal to the minimum spacing between said shroud and said flow control wall.

4. The apparatus of claim 2 wherein:

a. the spacing between said entry end and said backing roll is greater than the minimum spacing between said shroud and said flow control wall.

5. The apparatus of claim 1 wherein:

a. said flow control wall and shroud terminate in opposed terminal portions, and

b. a diffuser section is attached to and extends from said terminal portions

c. said diffuser having wall portions extending in diverging relationship to each other from terminal portions.

6. The apparatus of claim 5 further comprising:

a. vanes positioned in said diffuser section in spaced relationship to said diverging wall portions.

7. The apparatus of claim 6 wherein:

a. portions of said diffuser section define an exit end thereof, and

b. a sump is positioned beneath said exit end of said diffuser to collect liquid coating therefrom.

8. The apparatus of claim 7 further comprising:

a. a filter chamber having an open end positioned in spaced relationship to said diffuser section with said open end facing said exit end, and

b. a filter extending across said open end.

9. The apparatus of claim 1 further comprising:

a. means for injecting moisture into the area defined by said flow control wall and said shroud.

10. The apparatus of claim 9 wherein said moisture injecting means comprises:

a. an atomizing nozzle positioned adjacent said inlet end,

b. an outlet of said nozzle being directed between said inlet end and said bottom wall.

11. The apparatus of claim 9 wherein said moisture injecting means comprises:

a. an atomizing nozzle positioned adjacent said entry end of said shroud,

b. an outlet of said nozzle being directed between said entry end and said backing roll.

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