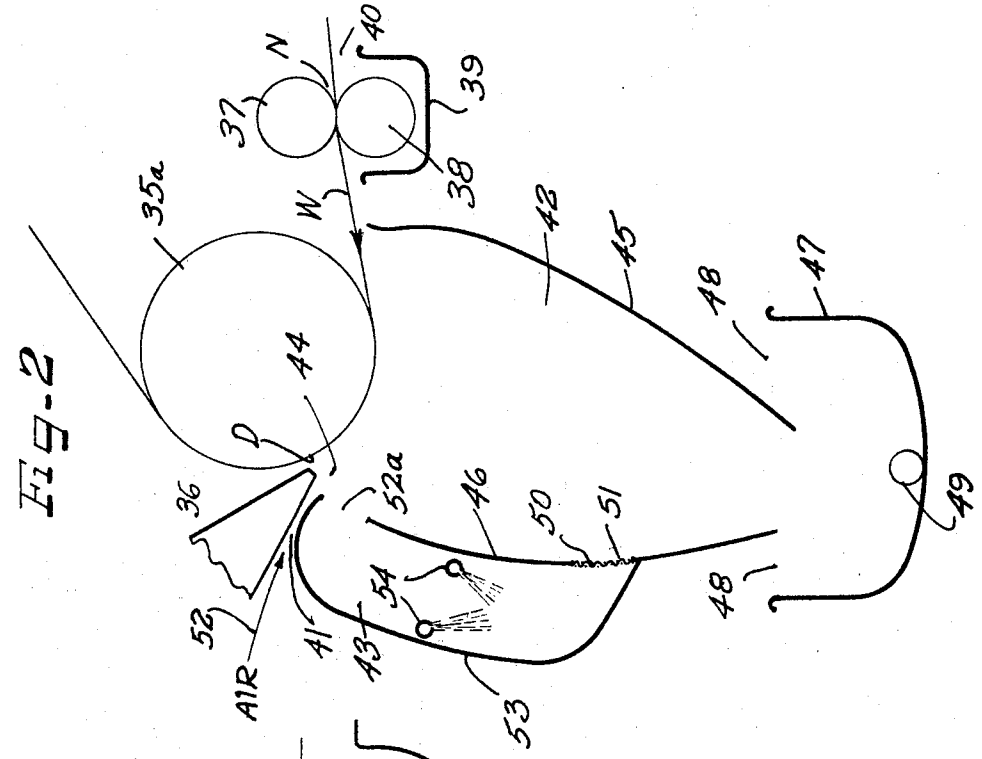
Aug. 20, 1968 R. P. MAHONEY ET AL 3,397,673

AIR KNIFE COATING PAN

Filed Feb. 14, 1966 2 Sheets-Sheet 1



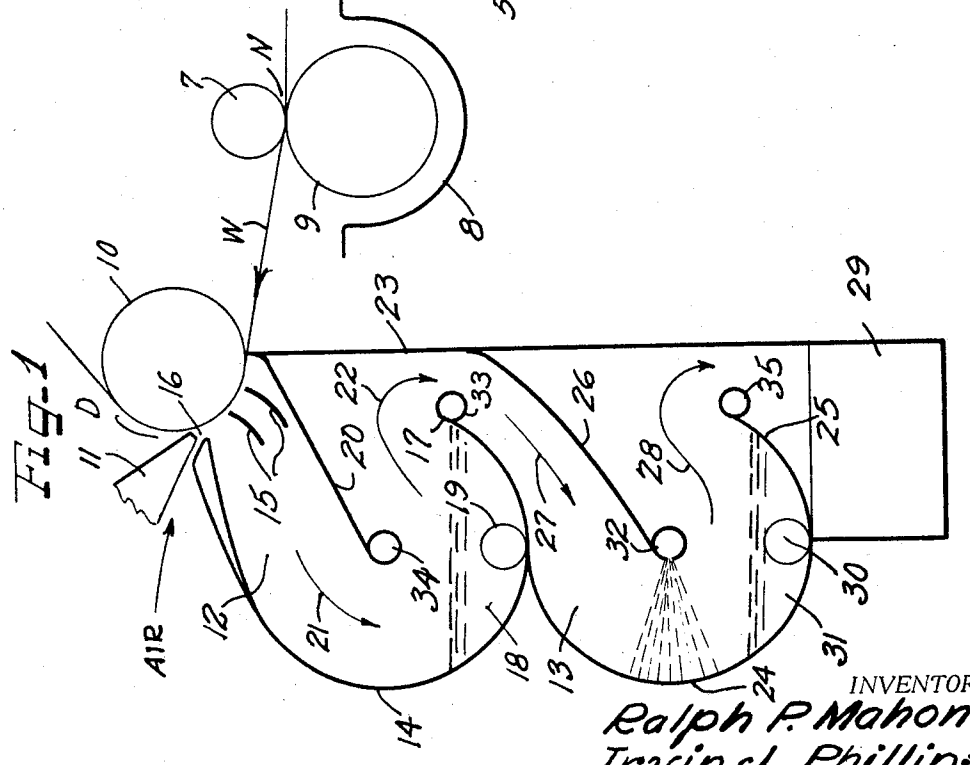


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Fig. 5

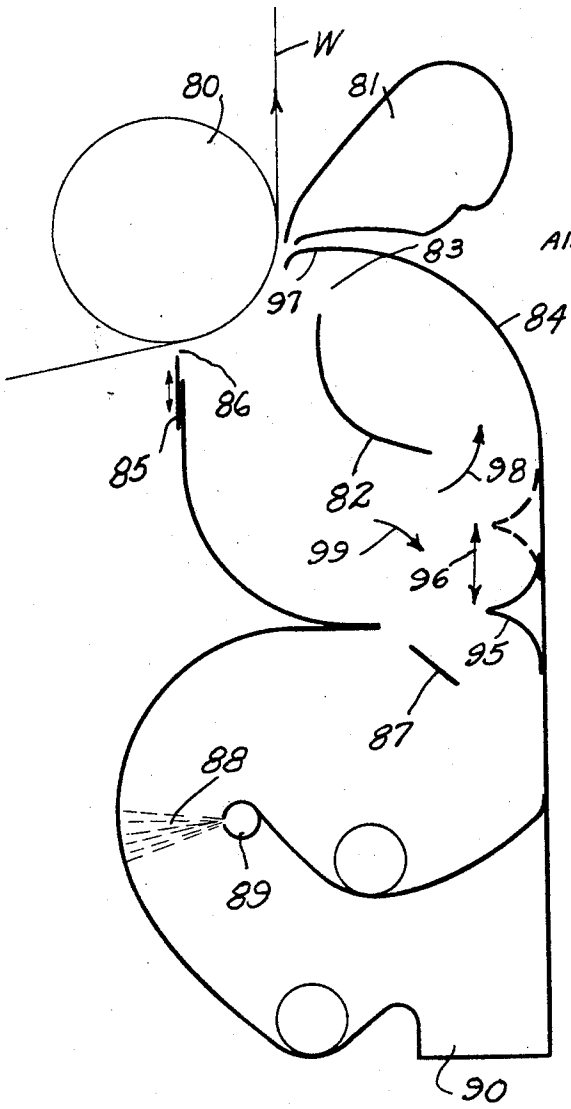


Fig. 3

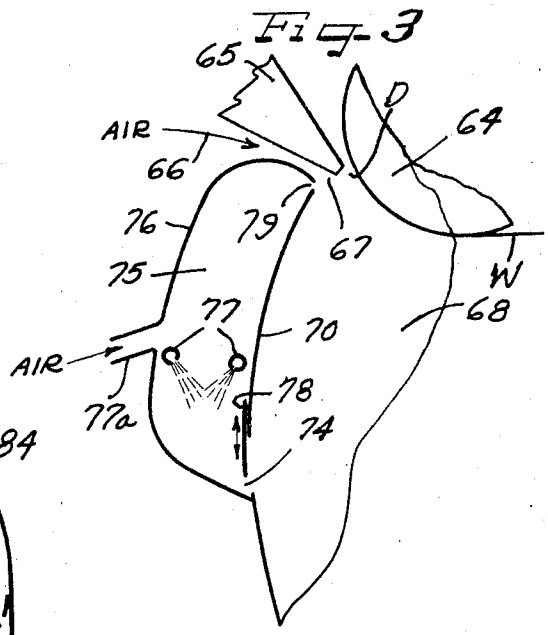
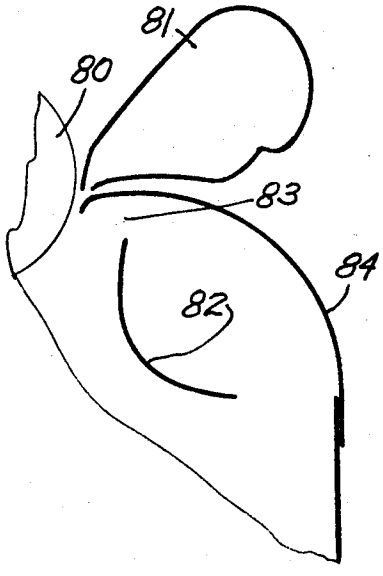


Fig. 4



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AIR KNIFE COATING PAN

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ABSTRACT OF THE DISCLOSURE

A coating mechanism for coating a traveling web wherein a layer of coating is applied to the web and an air knife smooths the coating. The mechanism is provided with a series of baffled chambers for depositing and collecting the mist formed by the coater with pools of liquid for receiving the collected mist.

The present invention relates to improvements in traveling web coating mechanisms and more particularly to an improved air knife coater of the type used in paper paper web coating.

While the principles of the invention may in some circumstances be employed in coating various materials the features are particularly well adapted to use in coating a traveling paper web and the preferred embodiment will be described in connection with this environment. In air knife coating a layer of coating is first applied to a traveling web and the web is supported for stability on a backing roll with a curtain of relatively high velocity air directed against the oncoming web to smooth the coating surface and in some instances doctor off excess coating. The velocity of the air emitted from the air knife which is necessary for a satisfactory doctoring process, and the speed of the oncoming web tend to create a mist of particles of coating entrained in the flow of air which deflects off of the web. This becomes particularly true at increased web travel speeds, and with paper machine advancements and improvements and the necessity for increased production, higher web travel speeds become very desirable. The resultant mist reaches a stage so as to become prohibitive and tends to deposit in particles on the smooth coated web beyond the air knife. The particles of mist tend to become partially dried in the air and in depositing on the coated web cause imperfections therein. The mist also is undesirable in that it contaminates the surrounding air, deposits on machine parts and is annoying and disadvantageous to personnel and to other operations in the surrounding area. Attempts have heretofore been made to reduce the mist but devices contrived have not proven entirely successful.

It is accordingly an object of the present invention to provide an improved air knife coater embodying an apparatus for reducing and substantially eliminating undesirable mist created by the air knife.

A further object of the invention is to provide an improved mechanism for reducing the mist in an air knife coater which permits coating at higher speeds than possible with conventional air knife coaters and even those provided with mist reducing apparatus of the type heretofore available.

Yet, another object of the invention is to provide a mist collecting apparatus for an air knife coater which will carry away and capture the mist from the air permitting substantially clean air to be exhausted and permitting a useful collection of excess coating and mist for processing and re-use.

A feature of the invention in a preferred embodiment thereof employs means for applying coating to a traveling web supported on a backing roll with first and second

mist collecting chambers sequentially below the doctoring zone each provided with a concave back wall and a lower front wall over which the air escapes with a divider extending angularly into the chamber having upper surface facing the concave back wall and lower surface facing the lowered front wall and with the mist directed into the first chamber by curved baffles, with the chambers and walls arranged so that the mist carrying air flows through a path causing a series of air reversals and the heavier particles become deposited on the walls and the liquid coating is carried off and the cleaned air remains to be vented from the mechanism.

Other advantages, features and objects of the invention will become more apparent with the teaching of the principles thereof in connection with the disclosure of the preferred embodiments thereof in the specification, claims and drawings, in which:

FIGURE 1 is a schematic side elevational view of a mechanism constructed and operating in accordance with the principles of the present invention;

FIGURE 2 is a side elevational view shown in somewhat schematic form of a modified arrangement of an air knife coater and a mist collecting device;

FIGURE 3 is a fragmentary schematic side elevational view of a modified arrangement of the structure of FIGURE 2;

FIGURE 4 is a fragmentary schematic side elevational view of another arrangement; and

FIGURE 5 is a schematic side elevational view of a further form of the invention.

On the drawings:

FIGURE 1 illustrates a web W having coating applied to the surface thereof such as by a coating applicator roll **9** forming a nip N with an upper roll **7** and receiving coating from a pan **8**. The roll **9** is positioned to be submerged in the pan **8** a distance so that coating is carried up into the nip N sufficient to flood the nip so that the web is submerged before being pressed in the nip for improved hydraulic pressure coating. The offrunning side of the nip is exposed to atmospheric pressure.

The coated web W travels onto a backing roll **10** and in a doctoring zone D an air knife **11** directs a sheet of doctoring air against the oncoming surface of the web W. This smooths and removes excess coating. The high velocity air emerging from the air knife **11** and the oncoming web W creates a substantial coating mist below the doctoring zone.

With the present arrangement the doctoring air after it has engaged the web, and the entrained coating particles forming the mist pass downwardly successively into a first chamber **12** and a second chamber **13**.

The first chamber **12** has a back or rear wall **14** which is curved and concave to face the oncoming web and the upper edge of the wall **14** forms a throat **16** which tapers toward the backup roll **10** to aspirate an amount of ambient air with the air entraining the mist.

Concave baffles **15** curve the air downwardly into the chamber **12** against the rear wall **14**. The air and mist flow downwardly in the direction indicated by the air flow arrow **21** and the air changes direction reversing itself in the direction of the arrow **22**. The heavier entrained particles tend to be thrown centrifugally outwardly against the rear wall **14** and down into the puddle of coating **18** which is formed by the wall **14** which curves downwardly and upwardly to form a front wall **17**. A coating removal drain is provided draining off coating preferably maintaining it below the level of the upper edge of the front wall **17**.

To cause the air flow to reverse itself within the first chamber **12**, a downwardly angled divider wall **20** is positioned having an inclined upper surface facing the con-

cave rear wall **14** and a downwardly facing lower surface facing the front wall **17**.

As will be understood, the chamber **12**, and the walls which define the chamber extend across the coating machine parallel to the backing roll **10** in order to capture the entire flow of air from the air knife **11**.

Facing the opening through which the air flows over the top of the front wall **17** is a closing wall **23** which extends vertically downwardly to provide a support for the first divider wall **20** and the second divider wall **26**, and to aid in defining the air flow path.

The air next successively flows down into the second chamber **13** as indicated by the arrowed line **27**.

The second chamber **13** has a concave rear wall **24** which faces the air flow and the air turns downwardly beneath the second divider wall **26** following the path indicated by the arrowed line **28**. Any coating particles suspended in air flow downwardly. Below the second chamber **13** is a coating pool **31** held in a pan formed by the lower extension of the rear wall **24**, and the wall turns upwardly in a front wall **25**. The air flows over the upper edge of the front wall and down into an exhaust duct **29** which may be provided with a blower for removal of the air which by this time is substantially clear of coating mist. Coating from the second chamber **13** is retained in the pool **31** being removed by coating drain **30** which maintains the coating below the upper edge of the front wall **25**.

As the coating flows downwardly through the second chamber **13** it moves through a mist shower provided by an elongate horizontal shower pipe **32** positioned at the lower edge of the second divider wall **26**. Other showers may be located across the path of air flow if desired, such as at the locations shown at **33**, **34** and **35**. These will be arranged to direct a spray of water substantially horizontal across the air flow path. The shower path **33** is positioned at the upper edge of the front wall **17**, the shower pipe **34** is positioned at the lower edge of the first divider wall **20**, and the shower pipe **35** is positioned at the upper edge of the front wall **25**.

In operation of the arrangement of FIGURE 1, the mist created by the air knife **11** directing air into the doctoring zone D toward the oncoming web W flows downwardly through the first and second chambers **12** and **13** to reverse itself at least four definite times as indicated by the flow arrows **21**, **22**, **27** and **28**. The flow paths are arranged by the shape of the walls so as to effect a continual turning or changing direction of the air flow so that centrifugal force continually acts on the heavier particles tending to deposit them on walls which define the outer surface of the changing direction air flow path. In addition to capturing the particles, the air flow is entirely contained during the period of time while it is being treated so that mist particles do not escape into the surrounding air to deposit on machinery or the coated web.

FIGURE 2 illustrates another form wherein a traveling web W is supported by a backing roll **35***a* while being subjected to a doctoring action in a doctoring zone D by an air knife **36**.

Prior to the doctoring coating is applied to the lower surface of the web W by a pair of coating applicator rolls **37** and **38**, with the lower roll **38** being at least partially submerged in a pool of coating within a coating pan **39**. The submergence is adequate so that a coating pool builds up in the nip N to submerge the nip on the side of the web which is to be coated.

The air from the air knife with the entrained mist flows downwardly through a throat **44** into a first chamber **42** formed by downwardly extending concave walls **45** and **46**. Air is entrained through an ambient air throat **41** as indicated by an air flow arrow **52**, and in some instances a forced supply of air may be provided at this location to better carry the mist downwardly into the chamber **42**. Coating which settles out of the air in the expansion chamber **42**, wherein it reduces its velocity so the heavier particles can drop out, will flow downwardly into a pan **47** with a drain outlet **49** therein. The air is then permitted escape through the sides **48** of the pan and is preferably led to an exhaust system.

A portion of the air is aspirated upwardly through a second chamber **43** bounded by the wall **46** and an outer wall **53**. The air flows from the first chamber through a side opening **50** which may be opened, or which may be provided with a screen **51** on which additional particles of coating can deposit.

In the second chamber **43** the air may be subjected to water sprays **54** to further cleanse the air particles although experience has shown that possibly 99% of the coating mist will be removed from the air in the first chamber **42**.

The air flows upwardly through the second chamber **43** through an opening **52***a* to commingle with the mist which flows downwardly from the doctoring zone D. This additional air is aspirated out of the second chamber **43** and tends to slow the velocity of the air passing downwardly from the air knife **36**.

FIGURE 3 shows another modified arrangement of FIGURE 2 wherein a web W has coating applied to the lower surface thereof in a coating nip N formed between upper and lower applicator rolls not shown. The lower roll receives coating from a pan not shown to form a submerged nip on the onrunning side of the nip. The web is supported by a backing roll **64** and on the uprunning side of the backing roll an air knife **65** directs a flow of doctoring air into a doctoring zone D. Excess air flows downwardly with mist entrained therein into a first chamber **68** with an amount of ambient air being aspirated as indicated by the arrowed line **66**. The first chamber is defined between downwardly converging concave walls with wall **70** shown, and a coating receiving pan not shown, is located below the first chamber. Excess air escapes laterally through suitable openings, and a coating drain, now shown, is provided at the base of the pan. The parts not shown are similar to FIGURE 2.

A portion of air is let off laterally through an opening **74** leading to a second chamber **75**. The opening **74** is controlled, such as by sliding valve or gate **78** which is adjusted to a predetermined size as indicated by the double arrowed line. The upwardly ascending air in the second chamber **75** may pass through a water spray provided by spray tube **77**.

Additional ambient air is provided by an air supply **77***a* which flows upwardly through the chamber **75** through an upper outlet opening **79** leading to the first chamber **68**. The outlet opening mingles the air from the second chamber **75** with the mist entraining air from the air jet. The second chamber is defined between the wall **70** and an outer wall **76**.

As shown in FIGURE 4, a web is carried on a backup roll **80**, with coating on the surface, and subjected to a curtain of air from an air-knife **81**. The resultant mist passes through a throat **83** formed between a baffle **82** and an enclosing housing **84** with the droplets tending to be captured on the wall of the housing **84**.

FIGURE 5 shows an embodiment utilizing the features of FIGURE 4 in one arrangement wherein the housing is provided with an adjustable door **85** to control the side of the throat **86**.

The mist passes downwardly past a straight baffle **87** and through a throat **88** wherein mist particles are enveloped in a water spray from a spray tube **89**. The cleansed air passes outwardly through an outlet **90**.

An adjustable shaped baffle **95** may be positioned on the wall of the housing **84** to direct a portion of the air upwardly as shown by the arrowed line **98**, with the other portion of the air traveling downwardly as indicated by the arrowed line **99**. As the baffle **95** is shifted upwardly to its dotted line position, the amount of air recirculated through the path indicated by the arrowed line **98** is re-

duced. The adjustment is by a suitable mechanism shown schematically by the arrowed line **96** and adjustment may be made until the desired effects are obtained. Primarily this recirculation of air upwardly in the direction of the arrowed line **98** will tend to keep the lower surface of the lip at **97** clean of coating mist. The amount of air necessary to keep this location **97** clean is controlled by adjusting the baffle **95**.

Thus it will be seen that we have provided an improved air knife coater with mist removal and control apparatus which meets the objectives and advantages above set forth. The air is under complete control so that mist does not escape into the surrounding atmosphere and the mist is recovered within the apparatus. The apparatus is relatively simple so that it can be cleaned and maintained and the walls will be made so they can be removed for cleaning or easily washed down during periodic maintenance times.

It has been discovered that the arrangement will accommodate intense mist created with high speed operating mechanism without permitting the mist to escape in the air and effectively removing the mist. In present commercial devices speeds of 1150 feet per minute are commonly used with higher speeds being prohibited because of the mist which is generated. With the present arrangement speeds on the order of 1900 feet per minute have been found to be quite feasible and the mist can be effectively handled and controlled, thus greatly enhancing production speeds. The present arrangement also permits a greater amount of flexibility in operation of the air knife device and an improved product with coating which has been doctored in an improved manner will result. Further, the coating does not become damaged by the deposit of surrounding mist particles.

The drawings and specification present a detailed disclosure of the preferred embodiments of the invention, and it is to be understood that the invention is not limited to the specific forms disclosed, but covers all modifications, changes and alternative constructions and methods falling within the scope of the principles taught by the invention.

We claim:

1. An air knife coater for coating a traveling web comprising in combination:

a backing roll for carrying a traveling web, means applying coating to the surface of the web,

an air knife positioned on the uprunning side of the roll directing a flow of smoothing air against the oncoming surface of the web in a doctoring zone,

means defining a first chamber below said doctoring zone receiving air and mist flowing downwardly, pan means below said first chamber receiving liquid coating from mist deposited out of the air,

and a second chamber receiving air from the first chamber and having upper opening directing air to commingle with air entering said first chamber.

2. The air knife as defined in claim **1** wherein said second chamber includes an opening at its lower end communicating with the first chamber to receive air therefrom and an opening at its upper end for directing air into the first chamber commingling with air from the doctoring zone.

3. The air knife as defined in claim **1** including means directing an air stream of ambient air in advance of the first chamber to commingle with air and mist entering said first chamber from said doctoring zone and from said second chamber.

4. The air knife as defined in claim **1** wherein said first and second chambers include a common passage for heavy flow of air from the first to the second chamber, and a screen in said passage collecting mist from air passing therethrough.

5. The air knife as defined in claim **1** including means controllably adding air to said second chamber for an increased predetermined regulated flow through said upper opening to commingle with air entering the first chamber.

6. The air knife as defined in claim **1** wherein said second chamber includes a lower opening receiving air from the first chamber, and means controllably changing the area of said lower opening whereby the flow of air into the second chamber is controlled.

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