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(54) **APPARATUS AND METHOD OF MINIMIZING SKIP COATING ON A PAPER WEB**

VORRICHTUNG UND VERFAHREN ZUR MINIMIERUNG VON BESCHICHTUNGSLÜCKEN AUF  
EINER PAPIERBAHN

DISPOSITIF ET PROCÉDE DE REDUCTION AU MINIMUM DES SAUTS D'ENDUIT SUR UNE  
BANDE DE PAPIER

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**CA-A- 2 101 358**                      **US-A- 4 299 188**  
**US-A- 4 534 309**

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## Description

### Background of the Invention

The present invention relates to a method of and apparatus for applying liquid coating material onto a moving web of paper, and in particular to a coating method and apparatus of the fountain applicator type.

Coating a web of paper is generally effected by the application of a liquid coating material onto a moving web. The coating material may be comprised of a solid constituent suspended in a liquid carrier. The quality of the coating applied onto the paper web depends upon a number of factors, and important one of which being how the material is applied. The application of the coating material should preferably result in a coating that is continuous and uniform across the web.

One method previously used to coat paper webs was to feed liquid coating material to applicator rolls that applied the material directly onto the moving web. While the use of applicator rolls yields a fairly uniform coating across the web, as web speeds increase, there often occurs a film split pattern in the coating applied onto the web, i.e. cross-direction variations in the weight of the coating on the web. This technique therefore does not lend itself to coating webs at high speeds. Direct application by rolls also creates forces in the roll/web nip that imbed or force coating material into the web instead of covering the outer surface of the web to enhance smoothness.

In an attempt to avoid these and other problems, the art developed a coating process in which the liquid coating material was jetted in a free standing curtain of coating liquid directly onto the moving web with a fountain applicator. While fountain applicators overcome many of the limitations of roll applicators, in their use, skip coating often occurs. Skip coating is caused by air in the coating liquid being contacted against the paper web and preventing the coating liquid from uniformly contacting and being uniformly applied onto the web surface. To decrease the severity of the skip coating problem, fountain applicators customarily include coating/air separation equipment to remove air from coating liquid prior to delivery of the coating liquid to the applicator, but the equipment is not 100 % effective and some air remains entrained in the coating liquid jetted against the web surface and causes skip coating.

### Objects of the Invention

An object of the present invention is to provide an improved fountain applicator for applying liquid coating material onto a paper web, in which the resulting coating on the web is substantially skip free.

Another object is to provide such a fountain applicator, in which a sheet of coating liquid is flowed along a curved surface substantially immediately prior to being impinged against the web, to subject the sheet to cen-

trifugal force to cause air entrained in the coating liquid to move toward one side of the sheet away from the curved surface.

A further object is to provide such a fountain applicator, in which the sheet of coating liquid, after leaving the curved surface, is directed toward the web in a free standing jet curtain of coating liquid that is impinged against the web, such that the side of the jet curtain of coating liquid that corresponds to the opposite side of the sheet that is relatively free of entrained air contacts the web surface while the other side of the jet curtain of coating liquid is out of substantial contact with the web surface.

### 15 Summary of the Invention

In accordance with the present invention, an apparatus for applying a coating liquid onto a surface of a moving web comprises an elongate concave curved surface that is positionable proximate to, transversely of and spaced from the web; and means for forming an elongate sheet of coating liquid, for flowing the sheet along the curved surface, and for then projecting the sheet in a free standing jet curtain of coating liquid that is directed toward, against and across the surface of the web. The coating liquid sheet, upon being flowed along the curved surface, is subjected to centrifugal force to cause air entrained in the coating liquid sheet to move to one side of the sheet that is away from the curved surface. The free standing jet curtain of coating liquid is directed against the web such that a side of the jet curtain of coating liquid, which corresponds to an opposite relatively air-free side of the coating liquid sheet, contacts the web surface, while the other side of the jet curtain of coating liquid is out of substantial contact with the web surface. Thus, only coating liquid that is relatively free of entrained air contacts the web surface to provide on the web surface a coating that is substantially skip free.

The invention also contemplates a method of applying a coating liquid onto a surface of a moving web, which comprises the step of flowing a sheet of coating liquid along an elongate concave curved surface that is proximate to, extends transversely of and is spaced from the web, to subject the coating liquid sheet to centrifugal force to cause air entrained in the coating liquid to move to one side of the sheet that is away from the curved surface. Also included is the step of directing the sheet of coating liquid, after it has been flowed along the curved surface, in a free standing jet curtain of coating liquid toward, against and across the surface of the web to contact the web surface with a side of the jet curtain of coating liquid that corresponds to an opposite relatively air-free side of the coating liquid sheet, while maintaining the other side of the jet curtain of coating liquid out of substantial contact with the web surface, whereby only coating liquid that is relatively free of entrained air contacts the web surface.

### Brief Description of the Drawings

Fig. 1 shows a prior art fountain applicator;  
 Fig. 2 shows a fountain applicator that embodies the teachings of the present invention;  
 Fig. 3 illustrates a coating supply system of a type that may be used to deliver coating liquid to the fountain applicator of the invention;  
 Fig. 4 shows an alternate embodiment of a fountain applicator that incorporates the teachings of the invention; and  
 Figs. 5A and 5B are graphs that respectively show the degrees gloss and the Parker Printsurf smoothness of a coating applied onto a web with the fountain applicator of Fig. 2, for various speeds of travel of the web past the applicator.

### Detailed Description

#### The Prior Art

A fountain applicator of a type contemplated by the prior art is shown in Fig. 1 and indicated generally at 20. The applicator is part of a paper coating machine, and extends parallel to and coextensively with a movable support or backing roll 22 which rotates in a direction shown by an arrow 24 and supports a web of paper 26 during its travel past the applicator. The applicator has front and rear walls 28 and 30 that form an elongate metering slot 31 leading to an elongate outlet nozzle 32. The metering slot communicates with a chamber 34 that receives liquid coating material under pressure from a source of material, for flow of the coating liquid upwardly to and through the outlet nozzle, as indicated by the line and arrow. The outlet nozzle extends coextensively with the backing roll 22 and transversely of and across the paper web, and is proximate to and faces the paper web where it is supported on the backing roll. The upper end of the applicator rear wall 30 extends beyond the upper end of the applicator front wall 28 and defines a gap 36 with the web, and where it extends beyond the applicator front wall, the applicator rear wall has a flat surface 38. Coating liquid introduced into the chamber 34 flows upwardly to and out of the outlet nozzle in a sheet of coating liquid 40 that flows across the flat surface 38 at the upper end of the applicator rear wall. Upon leaving the flat surface, the sheet of coating liquid is directed in a free standing jet curtain of coating liquid against and transversely across the paper web, at an acute included angle  $\alpha$  within the web, as the web is moved past the applicator.

In operation of the applicator 20, the free standing jet curtain of coating liquid is impinged against the surface of the backing roll supported paper web 26 to apply onto the web surface an excess layer of coating liquid that is doctored to a desired coat weight by a downstream doctor 42. In order for the applicator to apply an excess coating layer that is reasonably free of voids or

skips, it is imperative that there not be an excessive amount of air entrained in the coating. To minimize entrained air, a conventional air removal system may be incorporated into the coating supply system that delivers coating liquid to the applicator, such air removal systems being well known in the art and two representative examples of such being taught by U.S. patents Nos. 4,290,791 and 4,643,746. However, even when an air removal system is employed, some air remains entrained in the coating and contacts the web, causing skip coating on the web, especially at high speeds of travel of the web past the applicator.

#### The Invention

In improving upon prior fountain applicators, the invention provides an improved fountain applicator that is uniquely configured to apply onto a surface of a paper web a coating layer that is essentially skip free. Such an applicator is shown in Fig. 2 and is configured to cause air entrained in a coating liquid sheet that is emitted from an elongate fountain outlet nozzle, to move to a side of the sheet that is opposite from the side that is impinged against the web, so that only coating liquid that is relatively free of entrained air contacts the web surface. This is accomplished by flowing the coating liquid sheet along a curved surface of the applicator, to subject the coating liquid sheet to centrifugal force to cause the dense coating liquid to move toward a side of the coating liquid sheet that is toward the curved surface and impinged against the paper web, and air entrained in the coating liquid to move toward an opposite side of the sheet that is away from the curved surface and out of substantial contact with the web. The radius of the curved surface is selected for the magnitude of centrifugal force desired, the magnitude also being a function of the flow velocity of the coating liquid sheet across the curved surface. The flow velocity of the coating liquid sheet is, in turn, a function of the cross sectional area of the fountain outlet nozzle and of the volume flow rate of coating liquid through the nozzle, and must be such as to ensure that the coating liquid applied onto the paper web completely and uniformly covers the web surface.

More particularly, the fountain applicator of Fig. 2 is indicated generally at 50 and applies onto a surface of a paper web 52, which is carried past the applicator on a backing roll 54 that rotates in a direction as shown by an arrow 56, an excess layer of coating liquid that is doctored to a desired coat weight by a downstream doctor means such as a blade 58. The fountain applicator is part of a paper coating machine, and extends in the cross-machine direction, parallel to the backing roll 54 and transversely of, across and spaced from the backing roll supported web. The applicator has front and rear walls 60 and 62, and attached to the upper end of the rear wall is a plate 64. The front and rear walls and the plate form a chamber 66 therewithin, into which liquid

coating material is delivered under pressure via a coating liquid distribution pipe 68 that extends longitudinally through the chamber and has a plurality of coating outlet openings 69 longitudinally spaced therealong. The front and rear walls may be hinged at their lower ends for movement apart to provide access to the chamber 66 for cleaning, for example as taught by U.S. patent No. 4,534,309.

A metering slot 70 is defined between the front wall 60 and the plate 64. The metering slot extends upwardly from the chamber 66 and transversely of and across the backing roll supported web 52, and from bottom to top is inclined toward the front of the applicator to enhance a migration of air entrained in the coating liquid toward the side of the metering slot defined by the plate. A replaceable elongate deflector tip 72 is at the upper end of the front wall and an elongate outlet nozzle 74 from the metering slot is at the top of the plate 64 between the plate and the deflector tip. On its side toward the outlet nozzle, the deflector tip has an elongate flat surface 76 and an elongate concave curved surface 78 that is positioned proximate to, transversely of and spaced from the web. The flat surface begins within the metering slot, it may but does not necessarily need to extend upwardly beyond the outlet nozzle, and leads to the curved surface. Coating liquid exiting the elongate outlet nozzle flows in a sheet along the flat surface of the deflector tip to, along and then off of the curved surface in a free standing jet curtain of coating liquid that is directed against and across the web surface at an appropriate included acute angle. If desired, the downstream end of the coating liquid flow surface of the deflector tip could terminate in an elongate flat surface (not shown) of relatively limited length beyond the curved surface 78, along which the coating liquid sheet would flow after leaving the curved surface and before being projected toward the web in a free standing jet curtain of coating liquid. Also, adjustable deckle devices (not shown) may be at opposite ends of the elongate outlet nozzle to control its transverse extent and, therefore, the transverse extent of the sheet of coating liquid, thereby to control the width of the coating layer applied onto the web.

Before considering the manner of operation of the fountain applicator 50, a typical coating supply system for the applicator will first be considered in general terms. As seen in Fig. 3, a coating supply system may include a covered surge tank 82 for holding a main supply of liquid coating material that is stirred by a motor driven impeller unit 84. Coating liquid flows from the tank through a valve 86 to a pump 88 that delivers the coating liquid under pressure through a valve 90 and a mesh filter 92 to an air removal device 94. The air removal device may be of a conventional type, and operates to remove entrained air from coating liquid supplied from the surge tank and to deliver the removed air, carried in a small portion of the coating liquid, through a valve 96 for return to the surge tank. The remaining coating liquid exiting the air removal device is flowed through a valve

98 into one end of the distribution pipe 68 of the fountain applicator 50. At an opposite end of the distribution pipe there is an outlet 100 from the top of the distribution pipe (Fig. 2), that leads back to the surge tank through a valve 102. The outlet allows recirculation of a small portion of the coating liquid supplied to the distribution pipe, in order to remove accumulated air from the top of the distribution pipe and enhance a uniform pressure of coating liquid throughout the chamber 66 for uniform application of coating onto the moving web. Valves 104 and 106 selectively direct coating liquid returned from the fountain applicator to the surge tank, to a sewer and/or to reclamation apparatus. A valve 108 is connected between the upstream side of the valve 90 and the surge tank, and a valve 110 at an outlet from the surge tank leads to the sewer or the reclamation apparatus. When the fountain applicator is operating, the valves 86, 90, 96, 98, 102 and 104 are open and the valves 106, 108 and 110 are closed. When the fountain applicator is not operating, the various valves are selectively opened or closed to accomplish a desired result (e.g., to accommodate cleaning of the system with wash water), as is readily understood by those skilled in the art.

In operation of the fountain applicator 50 and with reference to Fig. 2, coating liquid delivered to the applicator by the coating supply system is introduced into one end of the distribution pipe 68 and flows through the pipe openings 69 into the chamber 66. The air removal device 94 removes from the coating liquid much of the entrained air, but it is not 100 % effective, so some air remains entrained in the coating liquid delivered to the applicator. Some of the remaining air that accumulates at the top of the distribution pipe passes through the outlet 100 and is removed, but some still remains entrained in the coating, and with prior fountain applicators this limited amount of remaining entrained air causes skip coating on a paper web. However, in use of the applicator of the invention, entrained air remaining in the coating liquid flowed from the chamber 66 and out of the outlet nozzle 74 is prevented from contacting the surface of the web, and therefore from causing skip coating.

More specifically, coating liquid delivered into the chamber 66 flows upwardly through the metering slot 70 and exits the elongate outlet nozzle 74 in an elongate sheet 112 of coating liquid that extends transversely of the paper web 52. The sheet of coating liquid flows along the deflector tip flat surface 76 to the concave curved surface 78, where the sheet is forcefully flowed against the curved surface as its direction of flow changes to conform to the curved surface. Causing the coating liquid sheet to follow the curved surface subjects it to centrifugal force that causes the dense coating liquid to move toward a side 116 of the sheet that is toward the curved surface and the much less dense air entrained in the coating liquid to move toward an opposite side 118 of the sheet that is away from the curved surface. After flowing along the curved surface, the sheet of coating liquid is projected from the deflector tip in a free

standing elongate jet curtain of coating liquid that is directed toward, transversely across and against the paper web surface, such that an included acute angle  $\beta$  is defined between the plane of the jet curtain of coating liquid and a tangent to the web at the point of contact of the curtain with the web. In consequence, only the side of the jet curtain of coating liquid that corresponds to the side 116 of the coating liquid sheet that is relatively free of entrained air, is impinged against the surface of the web, while the side of the jet curtain of coating liquid that corresponds to the opposite side 118 of the sheet, to which most of the entrained air has moved, is out of substantial contact with the web, so that a skip-free coating is applied onto the web. The layer of coating liquid applied onto the web by the applicator is in excess and is doctored to a desired coat weight by the downstream doctor means 58.

The minimum centrifugal force to which the sheet of coating liquid 112 is to be subjected is that which just results in application of a substantially skip-free coating onto the paper web 52. As is known, the centrifugal force exerted on the sheet of coating liquid is equal to the product of the mass of the coating liquid and its flow velocity squared, divided by the radius of the deflector tip curved surface 78. The mass of the coating liquid may be considered as a constant, which in practical terms means that the centrifugal force may be varied by changing either the flow velocity of the coating liquid sheet or the radius of the curved surface. The flow velocity of the coating liquid sheet is a function of the cross sectional area of the elongate outlet nozzle 74 and of the volume flow rate of coating liquid through it, and is chosen so that the applied coating completely and uniformly covers the web surface. Since there are limits on the minimum volume flow rate of coating liquid required to obtain a uniform coating on the paper web, and since there are practical limits on the maximum volume flow rate of coating liquid that can be forced through the metering slot 70 and outlet nozzle 74, to subject the coating liquid stream to a desired centrifugal force, it usually is most convenient to control the radius of the deflector tip curved surface 78.

Nevertheless, while the magnitude of centrifugal force exerted on the coating liquid sheet may be increased by decreasing the radius of the deflector tip curved surface, there also are practical limits on how small the radius may be. It presently is contemplated that the curved surface have a radius on the order of about 0.31 cm (.125") to 1.27 cm (.500"), which is believed to be sufficient to properly densify the coating liquid on the side 116 of the coating liquid sheet that is impinged against the web or, put another way, to cause a sufficient amount of the entrained air to move to the side 118 of the sheet that is out of substantial contact with the web, so that skip coating does not result. It also is contemplated that the curved surface have an arcuate extent in the range of about 45° to 90°, with about 70° likely being optimum.

The angle of attack of the free standing jet curtain of coating liquid against the paper web, i.e. the included angle between the plane of the curtain of coating liquid and a tangent to the web surface at the point of contact of the curtain with the web, should be chosen to obtain optimum coating results. For the applicator 50, good coating results have been experimentally obtained with an included angle of 50° when using an outlet nozzle 74 having a width of 0.122 cm (.048"), with the linear distance between the upper end of the deflector tip curved surface 78 and the point of impact of the coating liquid curtain against the web being on the order of 0.792 cm (.312"), and with the deflector tip flat surface 76 having a length of about 0.310 cm (.125") in the direction of flow of the coating liquid sheet. However, these particular parameters may have other values, since the optimum value of each parameter is influenced by and generally dependent upon the values of the other parameters, and it is contemplated that the outlet nozzle have a width in the range of about 0.06 cm (.025") to 0.124 cm (.050") and also that the flat surface 76 on the deflector tip could be eliminated, in which case the curved surface 78 would begin immediately at the outlet nozzle 74.

While in the fountain applicator 50 shown in Fig. 2, the coating liquid flow surfaces 76 and 78 of the deflector tip 72 are exposed to the outside of the applicator and located downstream from the metering slot 70 and the elongate outlet nozzle 74, the fluid flow surfaces could be part of and located within the fluid flow path defined by the metering slot 70. In this case, as shown in Fig. 4, the upper end of the plate 64 is extended along, spaced from and curved to conform to the fluid flow surfaces 76 and 78, so that the metering slot then extends along and includes the fluid flow surfaces. With this arrangement the coating liquid sheet is subjected to centrifugal force while within the upper end of the metering slot, an elongate outlet nozzle 74' is at the uppermost end of the deflector tip, and the free standing jet curtain of coating liquid is emitted directly from the elongate outlet nozzle.

To collect run-off coating liquid that is not carried away on the paper web 52, a run-off deflector 120 is on the outer surface of a chilled water jacket 122 carried on the plate 64. The run-off deflector leads to a return pan, from which coating liquids is returned to the surge tank 82, and the chilled water jacket facilitates cleaning of the run-off deflector.

Figs. 5A and 5B show coating results obtained experimentally when coatings were applied onto the same grade of paper with a fountain applicator constructed according to Fig. 2 and operated according to the teachings of the invention. Fig. 5A shows 75° gloss obtained at various web speeds and Fig. 5B shows Parker Printsurf smoothness measurements obtained at various web speeds.

**Claims**

1. Apparatus for applying a coating liquid onto a surface of a moving web (52), comprising

- a coating liquid flow path that is laterally elongate;
- a downstream end of said flow path being positioned proximate to, spaced from and transversely of the web (52); and
- means for flowing coating liquid along said flow path and beyond said downstream end of said flow path in a free standing laterally elongate jet curtain of coating liquid that is directed toward, across and against the surface of the web, downstream doctor means for doctoring the applied coating liquid onto the surface of the web to a desired coat weight;

characterized in that

- said liquid flow path includes a laterally elongate concave curved surface (78), so that
- the coating liquid, while flowing along said flow path curved surface (78), being subjected to centrifugal force that causes air entrained in the coating liquid to move away from said curved surface (78), the free standing jet curtain of coating liquid being directed against the web (52) to impinge a side of the jet curtain of coating liquid, which consists substantially of coating liquid that was toward said curved surface, against the web surface while the other side of the jet curtain of coating liquid is out of substantial contact with the web surface, whereby only coating liquid that is relatively free of entrained air contacts the web surface (52) to provide on the web surface a coating that is substantially skip free.

2. Apparatus as in claim 1, wherein said curved surface (78) has an arcuate extent in the range of about 45° to 90°.

3. Apparatus as in claim 1, wherein said curved surface has a radius in the range of about 0,31 to 1,27 cm (.125 inch to .500 inch).

4. Apparatus according to any of the claims 1-3, wherein said elongate concave curved surface (78) is an elongate coating liquid deflector (72).

5. Apparatus according to any of the claims 1-4, wherein the included angle between the plane of the free standing jet curtain of coating liquid and the surface of the web at the point of contact of the free standing jet curtain of coating liquid with the web is

in the range of about 30° to 50°.

6. Apparatus according to any of the claims 1-5, wherein said concave curved surface (78) is proximate to said downstream end of said flow path (70).

7. Apparatus according to any of the claims 1-6, wherein a downstream end of said concave curved surface (78) is at said flow path downstream end.

8. Apparatus according to any of the claims 1-7, wherein said means for flowing includes an elongate outlet nozzle positioned along and laterally of said flow path and means for pressure delivery of coating liquid to said outlet nozzle for flow through said outlet nozzle (74) to and along said flow path concave curved surface (78) in an elongate sheet of coating liquid.

9. Apparatus as in claim 8, wherein said elongate outlet nozzle (74) has a width in the range of about 0,06 cm to 0,124 cm (.025" to .050").

10. A method of applying coating liquid onto a surface of a moving web, comprising:

forming a sheet of coating liquid;  
 subjecting the sheet of coating liquid to centrifugal force to cause air entrained in the coating liquid to move toward one side of the sheet, so that an opposite side of the coating liquid sheet is then relatively free of entrained air;  
 projecting the sheet of coating liquid toward the web in a free standing sheet of coating liquid;  
 and contacting the surface of the web (52) with the opposite side of the coating liquid sheet that is relatively free of entrained air while maintaining the one side of the coating liquid sheet out of substantial contact with the web surface;  
 the excess layer of coating liquid is doctoring to a desired coat weight onto a surface of a web.

11. A method as in claim 10, wherein said subjecting step comprises flowing the sheet of coating liquid across a concave curved surface (78).

12. A method as in claim 11, wherein the curved surface has an arcuate extent in the range of about 45° to 90°.

13. A method as in claim 11, wherein the curved surface has a radius in the range of about 0,31 to 1,27 cm (.125 inch to .500 inch).

14. A method according to any of the claims 10-13, wherein said step of projecting the coating liquid sheet is performed such that the included angle between the plane of the free standing jet curtain of

coating liquid and the surface of the web at the point of contact of the jet curtain of coating liquid with the web is in the range of about 30° to 50°.

15. A method according to any of the claims 11-14, wherein said flowing step of the sheet of coating liquid comprises delivering coating liquid under pressure to an elongate nozzle, emitting the coating liquid from the nozzle in an elongate sheet of coating liquid, and flowing the elongate sheet of coating liquid along the elongate curved surface to subject the coating liquid sheet to centrifugal force.
16. A method as in claim 15, wherein the elongate nozzle (74) has a width in the range of about 0,06 to 0,12 cm (.025" to .050").

### Patentansprüche

1. Vorrichtung zum Aufbringen einer Beschichtungs- bzw. Streichflüssigkeit auf die Oberfläche einer sich bewegenden Bahn (52) mit:

- einer in seitlicher Richtung länglich ausgebildeten Strömungsstrecke für die Beschichtungsflüssigkeit, deren stromabwärts gelegenes Ende benachbart zu der Bahn (52) so angeordnet ist, daß es sich in einem gewissen Abstand zu der Bahn (52) in Querrichtung erstreckt;
- Mitteln zum Strömenlassen der Beschichtungsflüssigkeit entlang der Strömungsstrecke bis über das stromabwärts gelegene Ende der Strömungsstrecke hinaus in Form eines freistehenden Strahlvorhanges bzw. Freistrahles aus Beschichtungsflüssigkeit, der in seitlicher Richtung länglich ausgebildet ist und sich in Richtung auf die Oberfläche der Bahn, über diese Bahnoberfläche hinweg und gegen diese Bahnoberfläche erstreckt; und mit
- einer stromabwärts angeordneten Rakel- oder Abstreifeinrichtung zum Abstreifen der auf die Oberfläche der Bahn aufgebrachten Beschichtungsflüssigkeit bis zu einer gewünschten Beschichtungsstärke bzw. Streichgewicht;

dadurch gekennzeichnet,  
daß die Strömungsstrecke für die Beschichtungsflüssigkeit eine sich in seitlicher Richtung erstreckende, längliche konkav gekrümmte Oberfläche (78) umfaßt, so daß die Beschichtungsflüssigkeit beim Strömen entlang der gekrümmten Oberfläche (78) der Strömungsstrecke einer Zentrifugalkraft ausgesetzt ist, durch die in der Beschichtungsflüssigkeit mitgeführte Luft von der gekrümmten Oberfläche (78) wegtransportiert wird, wobei sich der freistehende Strahlvorhang bzw. Freistrah aus Beschichtungsflüssigkeit so in Richtung auf die Bahn

(52) erstreckt, daß eine Seite des Strahlvorhanges aus Beschichtungsflüssigkeit, die im wesentlichen aus Beschichtungsflüssigkeit besteht, die sich an der gekrümmten Oberfläche befand, auf die Bahnoberfläche auftrifft, während sich die andere Seite des Strahlvorhanges aus Beschichtungsflüssigkeit nicht in einem merklichen Kontakt mit der Bahnoberfläche befindet, so daß lediglich Beschichtungsflüssigkeit mit der Bahnoberfläche (52) in Kontakt gerät, die relativ frei von mitgeführter Luft ist, und auf der Bahnoberfläche eine Beschichtung entsteht, die im wesentlichen frei ist von Skips bzw. von Beschichtungsfehlern auf Grund mitgeführter Luft.

2. Vorrichtung nach Anspruch 1, wobei die gekrümmte Oberfläche (78) eine Krümmung zwischen etwa 45° und 90° aufweist.

3. Vorrichtung nach Anspruch 1, wobei die gekrümmte Oberfläche einen Radius im Bereich zwischen etwa 0,31 und 1,27 cm (0,125 Zoll bis 0,500 Zoll) aufweist.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, wobei die längliche konkav gekrümmte Oberfläche (78) eine längliche Ablenkeinrichtung (72) für die Beschichtungsflüssigkeit ist.

5. Vorrichtung nach einem der Ansprüche 1 bis 4, wobei der eingeschlossene Winkel zwischen der Ebene des freistehenden Strahlvorhanges bzw. Freistrahles aus Beschichtungsflüssigkeit und der Oberfläche der Bahn an dem Kontaktpunkt des freistehenden Strahlvorhanges bzw. Freistrahles aus Beschichtungsflüssigkeit mit der Bahn etwa 30° bis 50° beträgt.

6. Vorrichtung nach einem der Ansprüche 1 bis 5, wobei die konkav gekrümmte Oberfläche (78) benachbart zu dem stromabwärts gelegenen Ende der Strömungsstrecke (70) angeordnet ist.

7. Vorrichtung nach einem der Ansprüche 1 bis 6, wobei sich das stromabwärts gelegene Ende der konkav gekrümmten Oberfläche (78) an dem stromabwärts gelegenen Ende der Strömungsstrecke befindet.

8. Vorrichtung nach einem der Ansprüche 1 bis 7, wobei das Mittel zum Strömenlassen der Beschichtungsflüssigkeit eine seitlich entlang der Strömungsstrecke angeordnete längliche Austrittsdüse und eine Einrichtung umfaßt, um die Beschichtungsflüssigkeit unter Druck der Austrittsdüse (74) zuzuleiten und in Form einer länglichen Beschichtungsflüssigkeitsschicht aus der Austrittsdüse (74) in Richtung auf die konkav gekrümmte Oberfläche

der Strömungstrecke und entlang dieser Oberfläche austreten zu lassen.

9. Vorrichtung nach Anspruch 8, wobei die Breite der länglichen Austrittsdüse (74) etwa 0,06 cm bis 0,124 cm (0,025 Zoll bis 0,050 Zoll) beträgt. 5
10. Verfahren zum Aufbringen einer Beschichtungsflüssigkeit auf die Oberfläche einer sich bewegenden Bahn mit folgenden Verfahrensschritten: 10
- Bilden einer Schicht aus Beschichtungsflüssigkeit;  
Einwirkenlassen einer Zentrifugalkraft auf die Beschichtungsflüssigkeitsschicht, um die von der Beschichtungsflüssigkeit mitgeführte Luft auf eine Seite der Schicht zu transportieren, so daß die gegenüberliegende Seite der Beschichtungsflüssigkeit relativ frei ist von mitgeführter Luft;  
Ausstoßen der Beschichtungsflüssigkeitsschicht in Richtung auf die Bahn in Form einer freistehenden Schicht aus Beschichtungsflüssigkeit und  
in Kontakt bringen der Oberfläche der Bahn (52) mit der gegenüberliegenden Seite der Schicht, die relativ frei ist von mitgeführter Luft, wobei sich die eine Seite der Schicht im wesentlichen nicht in Kontakt mit der Bahnoberfläche befindet und wobei überschüssige Beschichtungsflüssigkeit bis zu einer gewünschten Beschichtungsstärke von der Oberfläche der Bahn abgestreift wird. 15
11. Verfahren nach Anspruch 10, wobei das Einwirkenlassen einer Zentrifugalkraft das Strömenlassen der Beschichtungsflüssigkeitsschicht über eine konkav gekrümmte Oberfläche (78) umfaßt. 20
12. Verfahren nach Anspruch 11, wobei die gekrümmte Oberfläche eine Krümmung zwischen etwa 45° und 90° aufweist. 25
13. Verfahren nach Anspruch 11, wobei die gekrümmte Oberfläche einen Radius im Bereich zwischen 0,31 und 1,27 cm (0,125 Zoll bis 0,500 Zoll) aufweist. 30
14. Verfahren nach einem der Ansprüche 10 bis 13, wobei das Ausstoßen der Beschichtungsflüssigkeitsschicht so erfolgt, daß der eingeschlossene Winkel zwischen der Ebene des freistehenden Strahlvorhangs aus Beschichtungsflüssigkeit und der Oberfläche der Bahn an dem Kontaktpunkt des Strahlvorhangs mit der Bahn zwischen 30° und 50° beträgt. 35
15. Verfahren nach einem der Ansprüche 11 bis 14, wobei das Fließenlassen der Beschichtungsflüssig-

keitsschicht die folgenden Verfahrensschritte umfaßt:

Zuführen der Beschichtungsflüssigkeit unter Druck zu einer Austrittsdüse;  
Ausstoßen der Beschichtungsflüssigkeit aus der Düse in Form einer länglichen Beschichtungsflüssigkeitsschicht; und  
Strömenlassen der länglichen Beschichtungsflüssigkeitsschicht entlang der länglichen gekrümmten Oberfläche, um auf die Beschichtungsflüssigkeit eine Zentrifugalkraft auszuüben.

16. Verfahren nach Anspruch 15, wobei die Breite der länglichen Düse (74) etwa 0,06 bis 0,12 cm (0,025 Zoll bis 0,050 Zoll) beträgt. 40

## 20 Revendications

1. Dispositif d'application d'un enduit liquide sur une surface d'une bande mobile (52), comprenant

- un chemin d'écoulement d'enduit liquide allongé latéralement ;
- l'extrémité aval du chemin d'écoulement étant positionnée à proximité, à une certaine distance d'espacement et transversalement par rapport à la bande (52) ;
- des moyens pour faire couler l'enduit liquide le long du chemin d'écoulement et au-delà de l'extrémité aval de ce chemin d'écoulement, sous la forme d'un jet en rideau allongé latéralement et autonome, c'est à dire se tenant librement tout seul, d'enduit liquide qui est dirigé vers, en travers et contre la surface de la bande ;
- des moyens de lame d'étalement placés en aval pour niveler l'enduit liquide appliqué sur la surface de la bande, à un poids d'enduit voulu ;

caractérisé en ce que

le chemin d'écoulement d'enduit liquide comprend une surface courbe concave allongée latéralement (78), de sorte que l'enduit liquide, tout en s'écoulant le long de la surface courbe (78) du chemin d'écoulement, est soumis à une force centrifuge qui amène l'air entraîné dans l'enduit liquide à s'écarter de la surface courbe (78), le jet en rideau autonome d'enduit liquide étant dirigé contre la bande (52) pour faire tomber sur la surface de la bande le côté du jet en rideau d'enduit liquide constitué essentiellement de l'enduit liquide qui était tourné vers la surface courbe, tandis que l'autre côté du jet en rideau d'enduit liquide est essentiellement hors de contact avec la surface de la bande, de sorte que seul l'enduit liquide qui est relativement débarrassé d'air entraîné, vient en contact avec la surface de la bande

- (52) pour former, sur cette surface de la bande, un revêtement d'enduit essentiellement débarrassé de sauts d'enduit.
- 2.** Dispositif selon la revendication 1, dans lequel la surface courbe (78) a une étendue courbe se situant dans la plage d'environ 45° à 90°.
- 3.** Dispositif selon la revendication 1, dans lequel la surface courbe a un rayon se situant dans la plage d'environ 0,31 à 1,27 cm (0,125 à 0,500 pouces).
- 4.** Dispositif selon l'une quelconque des revendications 1 à 3, dans lequel la surface courbe concave allongée (78) est un déflecteur d'enduit liquide allongé (72).
- 5.** Dispositif selon l'une quelconque des revendications 1 à 4, dans lequel l'angle inscrit entre le plan du jet en rideau autonome d'enduit liquide, et la surface de la bande au point de contact du jet en rideau autonome d'enduit liquide avec la bande, se situe dans la plage d'environ 30° à 50°.
- 6.** Dispositif selon l'une quelconque des revendications 1 à 5, dans lequel la surface courbe concave (78) est à proximité de l'extrémité aval du chemin d'écoulement (70).
- 7.** Dispositif selon l'une quelconque des revendications 1 à 6, dans lequel l'extrémité aval de la surface courbe concave (78) se trouve à l'endroit de l'extrémité aval du chemin d'écoulement.
- 8.** Dispositif selon l'une quelconque des revendications 1 à 7, dans lequel les moyens d'écoulement d'enduit liquide comprennent une buse de sorte allongée positionnée latéralement le long du chemin d'écoulement, ainsi que des moyens de fourniture d'enduit liquide sous pression à la buse de sortie, pour faire s'écouler cet enduit liquide à travers la buse de sortie (74), en direction et le long de la surface courbe concave (78) du chemin d'écoulement, sous la forme d'une nappe allongée d'enduit liquide.
- 9.** Dispositif selon la revendication 8, dans lequel
- la buse de sortie allongée (74) a une largeur se situant dans la plage d'environ 0,06 cm à 0,124 cm (0,025 à 0,050 pouce)).
- 10.** Procédé d'application d'un enduit liquide sur une surface d'une bande mobile, comprenant les étapes consistant à :
- former une nappe d'enduit liquide ;
  - soumettre la nappe d'enduit liquide à une force centrifuge pour amener l'air entraîné dans l'enduit liquide à se déplacer vers un côté de la nappe, de façon que le côté opposé de la nappe d'enduit liquide soit alors relativement débarrassé d'air entraîné ;
  - projeter la nappe d'enduit liquide vers la bande sous la forme d'une nappe autonome
  - d'enduit liquide ; et amener la surface de la bande (52) en contact avec le côté opposé de la nappe d'enduit liquide qui est relativement débarrassé d'air entraîné, tout en maintenant le premier côté de la nappe d'enduit liquide essentiellement hors de contact avec la surface de la bande ;
  - niveler la couche d'enduit liquide en excès, à un poids d'enduit voulu sur la surface de la bande.
- 11.** Procédé selon la revendication 10, dans lequel l'étape soumettant la nappe d'enduit liquide à la force centrifuge consiste à faire couler la nappe d'enduit liquide en travers d'une surface courbe concave (78).
- 12.** Procédé selon la revendication 11, dans lequel la surface courbe a une étendue courbe se situant dans la plage d'environ 45° à 90°.
- 13.** Procédé selon la revendication 11, dans lequel la surface courbe a un rayon se situant dans la plage d'environ 0,31 à 1,27 cm (0,125 à 0,500 pouce).
- 14.** Procédé selon l'une quelconque des revendications 10 à 13, dans lequel l'étape de projection de la nappe d'enduit liquide est effectuée de façon que l'angle inscrit entre le plan du jet en rideau autonome d'enduit liquide, et la surface de la nappe au point de contact du jet en rideau d'enduit liquide avec la bande, se situe dans la plage d'environ 30° à 50°.
- 15.** Procédé selon l'une quelconque des revendications 11 à 14, dans lequel

l'étape pour faire couler la nappe d'enduit liquide consiste à délivrer l'enduit liquide sous pression à une buse allongée, à émettre l'enduit liquide par la buse sous la forme d'une nappe allongée d'enduit liquide, et à faire couler la nappe allongée d'enduit liquide le long de la surface courbe allongée, pour soumettre cette nappe d'enduit liquide à la force centrifuge.

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- 16.** Procédé selon la revendication 15, dans lequel la buse allongée (74) a une largeur se situant dans la plage d'environ 0,06 à 0,12 cm (0,025 à 0,050 pouce).

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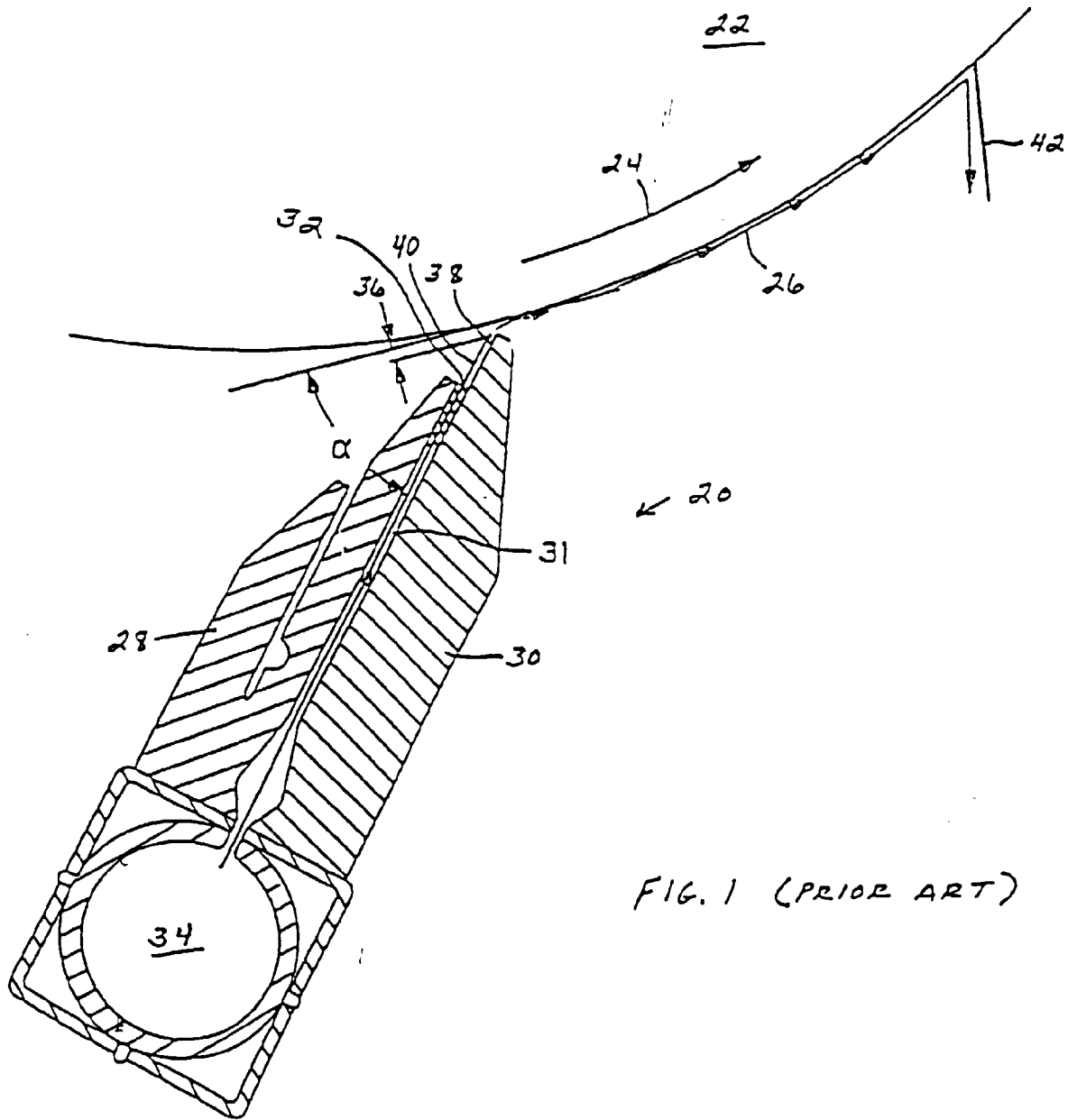


FIG. 1 (PRIOR ART)

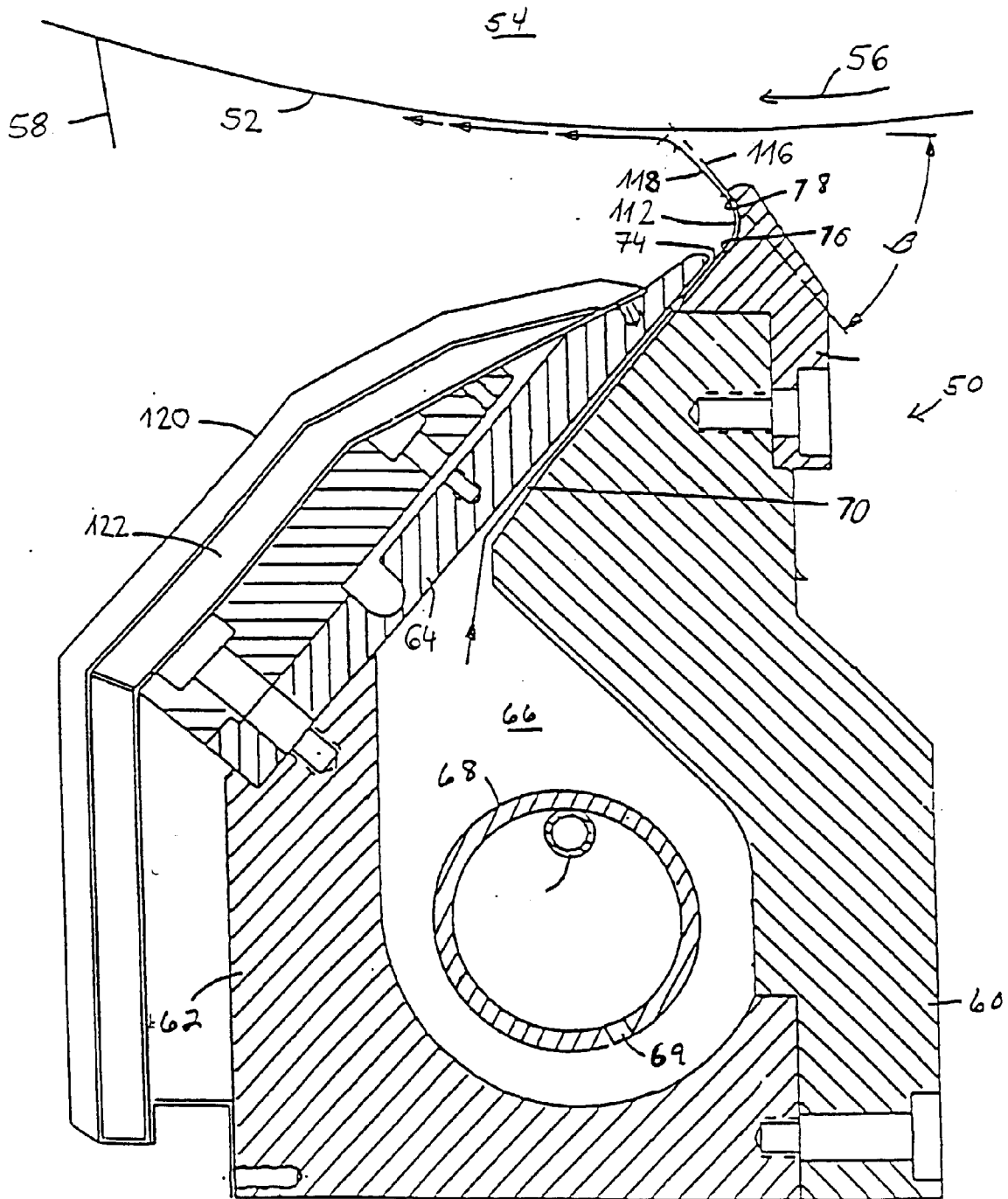


FIG. 2

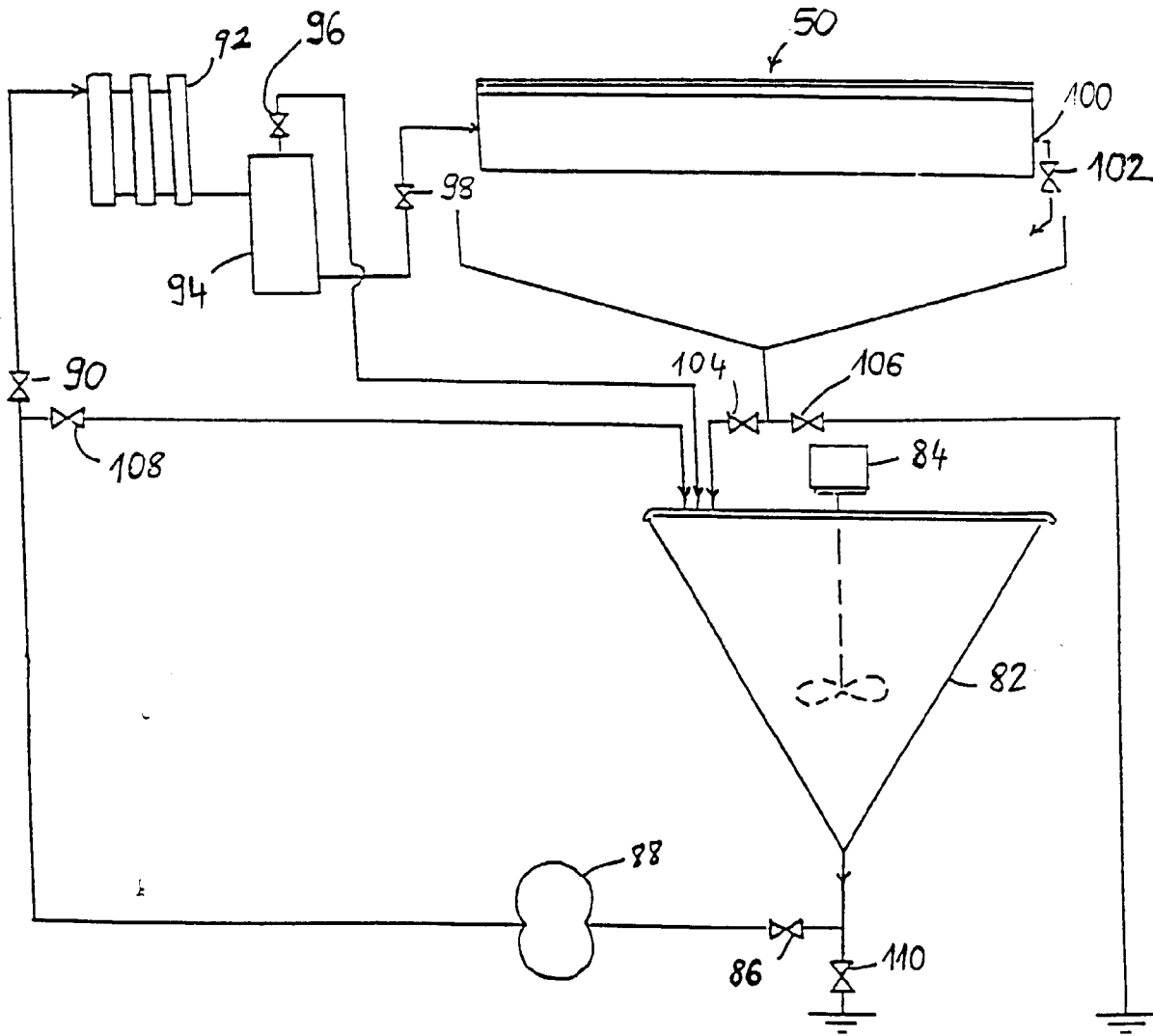


FIG. 3

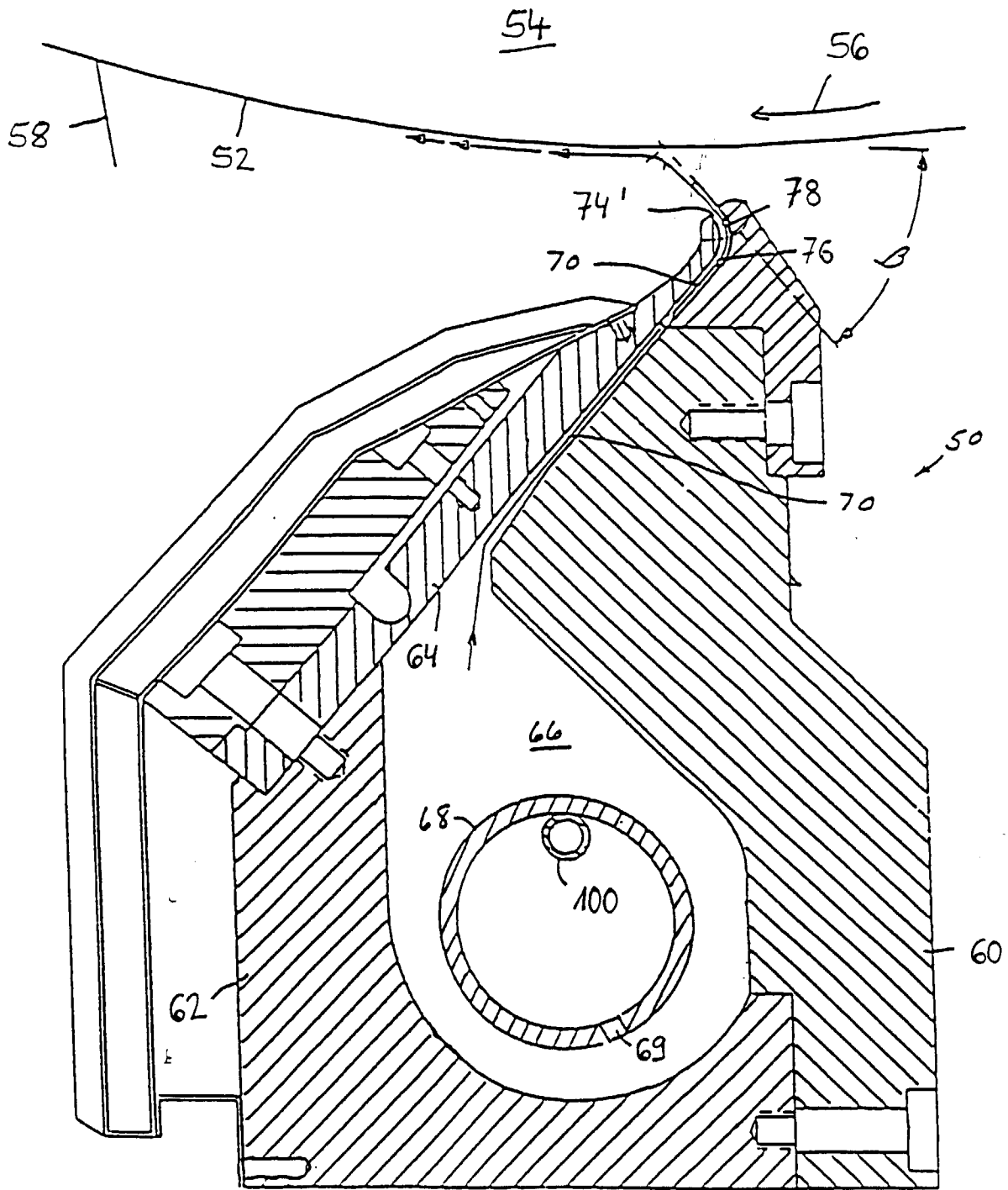


FIG. 4

