



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) **EP 0 906 787 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention  
of the grant of the patent:  
**08.01.2003 Bulletin 2003/02**

(51) Int Cl.7: **B05C 5/00, G03C 1/74**

(21) Application number: **98203158.5**

(22) Date of filing: **21.09.1998**

(54) **Combined water inlet and bendback flag for wire edge guides of curtain coating apparatus**

Kombiniertes Wasserzulauf- und Krümmungs-Element für die Führungsdrähte einer Vorrichtung zur Vorhangbeschichtung

Arrivée d'eau et élément d'inflexion combinés pour les fils de guidage latéraux d'un dispositif d'enduction par rideau

(84) Designated Contracting States:  
**DE FR GB NL**

• **Humby, Douglas B., Eastman Kodak Company  
Rochester, New York 14650-2201 (US)**

(30) Priority: **02.10.1997 US 60668 P**

(74) Representative: **Haile, Helen Cynthia et al  
Kodak Limited  
Patent, W92-3A,  
Headstone Drive  
Harrow, Middlesex HA1 4TY (GB)**

(43) Date of publication of application:  
**07.04.1999 Bulletin 1999/14**

(73) Proprietor: **EASTMAN KODAK COMPANY  
Rochester, New York 14650 (US)**

(56) References cited:  
**EP-A- 0 649 054 US-A- 3 968 772**

(72) Inventors:  
• **Bilhorn, Robert B., Eastman Kodak Company  
Rochester, New York 14650-2201 (US)**

**EP 0 906 787 B1**

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

## Description

### FIELD OF THE INVENTION

[0001] The present invention relates generally to wire edge guides for curtain coating apparatus and, more particularly, to bendback flags and lubricating fluid delivering devices for use with curtain coating apparatus.

### BACKGROUND OF THE INVENTION

[0002] In a curtain coating apparatus a moving support is coated by causing a free falling curtain of coating liquid to impinge on the moving support to form a layer thereon. One curtain coating apparatus is described in U.S. Patent No. 3,508,947 to Hughes wherein a multi-layer composite of a plurality of distinct liquid layers is formed on a slide hopper and dropped therefrom to form a free falling curtain.

[0003] In a curtain coating process, particularly as used in the manufacture of multi-layer photographic materials, the quality of the coating is largely determined by the properties of the liquid curtain. It is important to insure that a stable laminar flow of coating solution is formed by the slide hopper and that an equally stable laminar liquid curtain is formed from that coating solution. To prevent contraction of the edges of the falling curtain under the effect of surface tension it is known that the curtain must be guided at its edges by curtain edge guides. However, the edge guides are made of solid materials which, if left unlubricated, slow the coating liquids because they produce a drag effect. This reduction in velocity results in a significant penalty in the maximum coating speed attainable near the edge. It is further known in the prior art that the introduction of a lubricating layer of water, or other low viscosity liquid, along the edge guide will reduce the drag and increase the velocity of the coating solution in the curtain edge.

[0004] Thin, vertically oriented edge guides have been used to attempt to match the width of the curtain such as, for example, taught in U.S. Patent Nos. 3,632,374 to Greiller, 4,479,987 to Koepke et al, and 4,830,887 to Reiter. Thin edge guides are used to keep the curtain from becoming non-uniform near the edges. However, while these edge rods have substantially the same width as the curtain edge and, while in some cases lubrication is used to reduce friction drag, they are not effective in avoiding problems associated with another phenomenon of curtain coating commonly referred to as "bendback". The natural trajectory of the curtain is parabolic and the curvature is greatest at the hopper lip. Bendback is characterized by a bending of the coating solution as it leaves the tip of the hopper lip. As the solution leaves the hopper lip, a moment is established about the tip of the hopper lip, and a horizontal velocity is established which causes the solution to bend inwardly toward the body of the hopper. Bendback increases as curtain velocity decreases or as the flow rate

per unit width of curtain increases. Bendback also increases as surface tension decreases.

[0005] U.S. Patent No. 3,968,772 to Greiller teaches a curtain coating apparatus where a free-falling curtain is formed between edge guides and is delivered to a moving support. EP 0649,054 A1 discloses an apparatus for forming stripes of liquid coating composition at the edges of a free-falling curtain. The stripes are guided by edge guides. A flushing fluid delivery device allows for the flushing fluid to flow from a radially diverging slot therein to form each stripe between the curtain and a respective edge guide.

[0006] Although bendback does not preclude the formation of uniform coating layers on the support, failure to accommodate the bendback of the coating solution (i.e., failure to allow the entire curtain width to follow its naturally inflected path) can produce a "standing wave" in the curtain. Standing waves are commonly produced, for example, when a narrow edge guide is attached to the hopper lip and guides the coating liquid down a vertical path different from its naturally inflected path. This creates a perturbation in the curtain at the point of intervention. A standing wave is produced which emanates from the source of the perturbation. This standing wave can produce longitudinal streaks in the dried coating.

[0007] U.S. Patent No. 4,135,477 to Ridley addresses the problem of bendback. Ridley discloses a curtain coating apparatus having wide edge guiding plates extending from the hopper lip all the way to the support to be coated. The edge guiding plates are wide enough to allow the curtain to follow its naturally inflected path to the support. In essence, the edge plate is substantially wider than the curtain edge over its entire length. This type of edge plate, however, creates other problems. Initially, the greater width of the edge plate relative to the curtain edge leads to a decreased velocity at the curtain edge. This decreased velocity reduces the stability of the curtain. In addition, a wide meniscus is formed between the curtain edge and the wide edge plate. This leads to a relative thinning of the curtain adjacent to the meniscus. As a result, there is a lack of uniform coverage across the width of the support proximate the outer edges of the curtain.

[0008] Curtain coating apparatus typically include fixed edge walls which projects from edge pads which are attached to the hopper. The fixed edge walls guide the edges of the coating solutions on the hopper slide itself. The edge pads extend from the hopper slots where the coating solutions emerge from the hopper to the hopper lip where the coating solutions leave the hopper to form the free falling curtain. It is critical in achieving a high degree of coating uniformity near the coating edge to carefully match the hopper edge pads and the curtain edge guides to the thickness and trajectory of the coating solutions. Mismatches in these areas result in disturbances to the flowing layers which can result in defects in the application of the coating to the support. One such defect is over or under coverage of one or

more of the coating layers in the vicinity of the coating edge. Flow disturbances can also result in wave formation that results in coating streaks which can occur at distances up to approximately 10 cm from the coating edge.

[0009] Matching the thickness and trajectory of the coating solutions can be particularly difficult in the region of the hopper lip where the curtain can, under some conditions, assume a high degree of curvature or bendback as discussed above. The solution thickness also changes rapidly near the lip due to the acceleration that takes place as the curtain begins its free fall. The precise trajectory that the curtain assumes in the vicinity of the hopper lip, termed the initial bendback, is a function of the lip geometry, the solution properties, and the flow rate.

[0010] Errors in matching the curtain thickness or trajectory in the initial bendback region result in disturbances to the flow at the curtain edge. Mismatches can be the result of poor alignment between the components at joints, or simply poor match between equipment geometry and actual curtain shape. The flow disturbances result in standing waves in the curtain which emanate from the point of the disturbance and which extend in to the main body of the curtain. Standing waves can result in longitudinal streaks in the coating at the point of wave impingement on the substrate. Additionally, standing waves may redistribute the flow of liquid under the wave altering the coverage in the entire area between the streak and the coating edge.

[0011] The prior art fails to provide curtain edging hardware that is easily and reproducibly installed and that does a good job in matching curtain trajectories for a variety of coating solutions and parameters. The prior art further fails to teach a lubricating inlet design which represents a solution to the problem of matching the initial trajectory of the curtain in combination with providing a path for the flow of lubricating liquid to the wire edge guide.

### SUMMARY OF THE INVENTION

[0012] It is, therefore, an object of the present invention to provide curtain edging hardware that is easily and reproducibly installed to allow for relatively quick change out to meet the requirements of different coating solutions and coating parameters.

[0013] It is a further object of the present invention to provide a lubricating liquid inlet which has incorporated therein a bendback flag.

[0014] Still another object of the present invention is to provide an integrally formed lubricating liquid inlet and bendback flag which allows for interchangeable mounting onto the strut of a curtain coating apparatus so that the integrally formed lubricating liquid inlet and bendback flag can be quickly and easily changed to meet the specific work requirements of the coating solution being applied.

[0015] Briefly stated, the foregoing and numerous

other features, objects and advantages of the present invention will become readily apparent upon a reading of the detailed description, claims and drawings set forth herein. These features, objects and advantages are accomplished by providing curtain edging hardware wherein the water inlet body is integrally formed with the bendback flag and wherein such water inlet body is adapted to be interchangeably mounted to the supporting strut which forms part of the curtain coating apparatus allowing the water inlet body to be easily changed depending on the specific coating solution and coating apparatus operating parameters. The lubricating liquid inlet body includes a curtain-side surface, a front surface, a bottom surface and an inclined surface wherein the inclined surface resides between the front surface and the bottom surface. There is a water inlet port in the water inlet body and there is a channel beginning in the front surface and extending generally downward across the inclined surface and the bottom surface. The channel is angled toward the curtain-side surface. A bore is formed through the water inlet body from the water inlet port to the channel and there is an edge guide surface projecting from the curtain-side surface wherein the edge guide surface follows a generally curved path. The width of the edge guide surface and the curvature of the edge guide surface depend upon the solution or solutions forming the coating and the operating parameters of the coating apparatus. A mounting bracket integrally formed with the water inlet body and extending therefrom is adapted to allow the mounting of the water inlet body to the top of the strut. In such manner, not only can the bendback trajectory be closely matched for a variety of solutions and coating parameters but the width of the bendback flag can be matched to the thickness of the coating solution thereby obviating the thinning problems created by the wider bendback flags of the prior art.

[0016] As mentioned above, the integrally formed water inlet body of present invention allows for the adoption of a strategy of efficiently using edge guide hardware customized for specific flow conditions encountered in various product mixes. One water inlet body of the present invention can be quickly interchanged with another water inlet body designed for specific flow conditions of the next coating application without disturbing the wires themselves.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Figure 1 is a perspective schematic view of a curtain coating apparatus.

[0018] Figure 2 is a perspective view of the right side edge guiding hardware of a curtain coating apparatus incorporating the water inlet body of the present invention.

[0019] Figure 3 is a perspective exploded view of the water inlet body of the present invention and the edge guide strut.

[0020] Figure 4 is a perspective view of the water inlet

body of the present invention.

**[0021]** Figure 5 is a rear elevation of the water inlet body depicted in Figure 4.

**[0022]** Figure 6 is yet another perspective view of the water inlet body of the present invention.

**[0023]** Figure 7 is a bottom plan view of the water inlet body depicted in Figures 4 and 6.

**[0024]** Figure 8 is a curtain side elevation of the water inlet body of the present invention depicted in Figures 4 and 6.

**[0025]** Figure 9 is a side elevation of the water inlet body of Figure 6 viewed from the side opposite the curtain side.

## DETAILED DESCRIPTION OF THE INVENTION

**[0026]** Turning first to Figure 1, there is shown a perspective schematic view of a coating apparatus 10 incorporating the water inlet body 12 (as shown in Figure 2) of the present invention. The curtain coating apparatus includes a slide hopper 14 having multiple metering slots 16 which emit coating liquid. The coating liquids flow down the slide surface 18 to the hopper lip 20. The coating liquids then form a free falling curtain as they exit the hopper lip 20 from the tip 22 thereof. The free falling curtain falls on a moving support 24 supported on a coating roller 26. Extending downward from the hopper lip 20 toward the coating roller 26 are the left and right edge guiding hardware 28, 30.

**[0027]** Looking next at Figure 2, there is shown a perspective view of the right edge guiding hardware 30. The left edge guiding hardware 28 is a mirror image of the right edge guiding hardware 30. The right edge guiding hardware 30 includes an edge pad 32 which is affixed to the slide hopper 14. Projecting from the curtain-side surface 34 of edge pad 32 is fixed edge wall 36. The edge pad 32 extends from the metering slots 16 where the coating solutions emerges from the slide hopper 14, to the tip 22 of the hopper lip 20, where the coating solutions leave the slide hopper 14 to form the free falling curtain. Positioned below edge pad 32 is wire edge guide strut 38. Wire edge guide strut 38 is supported by means of mounting frame 40 (see Figure 1) which is affixed to edge pad 32. The water inlet body 12 of the present invention is affixed to the top of wire edge guide strut 38. Extending from the top to the bottom of wire edge guide strut 38 are a pair of wires 42 which guide the curtain. Water or other lubricating fluid is delivered to the wires 42 by the water inlet body 12. By introducing the water to the back (the side opposite the curtain) of the wires 42, the spacing between the edge wall 36 and the wires 42 can be significantly reduced. The wires 42 serve as edge guides for the free falling curtain. A vacuum block 43 is supported at the base of strut 38 allowing for the removal of the lubricating liquid as the free-falling curtain contacts the moving support 24. The wires 42 may be protected by bumpers 45 mounted to strut 38.

**[0028]** Turning next to Figure 3, there is shown an ex-

ploded perspective view of the wire edge guide strut 38 and the water inlet body 12. Extending from the upper portion of strut 38 is inlet support tab 44. Inlet support tab 44 includes two planar surfaces 46, 48 arranged at right angles to each other. There are a pair of grooves 47 in inlet support tab 44 providing residence for wires 42. The wires 42 are affixed to the backside of strut 38 by means such as screws 49 which extend through bores 51 and are retained by means of nuts 53 to allow the tension of wires 42 to be adjusted. Inlet support tab 44 provides vertical and one dimension of horizontal registration for the water inlet body 12. The radiused end 50 of inlet support tab 44 provides a stop which restricts the second horizontal degree of freedom of the water inlet body 12. There are two tapped holes 52, 54 in planar surface 46 of inlet support tab 44. When water inlet body 12 is mounted to inlet support tab 44, countersunk holes 56, 58 in water inlet body 12 generally align with tapped holes 52, 54. There is, however, a slight intentional offset in the alignment of countersunk holes 56, 58 with tapped holes 52, 54. This slight offset in alignment provides a lateral force when flathead screws 60 are threadably engaged with tapped holes 52, 54. This force pulls the water inlet body 12 snugly up against the reference surfaces 46, 48, 50 of water inlet body 12 to insure proper alignment of the water inlet body 12. The intentional misalignment between the tapped holes 52, 54 and the countersunk holes 56, 58 should be about 0.005 inches. A water delivery tube 59 (shown partially) is connected to the water inlet body.

**[0029]** Looking next at Figures 4 through 9, there is shown the water inlet body 12 of the present invention in greater detail. The water inlet body 12 includes an inlet mounting bracket 62 extending from the rear side thereof. Countersunk holes 56, 58 actually reside in inlet mounting bracket 62. Water inlet body 12 includes a top surface 64, a front surface 66 which resides substantially perpendicularly to top surface 64, a bottom surface 68 which is substantially parallel to top surface 64 and inclined surface 70 residing between front surface 66 and bottom surface 68. Water inlet body 12 further includes a curtain-side surface 72 and an inlet-side surface 74 which is opposite curtain-side surface 72 (see Figure 9). Projecting from curtain-side surface 72 is edge guide or bendback flag 76. There is a bore 78 in inlet surface 74 extending into water inlet body 12. The diameter of bore 78 is preferably about 0.090 inches. That portion of bore 78 immediately adjacent water inlet surface 74 will be larger to allow for receipt of water delivery tube 59. There is a channel 80 which begins in front surface 66 and crosses inclined surface 70 and bottom surface 68. At that portion of the channel 80 which crosses front surface 66, there is a bore 82 which intersects bore 78. In such manner, water inlet body 12 has a lubricating liquid flow path wherein the water or other lubricating liquid flows through bore 78, bore 82 and channel 80. Channel 80 is sized to accommodate water flow rate in the range of from about 25 to 30 mil-

liliters per minute. Channel width is preferably about 0.070 inches and channel depth is preferably about 0.075 inches, the cross section of channel 80 is rectangular.

**[0030]** Looking at Figure 5 it can be seen that inlet mounting bracket 62 includes a generally horizontal planar surface 84 and the generally vertical planar surface 86. In addition, inlet mounting bracket 62 further includes a radius internal surface 88. Generally horizontal planar surface 84 is adapted to mate with planar reference surface 46. Generally vertical planar surface 86 is adapted to mate with planar reference surface 48. Radiused internal surface 88 is adapted to mate with radiused end 50. As mentioned previously, the two countersunk holes 56, 58 in the water inlet body 12 are slightly offset with respect to the two tapped holes 52, 54 in the inlet support tab 44. This slight intentional offset ensures full engagement of the water inlet body 12 with the inlet support tab 44 when the flathead screws 60 are used to connect water inlet body 12 to the inlet support tab 44.

**[0031]** Referring back to Figure 4, the wall height at the top of channel 80 tapers away to zero before the channel 80 reaches top surface 64 of water inlet body 12 in order to provide a natural leak stop. If the channel 80 continued to the top surface 64, liquid would be drawn by capillary forces along the corners formed between the bottom of channel 80 and the walls of channel 80 to the top surface 64. Once at the top surface 64 the liquid could potentially spread creating a contamination concern. The lubricating fluid delivery channel 80 commencing from bore 82 angles toward front surface 72. The depth of channel 80 as it crosses inclined surface 70 and bottom surface 68 (Figure 7) is preferably constant. Inclined surface 70 was necessary in order to maintain a generally constant depth to channel 80. In such manner, no additional corners are created that might serve as points for liquid to pin. The creation of unintentional pinning points can lead to contamination and undesired flow paths. Channel 80 preferably resides at an angle in the range of from about 15 to about 45 degrees from vertical and most preferably at an angle of about 25 degrees from vertical. Inclined surface 70 is preferably located at an angle of in the range of from about 15 to about 50 degrees from vertical and most preferably at an angle of about 35 degrees from vertical. The lower section 89 of the delivery channel 80 is cut at a steeper angle than the main section 91 of the channel 80 (see Figure 7). The lower section 89 is preferably cut at an angle in the range of from about 45 to about 75 degrees from vertical, and most preferably at an angle of about 55 degrees from vertical. Another feature of the channel 80 that is enabled by cutting the channel 80 in two sections 89, 91 is the extension of the back wall 93 of the lower section 89 of channel 80 beyond the centerline of the inlet behind the wires 42. Extending the back wall of the lower channel segment beyond the centerline at the wires 42 provides a corner for liquid pinning and thereby reduces the meniscus that is formed in the

liquid.

**[0032]** It should be noted that lubricating liquid delivered through channel 80 is delivered to the back of the wires 42 with respect to the curtain. In the prior art, water delivery was generally terminated above the wires and on the same side of the wires as the curtain. Termination of the channel in front of the wires, however, restricts the minimum distance that the wires can be set back from the initial guiding edge wall 36. By introducing the liquid to the back of the wires 42, the integrity of the inlet face 72, 92 and the bendback flag 76 are not compromised, and the spacing between the bendback flag 76 and the wires 42 is significantly reduced.

**[0033]** The lower edge 90 of gusset 92 which forms part of mounting bracket 62 is cut back at an angle of 45 degrees from horizontal (Figure 8). This further minimizes the size of the meniscus which forms in the lubricating liquid as it leaves channel 80 and joins the curtain. If the lower edge 90 of gusset 92 was horizontal, lubricating liquid would follow that surface away from the curtain thereby enlarging the meniscus in the direction toward the hopper 14.

**[0034]** Ideally, bendback flags 76 are designed to closely match the exact shape of the curtain as the curtain leaves the tip 22 of the hopper lip 20. In practice, some allowance is made for variations in viscosity and flow rate by designing the bendback flag 76 to be a little wider than the thickness of the curtain. Also, curved shapes are often approximated by multiple straight line segments. Maintaining the thickness of the curtain at the edge so that it matches the thickness away from the edge is important for preventing the formation of standing waves. Allowing the curtain edge to spread across an overly wide edge wall results in a thin region in the curtain just inside the edge. Thin regions in the curtain will result in low coverage, are more prone to rupture if surface active contaminants are present, and may have a lower speed of wetting than the main portion of the curtain. For these reasons, it is critical that only the edge of the bendback flag 76 be allowed to be wet by the coating solutions. If fluid migrates onto either side of the bendback flag 76, a swollen edge is produced resulting in the problems mentioned above.

**[0035]** The coating solutions are prevented from wetting beyond the intended surface of the bendback flag 76 by presenting a sharp corner to which the air-liquid interface can pin.

**[0036]** It has been found that different requirements exist for edge wall or bendback flag height on the concave side of the curtain as opposed to the convex side of the curtain. The concave side of the curtain is more prone to difficulties associated with the coating fluids wetting around the corner of the edge wall and then on to the curtain-side surface 72. Additionally, it has been found that a fillet radius much smaller than 0.047 inches at the base of bendback flag 76 does not sufficiently reduce the propensity for the coating liquids to pin in the corner. As a result, the minimum value for the distance

from the face of bendback flag 76 to the face of gusset 92 has been found to be that distance which gives a 90 degree corner for pinning and allows a 3/32 inch diameter fillet. On the concave side of the curtain, the distance from the surface of the bendback flag 76 to the curtain-side surface 72 is increased to 0.060 inches with the fillet diameter maintained at .33 inch. This increase in distance results in a design which is robust to flag flooding as may occur during hopper fills. That is, liquid that is splashed or otherwise deposited on the side of the bendback flag 76 is spontaneously drawn back into the curtain so that the curtain remains pinned on the corner of the bendback flag 76.

**[0037]** Minimizing the distance the bendback flag 76 extends from surfaces 72, 92 allows the wires 42 to be moved closer to the curtain edge. This results in minimizing the disturbance to the flow of the curtain at the transition from the bottom of the bendback flag 76 to the water stripe at the wires 42.

**[0038]** Fabrication of the water inlet body 12 of the present invention is relatively simple. The water inlet body 12 of the present invention is an integrally formed single piece. With the exception of the contour of the bendback flag 76, all of the machining steps can be carried out manually or, in other words, without computer control of the table feeds. The contour of the bendback flag 76 is cut with numerical control of two axes of the milling machine thereby allowing contours of any complexity to be cut. In principal, any number of line segments can be used resulting in an essentially smooth curve.

**[0039]** Alternatively, a greater economy in the manufacture of the water inlet body 12 of the present invention can be accomplished by casting the parts from a suitable epoxy material. For this operation, a silicon mold is made from a master and multiple parts are cast from the reusable mold. Suitable masters can be machined from, for example, a polycarbonate such as Lexan® or aluminum rather than from titanium or stainless steel as would be required if the part were being fabricated for a long term production use. Masters can also be made from the cast material enabling rapid prototyping. Masters can be made without the contour of the bendback flag 76 cut into the part thereby allowing such masters to be used to make molds which will yield blanks. The blanks can then, in turn, be machined to produce prototypes with the desired bendback flags for experimentation or pilot use.

**[0040]** The particular epoxy used for molding the water inlet body 12 of the present invention should be selected based on factors such as mechanical toughness, dimensional stability and chemical resistance. Hysol 2039 resin, YSE-cure N001 which is available from Dexter Corp. of Seabrook, NH, and PT4029 which is available from PTM & W Industries are two epoxies which are suitable for use in molding the water inlet bodies 12 of the present invention.

**[0041]** The water inlet body 12 of the present inven-

tion can be molded with a specific and predetermined bendback flag 76. The bendback flag 76 can be sized and shaped to fit the specific solution and curtain flow. In such manner, the thickness and trajectory of the coating solutions are matched to thereby minimize disturbance of the curtain. The shape and width of the bendback flag 76 to be used for a specific coating solution can be predicted by a mathematical model or, alternatively, can be determined empirically. Ideally, the bendback flag 76 is designed to closely match the exact shape of the curtain with some allowance made for variations in viscosity and flow rate to allow the bendback flag 76 to be slightly wider than the thickness of the curtain. The curved shape of the bendback flag 76 may be closely approximated by a plurality of straight line segments.

**[0042]** In that the water inlet body 12 of the present invention which incorporates an integrally formed bendback flag 76 is attached to the inlet support tab 44 of the strut 38 by means of only two flathead screws 60, it becomes a relatively simple matter to substitute one water inlet body 12 for another to adapt the edge guiding hardware 30 of the coating apparatus 10 for application of different coating solutions. No disturbance of the wires 42 is necessary in changing the water inlet body 12. In addition, because of the integration of the bendback flag 76 into the water inlet body 12, water may be introduced higher in the curtain relative to water inlets of the prior art. This minimizes disturbance of the curtain because of lower velocity near the hopper lip 20. In addition, the integrally formed water inlet body 12 completely eliminates one standing wave source typically found in prior art apparatus. With the water inlet body 12 of the present invention water is introduced at the same point as the curtain transitions to the wires 42.

**[0043]** From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are apparent and which are inherent to the device.

**[0044]** It will be understood that certain features and subcombinations are of utility and may be employed with reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

**[0045]** As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth and shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

## Claims

1. A device for supplying water to a wire edge guide (42) in a curtain coating apparatus (10) where a free-falling curtain is delivered to a moving support (24), said device comprising a water inlet body (12)

including a water inlet port (78) **characterized by:**

said water inlet body is integrally formed and includes

- (a) a water delivery path (80), (82) integrally formed in said water inlet body (12) for carrying water from said water inlet port (78) to the wire edge guide (42); and
- (b) an edge guide surface (76) projecting said water inlet body (12), said edge guide surface (76) following a generally curved path which substantially matches the curvature and thickness of the free-falling curtain.

2. A device as recited in claim 1 further comprising:

a mounting bracket (62) integrally formed with said water inlet body (12) which allows one water inlet body to be interchanged with another water inlet body and precisely positioned with respect to the wire edge guide without disturbing the wire edge guide.

3. A device as recited in claim 1, said water inlet body including:

a curtain-side surface (72), a front surface (66), a bottom surface (68), and an inclined surface (70), said inclined surface residing between said front surface and said bottom surface (68), said edge guide surface projecting from said curtain-side surface.

4. A device as recited in claim 3 further comprising:

- (a) a channel (80) in said water inlet body (12) beginning in said front surface (66) and extending generally downwardly across said inclined surface (70) and said bottom surface (68), said channel (80) angled toward said curtain-side surface (72); and
- (b) a conduit path (82) through said water inlet body (12) from said water inlet port to said channel.

5. A device as recited in claim 4 wherein:

Said channel (80) delivers lubricating liquid to the wire edge guide on the side of the wire edge guide away from the free-falling curtain.

6. A device as recited in claim 5 further comprising:

a wire edge guide strut (38), said wire edge guide strut including

- (a) a first reference surface (46);
- (b) a second reference surface (48);
- (c) a third reference surface (50); and
- (d) at least one tapped hole (52) in said first reference surface.

7. A device as recited in claim 6, said inlet body further comprising:

- (a) a first mating surface (84) which mates with said first reference surface (46);
- (b) a second mating surface (86) which mates with said second reference surface (48);
- (c) a third mating surface (88) which mates with said third reference surface (50); and
- (d) at least one hole (56) in said first mating surface (84), said at least one hole being slightly misaligned with said at least one tapped hole (52) in said first reference surface (46) causing said inlet body (12) to be constrained in a precise and predetermined position when said inlet body is mounted on said wire edge guide strut (38) by at least one screw extending through said at least one hole in said first mating surface (84) and engaging said at least one tapped hole in said first reference surface (46).

8. A device as recited in claim 5 wherein:

said channel (80) has a substantially constant width.

9. A device as recited in claim 5 wherein:

said channel (80) in said front surface (66) and said bottom surface (68) has a substantially constant depth.

#### 40 Patentansprüche

1. Vorrichtung zum Zuführen von Wasser zu einer Draht-Kantenführung (42) in einem Vorhangbeschichtungsgerät (10), bei dem ein frei fallender Vorhang auf einen sich bewegenden Träger (24) aufbringbar ist, wobei die Vorrichtung einen Wasserzulaufbehälter (12) mit einer Zulauföffnung (78) aufweist, **dadurch gekennzeichnet, dass**

der Wasserzulaufbehälter einstückig ausgebildet ist und

- (a) eine Wasserzuführbahn (80, 82) aufweist, die im Wasserzulaufbehälter (12) einstückig ausgebildet ist, um Wasser von der Zulauföffnung (78) zur Kantenführung (42) zu transportieren, und
- (b) eine Kantenführungsfläche (76) umfasst, die in den Wasserzulaufbehälter (12) ragt und

einer im allgemeinen gekrümmten Bahn folgt, die im wesentlichen der Krümmung und Dicke des frei fallenden Vorhangs entspricht.

2. Vorrichtung nach Anspruch 1, **gekennzeichnet durch** eine Konsole (62), die mit dem Wasserzulaufbehälter (12) einstückig ausgebildet ist, derart, dass ein Wasserzulaufbehälter **durch** einen anderen austausch- und bezüglich der Kantenführung genau positionierbar ist, ohne diese zu stören. 5
3. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** der Wasserzulaufbehälter eine seitliche Fläche (72) für den Vorhang, eine vordere Fläche (66), eine untere Fläche (68) und eine geneigte Fläche (70) umfasst, die zwischen der vorderen Fläche (66) und der unteren Fläche (68) vorgesehen ist, wobei die Kantenführungsfläche von der seitlichen Fläche des Vorhangs absteht. 10
4. Vorrichtung nach Anspruch 3, **gekennzeichnet durch**
- (a) einen Kanal (80) im Wasserzulaufbehälter (12), der in der vorderen Fläche (66) beginnt und sich im allgemeinen über die geneigte Fläche (70) und die untere Fläche (68) nach unten erstreckt und zur seitlichen Fläche (72) hin abgewinkelt ist, und 25
- (b) eine Leitungsbahn (82) **durch** den Wasserzulaufbehälter (12), die sich von der Zulauföffnung bis zum Kanal erstreckt. 30
5. Vorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** der Kanal (80) der Kantenführung auf ihrer vom frei fallenden Vorhang entfernten Seite Schmierflüssigkeit zuführt. 35
6. Vorrichtung nach Anspruch 5, **gekennzeichnet durch** ein Draht-Kantenführungsgestänge (38) mit 40
- (a) einer ersten Referenzfläche (46);
- (b) einer zweiten Referenzfläche (48);
- (c) einer dritten Referenzfläche (50) und 45
- (d) mindestens einer mit Innengewinde versehenen Öffnung (52) in der ersten Referenzfläche.
7. Vorrichtung nach Anspruch 6, **dadurch gekennzeichnet, dass** der Wasserzulaufbehälter 50
- (a) eine erste Eingreiffäche (84) umfasst, die in Eingriff mit der ersten Referenzfläche (46) bringbar ist;
- (b) eine zweite Eingreiffäche (86), die in Eingriff mit der zweiten Referenzfläche (48) bringbar ist; 55
- (c) eine dritte Eingreiffäche (88), die in Eingriff

mit der dritten Referenzfläche (50) bringbar ist; und

(d) mindestens eine Öffnung (56) in der ersten Eingreiffäche (84) aufweist, wobei die mindestens eine Öffnung leicht versetzt ist gegenüber der mindestens einen mit einem Innengewinde versehenen Öffnung (52) in der ersten Referenzfläche (46), wodurch der Wasserzulaufbehälter (12) in einer genauen und vorbestimmten Position zusammengedrückt ist, wenn er auf das Kantenführungsgestänge (38) mittels mindestens einer Schraube aufgesetzt wird, die sich durch die mindestens eine Öffnung in der ersten Eingreiffäche (84) erstreckt und in Eingriff mit der mindestens einen, mit einem Innengewinde versehenen Öffnung in der ersten Referenzfläche (46) gelangt.

8. Vorrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** der Kanal (80) eine im wesentlichen konstante Weite hat.
9. Vorrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** der Kanal (80) in der vorderen Fläche (66) und der unteren Fläche (68) eine im wesentlichen konstante Tiefe hat.

#### Revendications

1. Dispositif destiné à fournir de l'eau à un guide de bord à fil (42) dans un appareil de couchage au rideau (10) où un rideau tombant librement est délié à un support mobile (24), ledit dispositif comprenant un corps d'entrée d'eau (12) comprenant un orifice d'entrée d'eau (78) **caractérisé en ce que :**

ledit corps d'entrée d'eau est formé en une pièce et comprend

(a) un trajet de distribution d'eau (80), (82) formé en une pièce dans ledit corps d'entrée d'eau (12) en vue de transporter de l'eau depuis ledit orifice d'entrée d'eau (78) vers le guide de bord à fil (42), et

(b) une surface de guide de bord (76) faisant saillie du corps d'entrée d'eau (12), ladite surface de guide de bord (76) suivant un trajet généralement courbe qui correspond sensiblement à la courbure et à l'épaisseur du rideau tombant librement.

2. Dispositif selon la revendication 1, comprenant en outre :

une patte de montage (62) formée en une pièce avec ledit corps d'entrée d'eau (12) qui permet

qu'un corps d'entrée d'eau soit échangé avec un autre corps d'entrée d'eau et positionné de façon précise par rapport au guide de bord à fil sans perturber le guide de bord à fil.

3. Dispositif selon la revendication 1, ledit corps d'entrée d'eau comprenant :

une surface du côté rideau (72), une surface avant (66), une surface inférieure (68) et une surface inclinée (70), ladite surface inclinée résidant entre ladite surface avant et ladite surface inférieure (68), ladite surface de guide de bord faisant saillie de ladite surface du côté rideau.

4. Dispositif selon la revendication 3, comprenant en outre :

(a) un canal (80) dans ledit corps d'entrée d'eau (12) commençant dans ladite surface avant (66) et s'étendant sensiblement vers le bas à travers ladite surface inclinée (70) et ladite surface inférieure (68), ledit canal (80) formant un angle vers ladite surface du côté rideau (72), et (b) un trajet de conduite (82) à travers ledit corps d'entrée d'eau (12) depuis ledit orifice d'entrée d'eau vers ledit canal.

5. Dispositif selon la revendication 4, dans lequel :

ledit canal (80) délivre un liquide de lubrification au guide de bord à fil sur le côté du guide de bord à fil à l'écart du rideau tombant librement.

6. Dispositif selon la revendication 5, comprenant en outre :

un montant de guide de bord à fil (38), ledit montant de guide de bord à fil comprenant

(a) une première surface de référence (46),  
 (b) une seconde surface de référence (48),  
 (c) une troisième surface de référence (50), et  
 (d) au moins un trou taraudé (52) dans ladite première surface de référence.

7. Dispositif selon la revendication 6, ledit corps d'entrée comprenant en outre :

(a) une première surface adaptative (84) qui s'adapte à ladite première surface de référence (46),  
 (b) une seconde surface adaptative (86) qui s'adapte à ladite seconde surface de référence (48),  
 (c) une troisième surface adaptative (88) qui

s'adapte à ladite troisième surface de référence (50), et

(d) au moins un trou (56) dans ladite première surface adaptative (84), ledit au moins un trou étant légèrement décalé par rapport audit au moins un trou taraudé (52) dans ladite première surface de référence (46), ce qui amène ledit corps d'entrée (12) à être contraint dans une position précise et prédéterminée lorsque ledit corps d'entrée est monté sur ledit montant de guide de bord à fil (38) par au moins une vis s'étendant à travers ledit au moins un trou dans ladite première surface adaptative (84), et venant en prise avec ledit au moins un trou taraudé dans ladite première surface de référence (46).

8. Dispositif selon la revendication 5, dans lequel :

ledit canal (80) présente une largeur sensiblement constante.

9. Dispositif selon la revendication 5, dans lequel :

ledit canal (80) dans ladite surface avant (66) et ladite surface inférieure (68) présente une profondeur sensiblement constante.

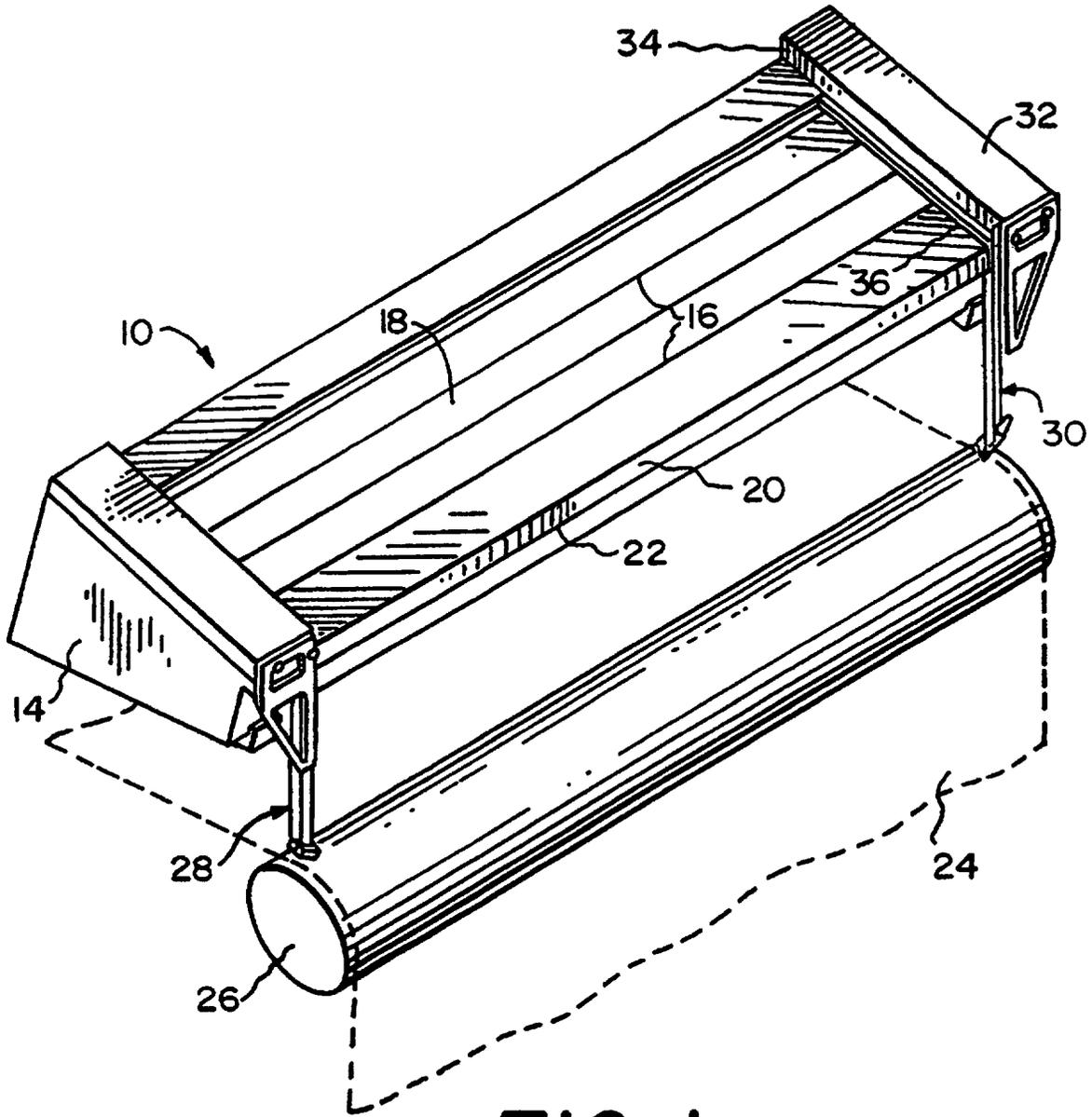


FIG. 1

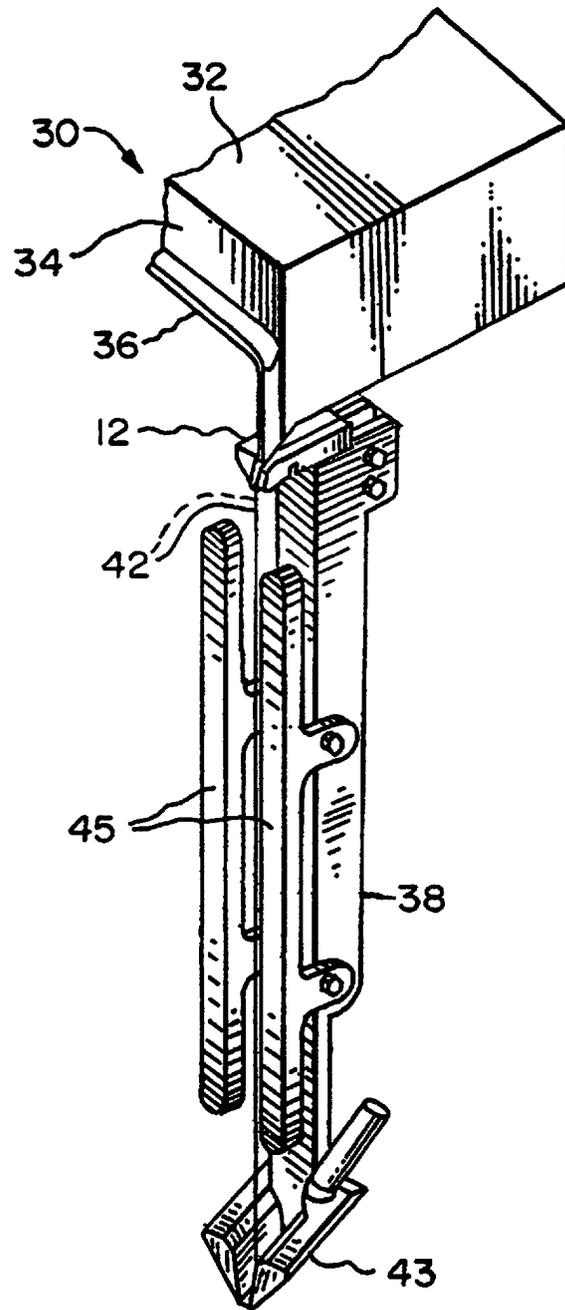


FIG. 2

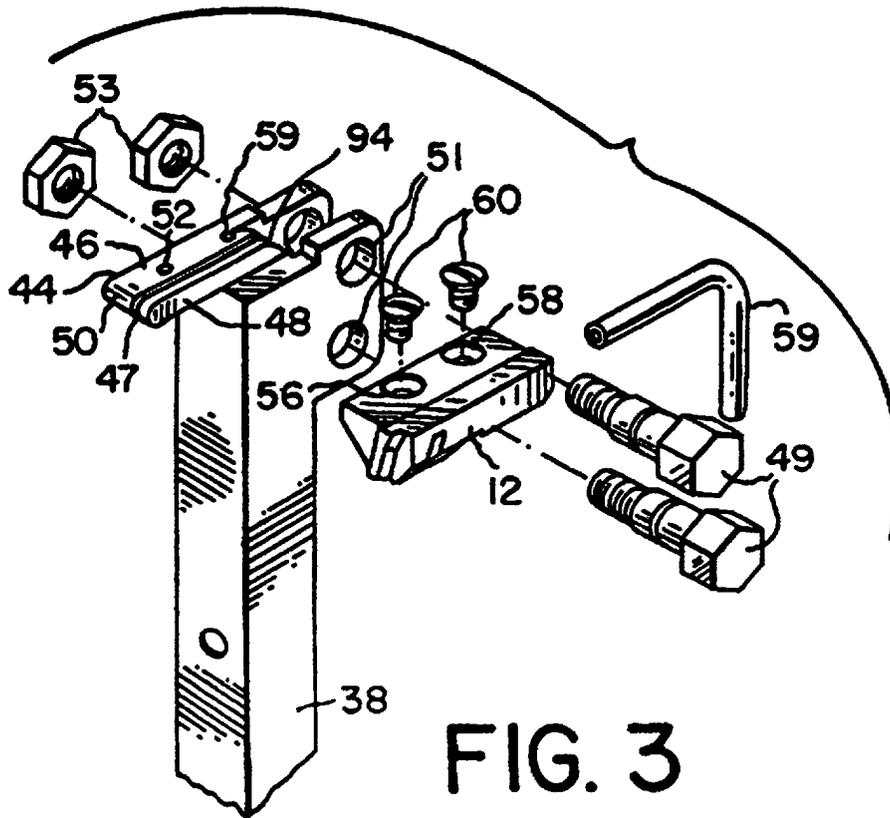


FIG. 3

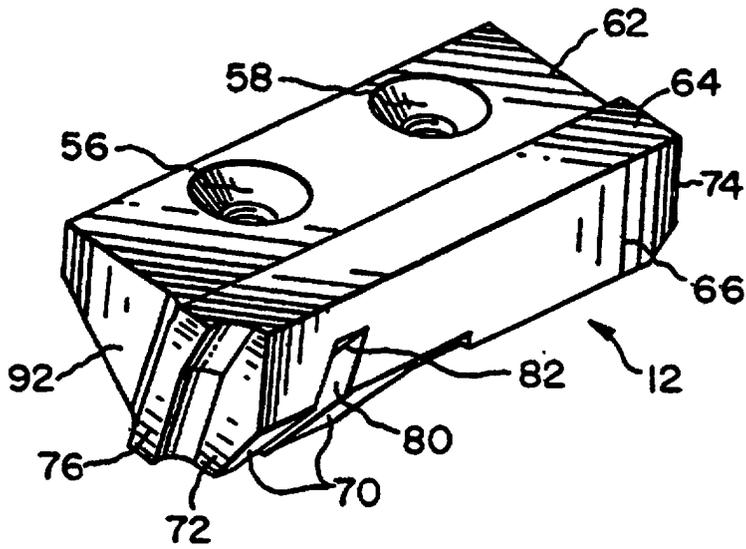


FIG. 4



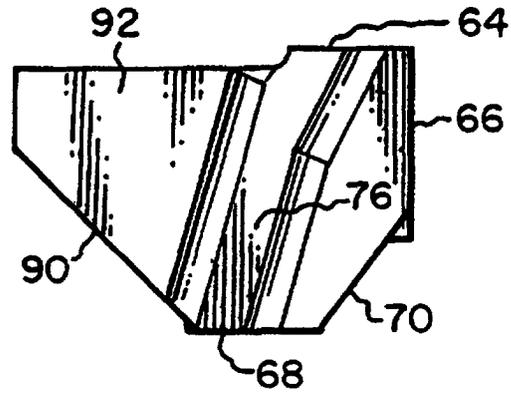


FIG. 8

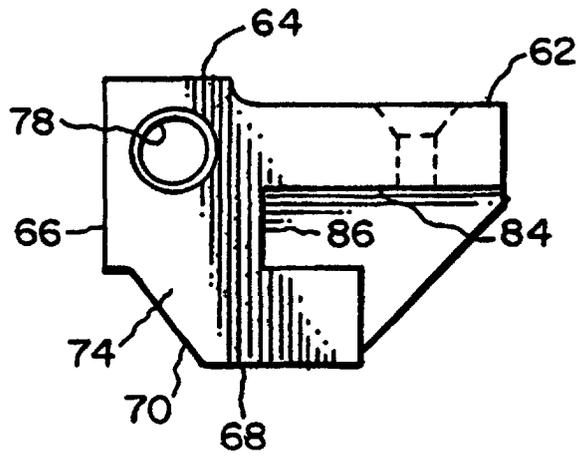


FIG. 9