United States Patent

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[54] **CURTAIN COATING APPARATUS**
19 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **118/324**
[51] **Int. Cl.** **B05c 5/00**
[50] **Field of Search** ..... 118/24, 324 (CC), 410, 411; 117/105.3; 53/140

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ABSTRACT: An improved coating device for use in coating objects passing along a path below the coating device and through a sheet of liquid coating material falling from the coating device, said device comprising a reservoir for holding a supply of liquid coating material, an internally disposed hollow housing for dispensing liquid coating material into the reservoir at a uniform chosen rate of flow, and a weir defining the effective upper edge of the reservoir over which the liquid coating material is directed, the weir having a downwardly extending surface terminating in an edge disposed in spaced relation above the objects to be coated and along which the liquid coating material overflowing the upper surface of the weir is adapted to flow to produce a downwardly falling sheet or curtain of liquid coating material through which the object is to be coated passes.

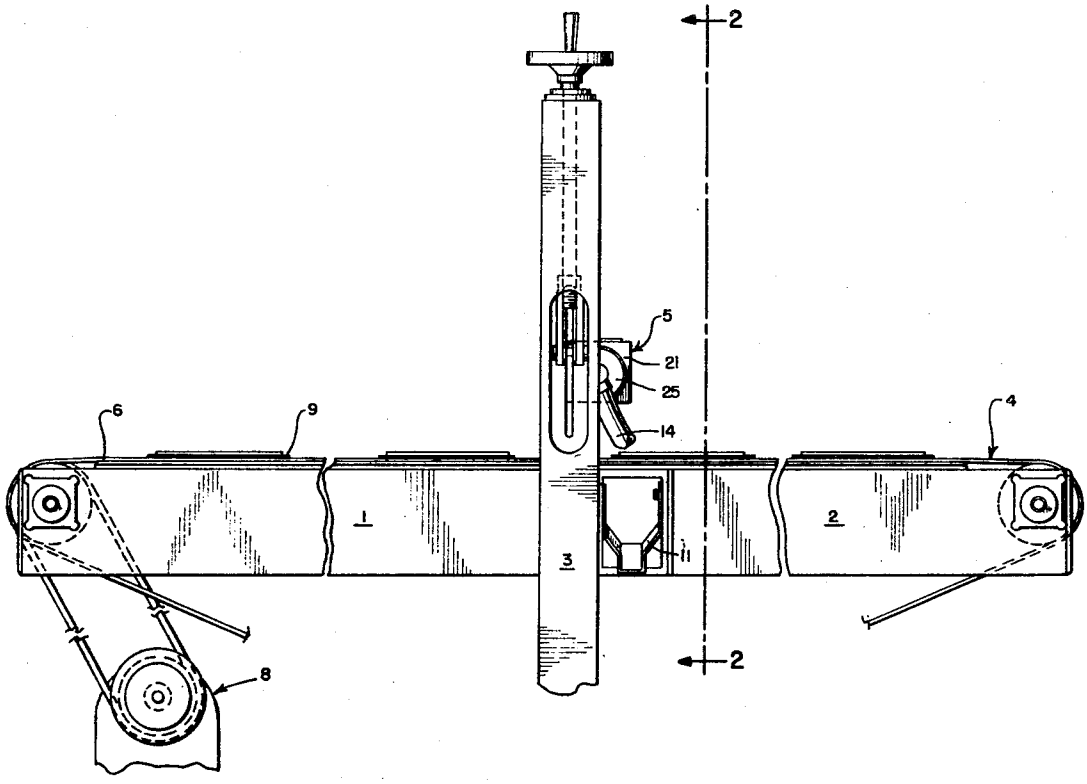

FIG. 1

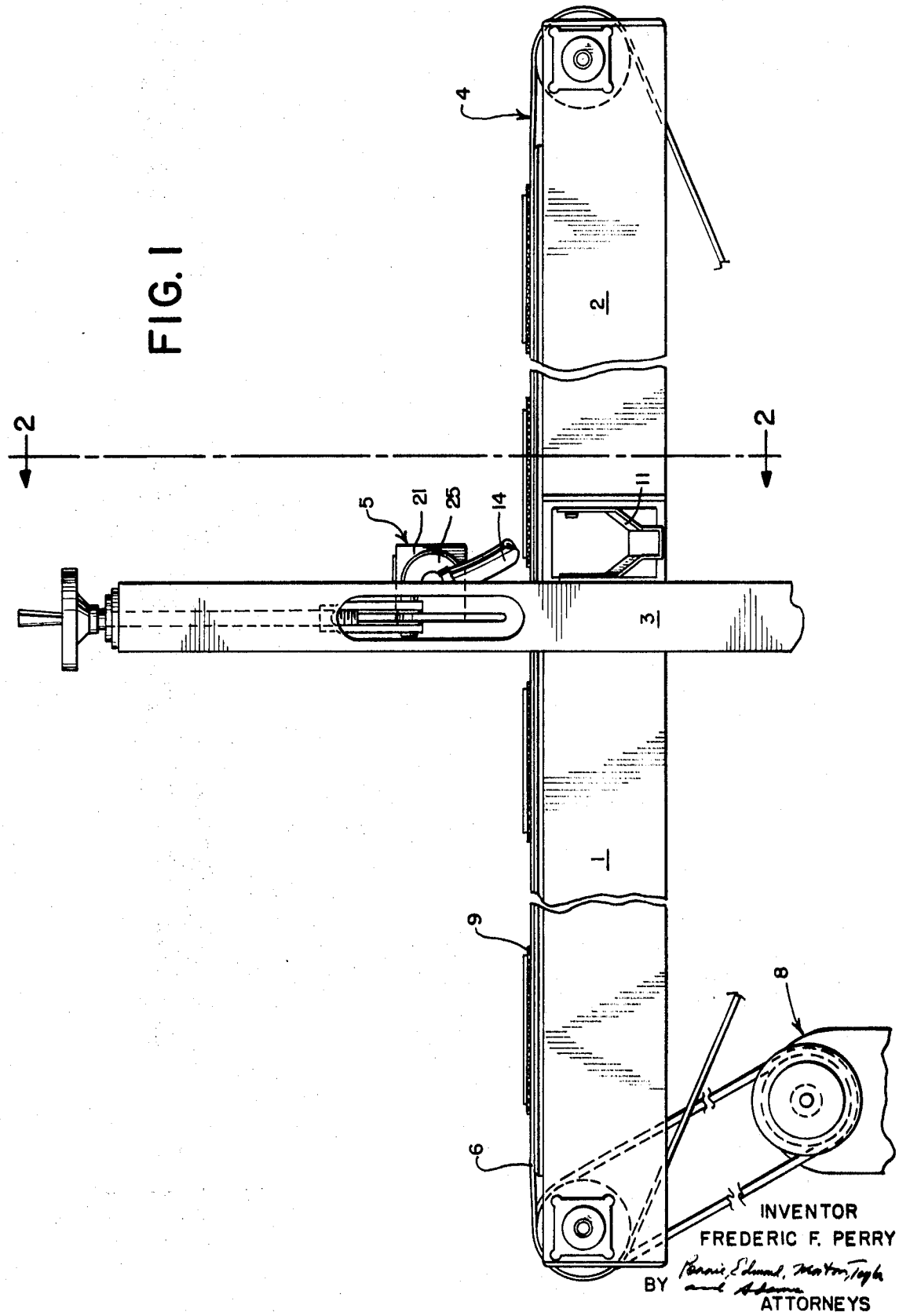

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FIG. 2

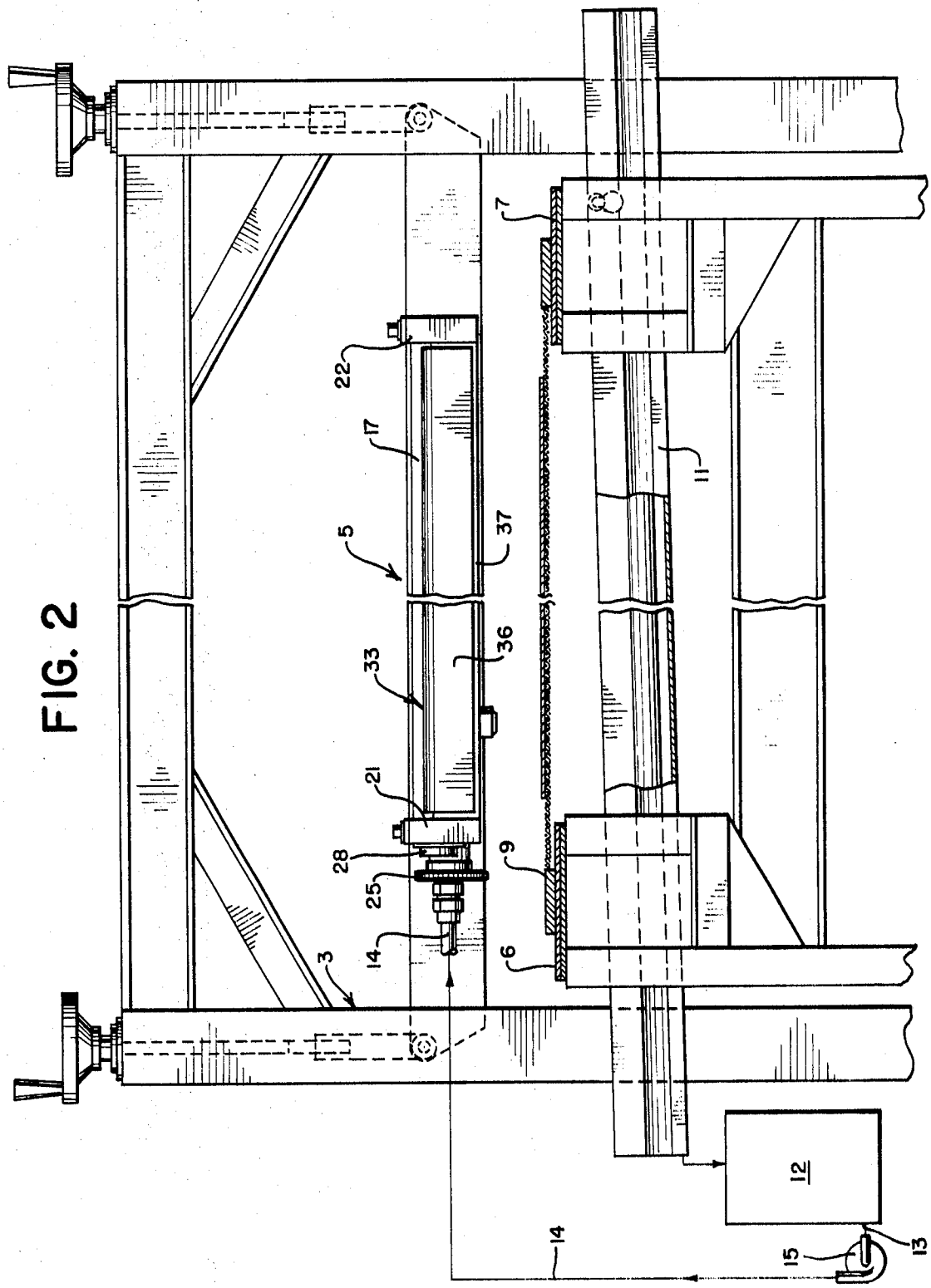

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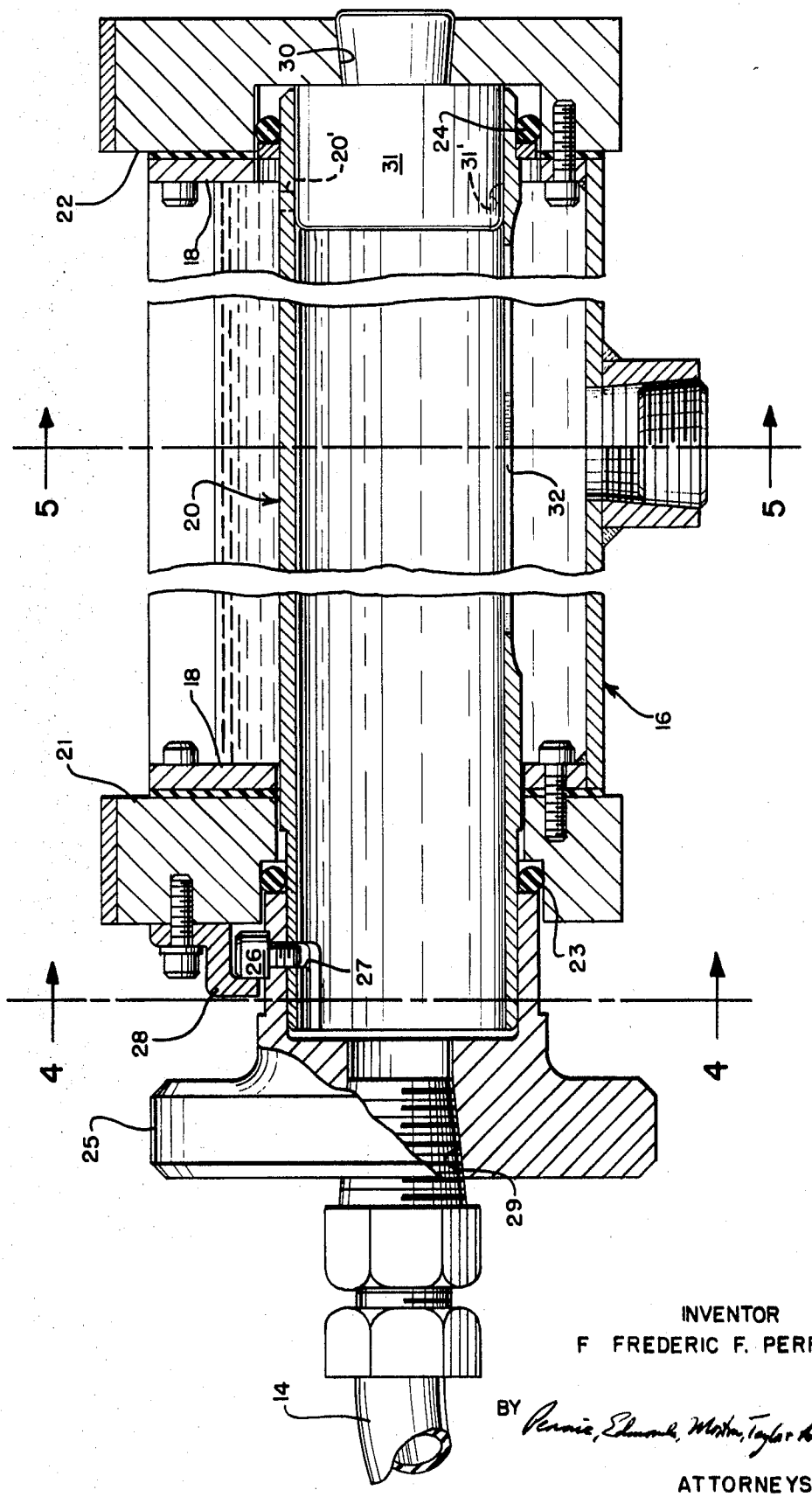
FIG. 3



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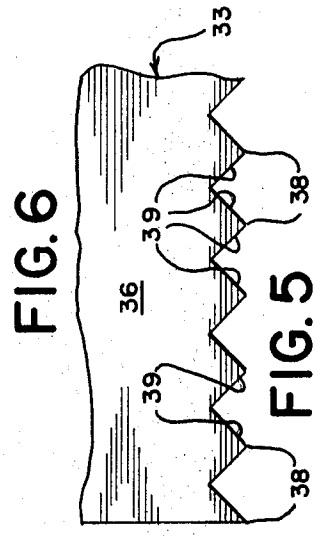

FIG. 6

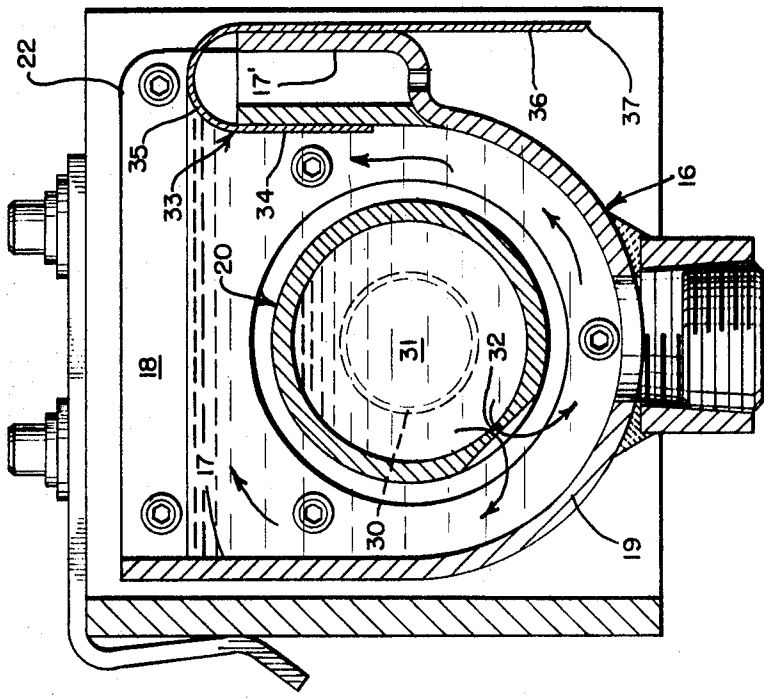

FIG. 5

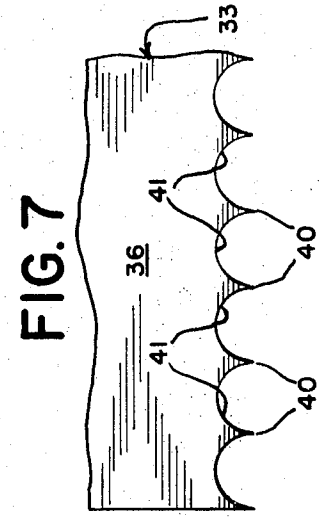

FIG. 7

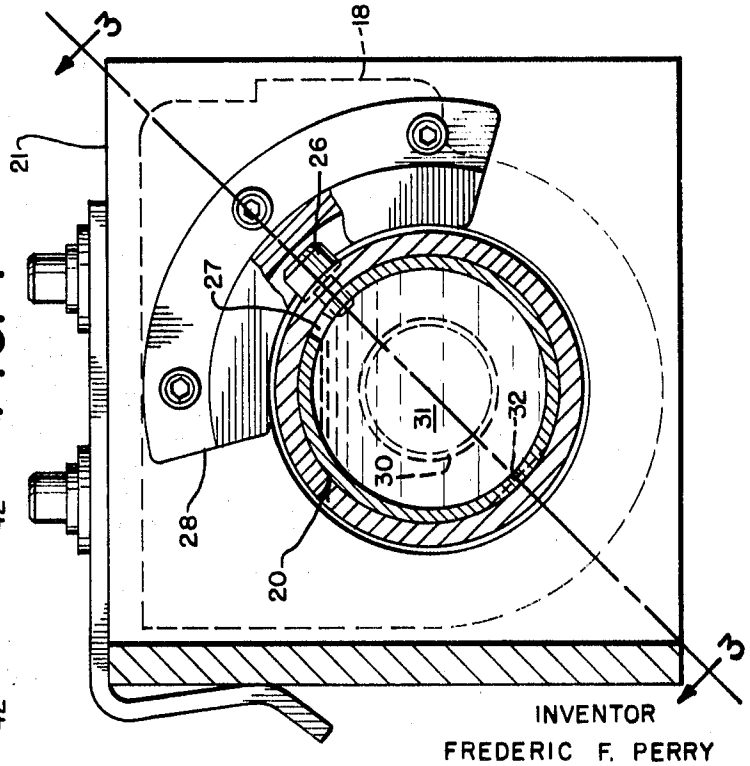

FIG. 4

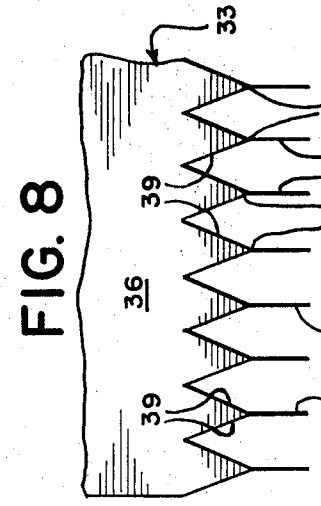

FIG. 8

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CURTAIN COATING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to coating systems and more particularly to a coating system for applying a layer of liquid coating material to the upper surface of an object as it passes through a downwardly falling sheet or curtain of coating material.

2. Description of the Prior Art

In the production of coated leather goods, such as used for making shoes, and in the production of other coated products, it is desirable to assure that an even layer of coating is applied to the surface of the object, which layer is free of irregularities and imperfections. In other coating applications, it is further desirable to coat the surface of the material with a predetermined pattern as for example a striped or dotted pattern.

In producing acceptable coated material products, difficulties have been encountered with presently available coating apparatus in assuring that the coating apparatus will operate both reliably and at the same time, efficiently. A primary cause of defective or unacceptable coatings arises from the manner in which the coating is applied to the surface of the object. In particular, with conventionally constructed curtain coating apparatus wherein the object to be coated is passed through a downwardly falling sheet or curtain of the coating material, the most pronounced imperfections in the coated surface are generally caused due to the fact that the falling sheet of liquid material is not uniform in thickness and not always continuous across the width of the sheet. Such irregularities in the makeup of the falling sheet of coating material produce imperfections, such as skipping, ridges and ripples, in the layer of coating applied to the surface of the object. Also, the liquid coating material contained in the reservoir is not maintained free of turbulence, air bubbles tend to be formed in the liquid and these bubbles flow with the liquid coating onto the coated surface of the object being coated. In addition, in the weir type of curtain coating apparatus where the coating material is dispensed from the supply by flowing it over a weir or dam forming one side of a liquid supply tank, turbulence in the supply will cause it to flow unevenly and in a pulsating manner over the weir and thus further accentuate the unevenness of the layer of coating applied to the material passing through the downwardly falling curtain.

SUMMARY OF THE INVENTION

In accordance with the teachings of the present invention, an improved weir-type coating head is provided in which the liquid coating material contained in the coating head may be readily kept free of turbulence which would otherwise tend to create air bubbles or unevenness or pulsating of the flow over the weir. In addition, the portion of the weir forming the upper edge of the coating head over which the liquid coating material is directed is constructed with a curved, smooth surface for assuring an even flow of material thereover; that is, a flow which is both uniform in thickness across the length of the weir and one which is nonpulsating in character. As a further aspect of the present invention, the lower edge of the weir from which the sheet of coating material falls downwardly onto the underlying object being coated is provided with a tapered knife edge of such construction which eliminates the collection of coating material along this edge of the weir and thus prevents the formation of droplets. In certain modified constructions of the weir, the lower edge thereof is also serrated in a particular pattern so as to provide a control for varying the pattern formed by the liquid coating material falling from this edge onto the object to be coated.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the coating apparatus incorporating the improved coating head constructed in accordance with the present invention;

FIG. 2 is a cross-sectional view of the coating apparatus shown in FIG. 1;

FIG. 3 is a longitudinal cross-sectional view of the hollow dispensing member disposed within the reservoir of the coating head;

FIG. 4 is a cross-sectional view taken along line 4–4 of FIG. 3;

FIG. 5 is a cross-sectional view of the improved coating head showing the construction of the weir and its position relative to the reservoir containing a supply of liquid coating material and the internally disposed liquid dispensing member;

FIG. 6 is a front view of the lower end of the weir of the present invention showing a modified construction of the lower edge thereof;

FIG. 7 is a front view of the lower end of the weir of the present invention showing another modified construction of the lower edge thereof; and

FIG. 8 is a front view of the lower end of the weir of the present invention showing a third modified construction of the lower edge thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIG. 1, the coating apparatus in which the improved coating head of the present invention is incorporated generally includes framework sections 1 and 2 disposed on opposite sides of a third framework section 3. The framework sections 1 and 2 are secured to each other as by bolts and carry conveyor means generally designated at 4 while the framework section 3 forms a bridge structure spanning the framework sections 1 and 2 for carrying the improved coating head 5 of the present invention in overlying spaced relation to the conveyor means. As shown in FIGS. 1 and 2, the conveyor means includes two laterally spaced conveyor belts 6 and 7 extending the full length of the framework sections. A conventional variable-speed motor 8 is provided for driving the conveyor belts at predetermined selected speeds. The object of be coated, as for example a piece of leather, is placed on a suitable support such as a wire frame member 9 which is in turn placed across the spaced conveyor belts for movement therewith along a predetermined path underlying the coating head 5. As with conventional curtain coating apparatus, the coating head 5 is adjustably secured to the framework 3 so that its height above the conveyor may be regulated.

The coating head is constructed to provide a downwardly falling sheet or curtain of liquid coating material passing between the spaced belts 6 and 7 and into a vertically aligned trough 11 secured to the framework section 2. The end of the trough 11 extends outwardly beyond one side of the framework section for directing the liquid material collected thereby into a liquid-collecting drum 12. The collecting drum 12 has an outlet 13 which is connected by fluid lines 14 back to the coating head 5. A suitable motor-driven pump 15 is provided in the line 14 for circulating the liquid coating material continuously through the system, conventional controls being provided for varying the operation of the pump to thus vary the rate of flow of liquid into the coating head. As with conventional curtain coating apparatus, the conveyor speed, rate of liquid flow and the height of the coating head may each be adjusted by the operator in a manner well known in the art to vary the characteristics of the layer of coating material applied to the upper surface of the object being coated.

In accordance with the teachings of the present invention, the coating head of the curtain coating apparatus is of improved construction eliminating many of the undesirable characteristics of conventional curtain coating apparatus. As shown in FIGS. 3, 4 and 5, the coating head includes an elongated reservoir means 16 in the form of an open-topped container having upwardly directed sidewall members 17, 17', end wall members 18 and a curved bottom wall member 19. The reservoir is constructed of stainless steel and the inner walls thereof are all finished to a smooth surface. The reservoir 16 is supported laterally across the bridge structure formed by the framework section 3 and thus laterally across the path of movement of the material positioned on the under-

lying conveyor belts for receiving a layer of coating on its upwardly facing surface. Disposed centrally within the reservoir structure is a liquid coating dispensing means **20** in the form of an elongated cylindrical housing or pipe constructed of stainless steel having both its inner and outer surfaces polished to a mirror finish. The dispensing pipe is open at both ends and supported at its ends in the end walls **18** of the reservoir structure **16**. As shown in FIG. **3**, the mounting means for the dispensing pipe includes trunnion members **21**, **22** rotatably receiving the ends of the dispensing pipe. Suitable sealing rings shown at **23**, **24** are provided for effecting a seal between the pipe and the trunnion members. Also, a handle **25** is connected to one end of the pipe to permit rotation of the pipe from outside of the reservoir. The handle includes a shank portion surrounding the end of the pipe; and a pin **26** extends through this shank portion and into an axial groove **27** in the end of the pipe for securing the handle against rotation relative to the pipe. As shown in FIG. **4**, a locking plate **28** connected to the trunnion support **21** is provided for holding the handle in fixed axial relation on the end of the pipe.

The liquid coating material to be supplied to the coating head is initially supplied to the interior of the dispensing pipe **20** positioned within the reservoir structure **16**. For this purpose, the handle **25** is provided with a centrally located opening **29** to which the fluid line **14** is adapted to be connected. The trunnion **22** at the opposite end of the pipe is provided with a central opening **30** aligned with the adjacent open end of the pipe. The fluid line **14** is preferably connected to the handle end of the dispensing pipe and a suitable plug **31** is provided for closing the other end of the dispensing pipe **20**. This plug is provided with an axial groove **31'** while the pipe includes an outlet hole **20'** which when aligned with the groove **31'** will permit the pipe to be drained.

As shown in FIGS. **3** and **5**, the dispensing pipe is provided with a continuous elongated slit **32**. In accordance with the teachings of the present invention, this slit extends effectively the full length of the reservoir structure **16**. Thus, liquid coating material supplied to the interior of the dispensing pipe is dispensed into the reservoir structure through the slit **32**; and with the slit being continuous and extending the full length of the reservoir, the flow through the slit is at a substantially uniform rate along the entire length of the reservoir.

Also shown in FIG. **5** the upper wall section **17'** of the reservoir is provided with a weir structure **33** forming the effective upper edge of the reservoir over which liquid coating material will flow as its level in the reservoir reaches the upper surface of the weir. In accordance with the teachings of the present invention, the weir is provided with a first portion **34** extending downwardly into the supply of liquid coating material, a second smoothly curved portion **35**, the upper surface of which defines as overflow wall or dam of the coating head, and a downwardly directed third portion **36** disposed outside of the reservoir and in vertical alignment with the underlying liquid collecting trough **11**. The weir is constructed of stainless steel and its outer surface over which the liquid coating material flows is polished to a mirror finish. In addition, the lower edge **37** of the weir is tapered backwardly, from the outer surface at an angle of about 30° to form a knife edge.

In setting the coating head for a coating operation, the pipe **20** is first rotated until the slit faces in an upwardly direction but with the outlet hole **20'** out of alignment with the groove **31'** of the plug **30**. Liquid coating material is then pumped into the handle end of the pipe with the air within the pipe being readily permitted to escape through the slit and not otherwise trapped therein. When the pipe and reservoir are filled with liquid coating material, the pipe is then rotated into a running position in which the continuous elongated slit **32** faces downwardly into the reservoir structure and away from the weir **33**. Thus, the liquid coating material as it is pumped through the slit **32** and into the reservoir during a coating operation is directed away from the weir and toward the curved smooth wall surface of the lower wall member **19** of the reservoir. With this positioning of the slit **32** relative to the weir **33** and with the construction of the parts of the improved coating head as described above, the liquid supplied to the reservoir and directed over the weir is substantially free of turbulence which would otherwise create air bubbles and pulsating of the liquid flow from the coating head. Also, the curved upper surface of the weir further acts to assure a constant and uniform rate of flow of liquid over the weir and down its outer surface due to the continuous slowly changing path of flow created by the upper curved surface of the weir. As the liquid coating material flows down this surface of the weir and falls away from the lower edge **37**, a continuous sheet or curtain of material having a uniform thickness is produced with the tapered construction of the edge **37** providing a sharp, well-defined edge from which the liquid may readily fall without first collecting along this edge, a condition which would tend to create unevenness in the thickness of the falling curtain of coating as the collected material became sufficiently heavy to fall away from the edge in droplet form.

In FIG. **6**, there is shown a modified construction of the weir of the present invention. As there shown, the lower edge of the weir portion **36** is serrated in a zigzag pattern to define a plurality of laterally spaced lower points **38** connected together by upwardly directed V-shaped edge sections **39**. FIG. **7** shows another modified construction similar to that shown in FIG. **6** wherein the lower edge is again serrated; but instead of having a straight-sided zigzag contour, it is provided with a plurality of lower laterally spaced points **40** which are connected together by upwardly curved edge sections **41**. FIG. **8** shows still another modified construction of the weir. In this construction, the lower edge is serrated in the same manner as in the construction shown in FIG. **6**; and to each lower point **38** is attached a needle member **42**. Each of these needle members extend perpendicularly downwardly in the plane of the weir portion **36**.

With the modified constructions of the weir as shown in FIGS. **6—8**, varying types of coating patterns may be produced on the material moving through the falling curtain. These variations in the coating pattern may, for example, be effected by changing the rate of flow of liquid coating material over the weir. By providing a very thin layer of coating material flowing down the outer surface of the portion **36** of the weir, such coating material will be caused to collect at the lowermost points of the lower edge of the weir and drop off these points or off the needles in droplets and thus form a dotted pattern on the material being coated. Increasing the rate of flow of liquid coating material over the weir will change this dotted pattern to a line pattern by forming continuous streams of coating material falling away from the weir at the lowermost points. By still further increasing the rate of flow of liquid coating material over the weir, a complete coverage of the material to be coated may be effected with heavy spaced lines also being formed. These spaced lines will be created due to the tendency of the liquid coating material to more readily flow off the lowermost points of the weir edge.

The above description of the present invention has been made with respect to the presently preferred construction and certain modified constructions of the weir; however, it is to be understood that various changes may be made thereto without departing from the scope of the invention as defined in the following claims.

I claim:

1. In a coating apparatus having conveying means for moving an object to be coated along a predetermined path, a coating head positioned in overlying relation to said predetermined path for directing a sheet of liquid coating material downwardly onto the upwardly facing surface of said object, and collecting means disposed below said conveying means in alignment with the downwardly falling sheet of coating material for collecting excess coating material falling past said object as the latter moves along said predetermined path and through said sheet of coating material, the improvement wherein said coating head comprises:

a. reservoir means extending laterally across the predetermined path of movement of said object for holding a supply of liquid coating material;

b. liquid coating material dispensing means disposed within said reservoir means and extending laterally across said predetermined path, said dispensing means comprising:

1. an elongated hollow housing having an open end for receiving liquid coating material from a source outside of said reservoir means and a continuous elongated slit extending longitudinally of said housing for dispensing liquid coating from the interior thereof into said reservoir means at a uniform rate along the entire length of the reservoir;

c. means for pumping liquid coating into the open end of said hollow housing at a substantially uniform rate; and

d. an overflow weir positioned at the top of said reservoir means at one edge thereof and extending in a direction laterally of the predetermined path of movement of said object, said weir comprising:

1. a first portion extending into the coating liquid material contained in said reservoir means,

2. a second portion extending laterally of said predetermined path and having a wide, smoothly rounded uppermost surface disposed in a horizontal plane at a level just below the level of the liquid coating material and defining the surface of said reservoir means over which said liquid coating material is directed to overflow said reservoir means, and

3. a third portion extending downwardly from said second portion on the outside of said reservoir means and terminating in a lower edge disposed in spaced relation above the path of movement of said object and in alignment with said collecting means, said third portion having an outer surface extending between the uppermost surface of said second portion and said lower edge along which said liquid coating material flows to form said sheet.

2. The improvement in the coating apparatus as set forth in claim **1** wherein:

a. the hollow housing is positioned within said reservoir means with the continuous elongated slit facing downwardly into said reservoir means and away from said weir.

3. The improvement in the coating apparatus as set forth in claim **2** wherein:

a. the hollow housing is positioned within said reservoir means with the continuous elongated slit disposed parallel to the uppermost horizontal surface of said weir.

4. The improvement in the coating apparatus as set forth in claim **2** wherein:

a. said elongated hollow housing is cylindrical in cross section; and

b. the inner wall surface of said reservoir means includes:

1. two upwardly directed sections extending longitudinally of said housing on opposite sides thereof, and

2. a curved lower section connecting said two upwardly directed surfaces together, said curved lower section having a center of curvature coincident with the cross-sectional center of said housing and having said upwardly directed surfaces extending tangentially therefrom.

5. The improvement in the coating apparatus as set forth in claim **4** wherein:

a. the inner and outer surface of said hollow housing, the inner wall surface of said reservoir means, and the outer surfaces of said weir, are all smooth, polished surfaces.

6. The improvement in the coating apparatus as set forth in claim **5** wherein:

a. said hollow housing is rotatably mounted within said reservoir means for adjusting the position of the slit therein relative to said weir.

7. The improvement in the coating apparatus as set forth in claim **6** wherein:

a. the lower edge of the third portion of said weir is tapered backwardly from the outer surface of said third portion to form a knife edge.

8. The improvement in the coating apparatus as set forth in claim **1** wherein:

a. the lower edge of the third portion of said weir is tapered backwardly from the outer surface of said third portion to form a knife edge.

9. The improvement in the coating apparatus as set forth in claim **8** wherein:

a. the outer surfaces of the second and third portions of said weir along which said liquid coating material flows are smooth, polished surfaces.

10. The improvement in the coating apparatus as set forth in claim **9** wherein:

a. the lower edge of the third portion of said weir is serrated in construction, the serrated lower edge having a plurality of spaced lower sections along the length thereof connected together by upwardly directed sections.

11. The improvement in the coating apparatus as set forth in claim **10** wherein:

a. the serrated edge of said weir includes a plurality of lower, laterally spaced points connected together by upwardly directed curved edge sections.

12. The improvement in the coating apparatus as set forth in claim **10** wherein:

a. the serrated edge of said weir includes a plurality of lower, laterally spaced points connected together by upwardly directed V-shaped edge sections.

13. The improvement in the coating apparatus as set forth in claim **12** further comprising:

a. a plurality of needle members, one of which is connected to each of the lowermost points of the serrated edge of said weir, each of said needles extending perpendicularly downwardly in the plane of said third surface of said weir.

14. A weir structure for directing a sheet of liquid coating material over the top of a coating head containing a supply of said material and downwardly onto the upper surface of an object to be coated as the latter moves along a predetermined path underlying said coating head in vertically spaced relation therewith, said weir comprising:

a. a first portion adapted to extend into the supply of coating liquid material;

b. a second portion forming an upwardly extending continuation of said first portion and disposed just below the level of said supply of liquid coating material, said second portion having a wide, smoothly rounded uniform outer shape defining the uppermost surface thereof over which said liquid coating material is directed from said supply; and

c. a third portion extending downwardly from said second portion and adapted to be positioned adjacent to but spaced from said supply, said third portion having an outer surface extending between the uppermost rounded surface of said second portion and terminating in a lower edge.

15. A weir structure as set forth in claim **14** wherein:

a. the outer surfaces of the second and third portions of said weir along which said liquid coating material flows are smooth, polished surfaces.

16. A weir structure as set forth in claim **15** wherein:

a. the lower edge of the third portion of said weir is serrated in construction, the serrated lower edge having a plurality of spaced lower sections along the length thereof connected together by upwardly directed sections.

17. A weir structure as set forth in claim **16** wherein:

a. the serrated edge of said weir includes a plurality of lower, laterally spaced points connected together by upwardly directed curved edge sections.

18. A weir structure as set forth in claim **16** wherein:

a. the serrated edge of said weir includes a plurality of lower, laterally spaced points connected together by upwardly directed V-shaped edge sections.

19. A weir structure as set forth in claim 18 further comprising:

a. a plurality of needle members, one of which is connected to each of the lowermost points of the serrated edge of said weir, each of said needles extending perpendicularly downwardly in the plane of the third surface of said weir.