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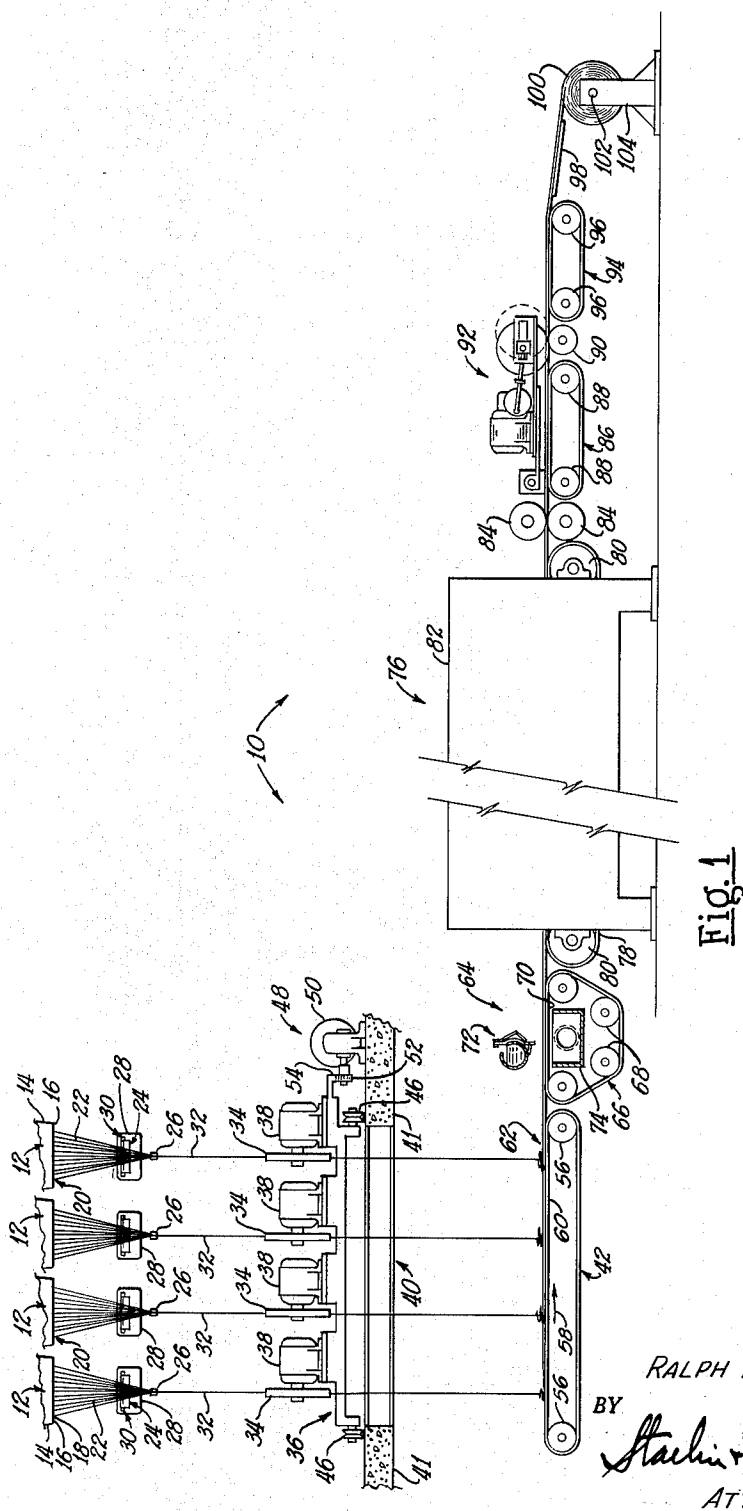
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3,219,012

APPARATUS FOR FORMING AN AIRBORN CURTAIN OF LIQUID MATERIAL

Filed Sept. 6, 1962

2 Sheets-Sheet 1



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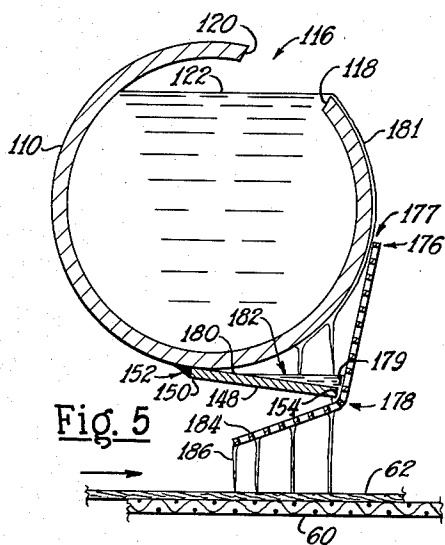
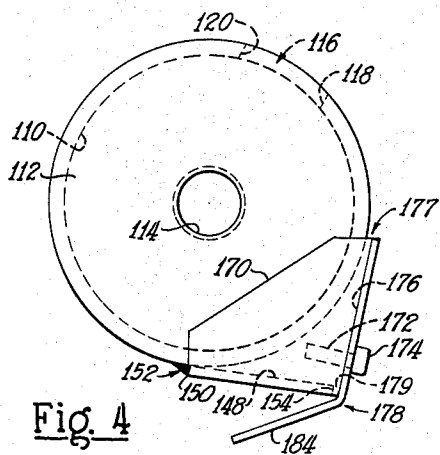
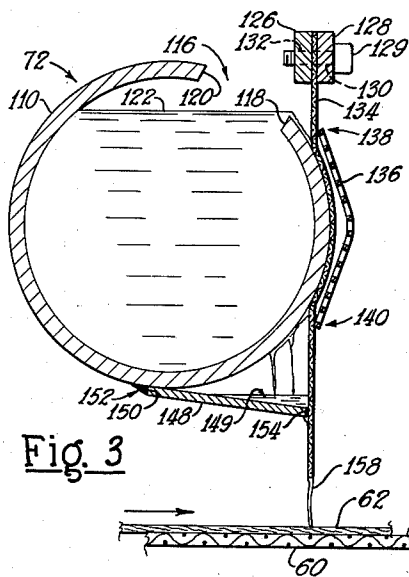
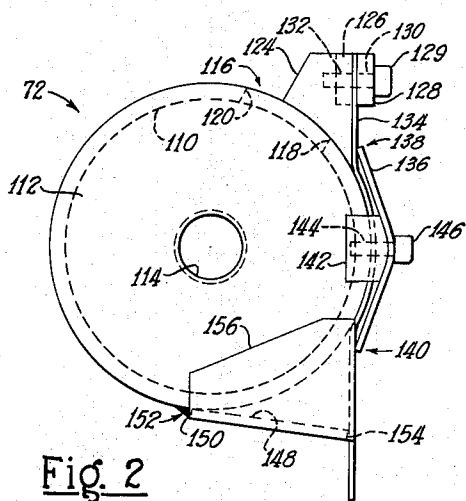
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APPARATUS FOR FORMING AN AIRBORN CURTAIN OF LIQUID MATERIAL

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2 Sheets-Sheet 2



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3,219,012

APPARATUS FOR FORMING AN AIRBORNE
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Filed Sept. 6, 1962, Ser. No. 221,734

6 Claims. (Cl. 118—324)

This invention relates to a coating device for applying liquid coatings to fibrous sheet materials, and more particularly to a device for applying uniform coatings of liquid binder materials to fibrous sheet or mat materials, characterized by a high degree of uniformity of application of the coatings to all of the fibers across the entire width of the material.

In the production of fibrous mats, such as those made from randomly interlaced strands of continuous glass fibers, the strands are laid down across the width of a suitable collecting member such as foraminous wire screen to form a randomly interfelted mat with the strands in loose, felted inter-engagement with one another. In order to bond the so-felted strands into a coherent mat, a liquid binder material is applied and the mat thereafter passed through a heated oven to cure the binder and thereby impart permanent coherency to the mat.

However, in view of the fact that the mats are of substantial width, a problem exists in the application of a uniform coating. Heretofore, spray guns have been used for coating or binder application. However, the jets of air issuing from the guns have been found to disrupt the lay of the fibers or strands in the mats, forming thin spots and other defects in the product.

Accordingly, it would provide a substantial advance in the art of coating fibrous mat or sheet materials to provide an applicator that uniformly distributes a liquid binder material across the entire width of a mat in a manner that does not disrupt the lay of the fibers with respect to one another; that comprises a unit which is economical to manufacture, as well as trouble free, and thus requiring only minimum maintenance over long periods of operation.

Accordingly, it is an important object of the present invention to provide a novel applicator for liquid materials.

It is a further object to provide a novel applicator for applying liquid binders to fibrous sheets materials, that is characterized by uniformity of application of liquid to the fibers across the entire width of the material.

A further object is to provide an apparatus for coating wide sheet materials while the fibers thereof are in loosely interfelted array, without disrupting the lay of the fibers.

A still further object is to provide an apparatus for applying liquid binder materials to loosely interfelted fibers in sheet form, characterized by application of thin uniform coatings of the liquid across the entire width of the sheet, and at a substantial line speed or rate of production.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

FIGURE 1 is a side elevational view of a continuous glass fiber mat production line wherein the novel binder applicator of the present invention is adapted to be used;

FIGURE 2 is an end elevation view of a first embodiment of the novel binder applicator of the present invention;

FIGURE 3 is a transverse section view through FIGURE 2;

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FIGURE 4 is an end elevational view of a second embodiment of the novel binder applicator of invention; and

FIGURE 5 is a transverse section view through FIGURE 4.

Before explaining the present invention in detail it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Perspective view

Briefly, the present invention relates to a novel liquid binder applicator for wide mat or sheet materials, utilizing an elongated reservoir extending the width of the material and positioned over the material to provide gravity flow of liquid onto the mat.

An important feature of the invention resides in the use of a foraminous screen, which, by capillary attraction of the liquid binder material for the surfaces thereof, acts to disperse and convey liquid material from the reservoir downwardly by gravity flow onto the subjacent fibrous mat material, as a descending curtain having a high degree of uniformity of liquid distribution along its length.

Another important feature of the present applicator, as contrasted to the compressed air gun-type applicators heretofore used, is the absence of disruption of the lay of the fibers while in loose condition, before bonding of the mat is completed. This provides a very substantial advance in the art when it is understood that mats produced in accordance with the invention are very thin in nature, generally of a thickness in the range from about .005 to about .010 inch, and rigid commercial requirements provide that these dimensions shall be substantially uniform throughout the width of the mat. Since these mats are used for such purposes as to wrap pipelines to hold a corrosion resistant coating thereon, it will be recognized that a defect will result in corrosion and failure of the pipeline; this will entail a substantial expenditure both in digging up and repairing the line as well as loss of throughput. Thus product specifications are rigid.

Therefore, when it is understood that mats of improved uniformity all across their width are produced using the present invention, proof of the effectiveness of the invention is presented.

The environment

As shown in FIGURE 1, there is illustrated a production line 10, utilized for making mats from randomly interfelted strands of continuous glass fibers.

The production line 10 typically includes a plurality of continuous fiber producing bushings 12, having body portions 14, suitably made of an alloy of a precious metal such as platinum. Electric current is fed through the bushings 12 by means of terminals, not shown, at either end, to heat the bushings by resistance, to glass melting temperatures. The electricity is suitably conducted to the bushings 12 by electric lines and terminal clamps as well known.

Atop each of the bushings 12 there is provided an opening through which glass forming materials such as glass marbles can be fed for melting to form a body of molten glass within the bushing.

The bottom 16 of each bushing 12 is provided with a plurality of aligned apertures or tips indicated by the reference numeral 18, through which the molten glass from within the bushing exudes as corresponding small molten

streams indicated by the arrow 20. When the molten streams 20 are attenuated at a sufficiently rapid rate, they are converted into very fine continuous glass fibers 22. The fibers 22 issue downwardly in converging array over a coating belt indicated at arrow 24 to a wear resistant, fiber converging guide block, indicated at 26. As the fibers 22 converge downwardly to the guide block 26, they pass tangentially over the surface of the belt 24, that is kept moving and thus wetted with a binder and size material. The belt 24 runs over a powered support roll positioned within a container 28 to which liquid size and binder is added to an appropriate level. A guide rod, positioned at the point 30, forms the belt 24 into a reverse curve for the aforementioned tangential contact with the fibers 22. This arrangement provides a very effective tangential wiping action of the fibers 22 over the belt 24 and thus they are uniformly coated with combination liquid binder and size, thereafter being brought together by the guide block into a continuous strand 32.

The attenuating force for the formation of the fibers 22 from the previously mentioned molten streams 20 is provided by pairs of contra-rotating pull rolls 34, running in peripheral engagement. These rolls are positioned upon the shafts of synchronized motors 38 and are thereby adapted to be driven. The motors 38 are mounted upon a reciprocable carriage 36. As the strands 32 are pulled downwardly between the peripheries of the rapidly rotated pull rolls 34, the attenuation force to form the fibers 22 is thereby provided.

As will be noted, the continuous strands 32 issuing from the pull rolls 34 are directed downwardly through an opening 40 in a support floor 41 and thence onto an endless foraminous conveyor or collection chain 42. To provide uniform distribution of the strands 32 across the width of the collection chain 42, the carriage 36 for the pull rolls 34 and their drive motors 38, is adapted to be reciprocated a sufficient distance to provide a desired strand throw. For this purpose, carriage 36 is mounted on rollers 46 and moved by a suitable reciprocating mechanism indicated generally by the arrow 48, which may take the form of a reversible gear motor 50 having a drive gear 52 thereon that is engaged with a toothed rack 54, attached along one edge of the carriage 36.

From the foregoing it will be understood that as the pull rolls 34 are reciprocated a proper distance across the width of the collector 42, at the same time being rapidly rotated to draw the strands 32, the strands will be whirled downwardly onto the collection chain and at the same time across the width thereof to lay up a mat as the collection chain is simultaneously moved forward.

The collection chain 42 is formed as a loop supported by spaced rotatable rolls 56, at least one of which is powered to move the chain in the arrow 58 direction at suitable mat forming speed. At the right end of the upper flight 60 of the chain 42, a full thickness of mat is provided as indicated by the numeral 62 and the mat then moves to a binder applicator section 64, which includes a second endless chain 66, carried upon rotatable rolls 68 for synchronized movement with collection chain 42. As the mat 62 moves along the upper flight 70 of chain 66 it passes beneath a liquid binder applicator 72, forming the subject matter of the present invention, which is effective to uniformly distribute a coating of heat curable or thermosetting binder of uniform and desired thickness throughout the fibers of the mat and across the entire width of the mat. A binder extractor 74, suitably taking the form of an open top suction box, is positioned beneath the upper flight 70, to pull excess liquid binder on through the mat 62 and flight 70 of chain 66 to provide a regulated retention in the mat.

From the binder applicator section 64, the mat 62 passes to a curing section 76, that includes a third endless chain 78, carried by spaced and aligned rolls 80 for movement. The chain 78 extends through a curing oven 82 that is adapted to be heated by a suitable fuel such as

electricity or gas, to provide appropriate curing of the binder material. As the mat 62 emerges from the oven 82, it leaves the end of chain 78 and passes between a pair of compaction rolls 84 to provide thickness control. From the compaction rolls 84, the mat 62 passes to a first runout chain 86 carried by rolls 88, and then over a backup roll 90 cooperating with a slitter 92, forming the subject matter of co-pending application Serial No. 221,724, filed September 6, 1962, also assigned to the same assignee. The slitter 92 is effective to slit the mat 62 into desirable widths, and also is used for edge trim when desired. From the back-up roll 90 and slitter 92, the mat 62 passes to a second runout chain 94, carried by spaced rolls 96, and thence over an inspection table 98 to be rolled into packages 100, rotatably supported upon a mandrel 102 carried by a support 104.

It is upon this environmental background that the binder applicator 72 of invention is superimposed, and a complete description thereof now follows.

The invention.—The first embodiment

As shown in FIGURES 2 and 3, the binder applicator 72 in a first embodiment includes an elongated conduit 110, suitably taking the form of an overflow supply pipe, closed at its ends by caps 112, provided with threaded openings 114 for attachment of supply conduits. As will be noted, the overflow supply pipe 110 is provided along its length, between the end caps 112, with an axially extending slot 116, the pipe being so oriented so that one side 118 of the slot 116 is lower than the other side 120, thus forming a horizontally disposed edge over which liquid binder 122 from within the conduit 110 can flow as a thin layer.

Support of the overflow supply pipe 110 is suitably provided by the aforementioned conduits, not shown, entering each end cap 112 by connection with the threaded openings 114. By connecting the conduits to each side of the machine as by vertically adjustable brackets, the conduit 110 can be leveled for uniform fluid layer formation and flow.

As shown in FIGURE 2, generally triangular support plates 124 are provided either integrally or as by welding to each of the end caps 112 and a horizontally disposed support arm 126 is extended the length of the supply pipe 110, between these support plates. A cooperating and removable support arm 128, generally of the same configuration as support arm 126, is adapted to be attached to the latter support arm as by means of bolts 129 passed through appropriate apertures 130 in arm 128, and thence into aligned threaded apertures 132 in the fixed arm 126.

To uniformly distribute the fluid overflowing the delivery side 118 of slot 116, and thus prevent channeling as the material runs down the side of the supply pipe 110, one edge of a rectangular sheet 134 of fine mesh screen, Dutch weave being desirably employed, is provided with apertures and positioned between the fixed arm 126 and removable arm 128, being fastened by drawing up the bolts 129 connecting these two elements together.

To provide intimate engagement between the upper median portion of the sheet of screening 134 and the exterior of the supply pipe 110, a rectangular sheet of perforated metal 136, bent to an obtuse angle to provide pressure points 138 and 140, is positioned in biased relation against the upper median portion of the screen 134. Thus in FIGURE 2 it will be observed that support of the rectangular sheet of perforated metal 136 is provided by a bracket 142, connected as by welding to each of the end caps 112. The brackets 142 are provided with horizontally disposed threaded apertures 144 to receive bolts 146 passed through appropriate apertures in the apex at the ends of the perforated metal sheet 136. It will be observed that when the bolts 146 are fully pulled up, the pressure points 138 and 140 will force the screen 134 into intimate contacting relationship with a portion of

the outer surface of the supply pipe 110. It will be noted that the perforated metal sheet 136, by virtue of the apertures therein, provides free breathing for the liquid running through the screen 134, facilitating uniformity of thickness of the sheet of liquid flowing therethrough.

The weir plate

An important aspect of the binder applicator 72 resides in the provision of a weir plate 148 at the bottom right hand side of the overflow supply pipe 110, being fastened at its left edge 150 as by a weld 152 to a bottom median point of the overflow pipe. It will be noted that the weir plate 148 tilts slightly downwardly from its connection point 152; and extends to a point where the right hand edge 154 contacts the sheet 134 of fine mesh screen.

Support for weir plate 148 is provided by brackets 156, attached at each end of the weir plate and to the outer surfaces of the end caps 112, FIGURE 2. Thus, liquid flowing onto the weir plate 148, tends to dam up against the screen 134 to provide a uniform flow over the screen at a point just above the mat 62.

Thus, it will be apparent that the subjacent reservoir formed by the screen 134 and the weir plate 148 provides a highly uniform curtain of binder; and this with gravity flow and thus without any disrupting forces such as air blasts or the like.

Summary of operation

From the foregoing, it will be observed that application of liquid binder to the interior of the elongated overflow supply pipe 110 through the threaded openings 114 at each end thereof serves to provide a thin, wide flow layer over a flow lip or ledge comprising the delivery side 118 of slot 116. Then the liquid flows as a film down through the sheet of fine mesh screen 134, which serves to distribute the same and prevent channeling. Thereafter, a portion of the fluid continues to follow by capillary attraction along the outer surface of supply pipe 110 to drop upon the weir plate 148, while a portion of the fluid continues down the fine wire mesh screen 134. The two streams then converge on top of the weir plate 148 behind screen 134 as a pool 149 just above the surface of the mat 62 to which application is to be made, then flowing as a combined, more uniform curtain 158 onto the surface of the moving mat. Thus, uniform distribution the full width of the mat 62 is provided.

Second embodiment of binder applicator of invention

A modification of the present invention is illustrated in FIGURES 4 and 5 of the drawings, and as there shown, similarly includes an elongated overflow supply pipe 110, with end caps 112, provided with coaxial threaded openings 114 for attachment of suitable supply pipes. Also, the overflow supply pipe 110 includes an axially extending slot 116 with a lower delivery edge 118.

This second embodiment of the invention also includes the weir plate 148 fastened at its left edge 150 to the bottom of the supply pipe 110 as by a weld 152, the right edge being disposed somewhat lower to provide gentle gravity flow from left to right. A minor difference is provided at the ends of the weir plate 148 in the generally equilateral triangle shape of the support brackets 170, also secured as by welding to the end caps 112 and also being connected to the ends of the weir plate. The brackets 170 are provided with threaded apertures 172 to receive bolts 174, the bolts serving to support a liquid distributor 176.

The liquid distributor 176 comprises a rectangular sheet of perforated metal, bent along a longitudinal line to an obtuse angle to form an apex at 178. At the ends of the distributor 176, suitable holes are provided to accommodate the bolts 174 which are threaded into the apertures 172 in brackets 170 to retain the distributor in the position shown in FIGURE 5; thus the apex 178 is brought close, but slightly gapped as at 179 against the

right hand edge 154 of the weir plate 148 and the upper edge is in very slightly spaced relation to the outer periphery of the supply pipe 110 as at 177 to permit a portion of the fluid film 181 to follow the periphery of the supply pipe and drop onto the weir plate upper surface 180. Thus a shallow pool 182 is provided along the length of the weir plate along the back side of the distributor 176.

It will be noted that the obtuse portion 184 of the distributor 176 extends beneath the weir plate 148 at an angle of about 30° to the horizontal. This disposition causes fluid to flow along the portion 184 by capillary action and drops downwardly as plural streams 186 extending the entire width of the mat 62. Thus, as the mat 62 moves in the arrow direction, FIGURE 5, a uniform coating of liquid binder material is applied across the width thereof by quiescent gravity flow, and thus without disrupting the lay of the strands in the mat.

Extended scope of the invention

While the foregoing description has related to the application of an aqueous phenolic resin or heat curable binder to a mat of randomly interlaced strands of continuous glass fibers, the concept is not to be limited thereto. Thus, in accordance with the broad scope of the invention, a method and apparatus providing improved uniformity of liquid coatings to a sheet of material of substantial width is provided. This is effected by flowing a film of liquid over an arcuate surface to provide initial film-like distribution, supplemented if desired by channel breakers on that surface, and subsequently diverting a portion of the flowing film onto a foraminous material, and another portion of the film into a long shallow pool, and thereafter combining those streams as a more uniform curtain, dropping along a line or path onto a sheet material to be coated.

Thus, it is to be included within the broad scope of the invention to coat sheet materials in general, of both woven and felted varieties in a uniform manner. Thus, blown glass wool mats, sheet materials, both pervious and impervious to liquids, fiber boards, woven fabrics, and the like can be coated in accordance with the present invention.

While the fine mesh screen referred to above was described as being of Dutch weave, this is not considered to be limiting upon the invention. It should be pointed out however, that an important factor in the make-up of the screen is its rigidity so that it can be held firmly against the pipe 110 as in FIGURE 3, and against the weir to form a low velocity dammed up or pool area. Thus, the perforated metal distributor 176, shown in FIGURE 5, operates in this manner as well as the rather stiff fine mesh wire cloth of Dutch weave, shown in FIGURE 3.

Also, the board scope of invention would included the application of paints to materials such as cellulosic fiber ceiling tiles, and other items of flat nature adapted to be coated by passing along a foraminous conveyor so that the runoff can be disposed of as by recovery and recirculation.

We claim:

1. In apparatus for forming an airborne curtain of liquid material, a reservoir having a horizontally disposed liquid flow lip and a subjacent arcuate, flow surface extending downwardly and transposing toward horizontal, a relatively rigid foraminous sheet member extending along said flow surface and having a portion in liquid receiving relation thereto, said foraminous sheet member having a freely hanging subjacent portion and a freely hanging lower portion transposing toward horizontal, a pool-forming member positioned in falling fluid receiving relation with respect to said flow surface, and said member having a part in pool forming relation with a median portion of said foraminous member.

2. In apparatus for forming an airborne curtain of liquid material, an elongated reservoir having a horizon-

tally disposed liquid flow lip and a vertically extending arcuate surface subjacent thereto, said arcuate surface extending from vertical disposition by transition downwardly to horizontal disposition, a substantially rigid foraminous sheet member extending the length of said liquid flow lip and having a first portion in contacting relation with said vertically extending arcuate surface of said reservoir, said foraminous sheet member also having a freely suspended portion beneath said first portion and out of contact with said reservoir, a horizontally disposed weir plate positioned beneath said arcuate surface in falling liquid receiving relation therebeneath, said weir plate having one edge positioned in abutting relation to a median portion of said freely suspended portion of said foraminous sheet, and said one edge being lower than the remainder of said weir plate to receive liquid flowing thereover.

3. In apparatus for forming an airborne curtain of liquid material, a reservoir having a horizontally disposed liquid flow lip and a subjacent vertically extending flow surface extending downwardly and transposing toward horizontal, a substantially rigid foraminous sheet member extending at least a portion of the length of said liquid flow lip and having a first portion in intimate contacting relationship with said vertically extending flow surface, said foraminous sheet member having a freely hanging subjacent portion, a horizontally disposed weir plate positioned in falling liquid-receiving relation beneath said portion of said flow surface, said weir plate having one edge in abutting relation to a median portion of said freely hanging subjacent portion, and said one edge being lower than the remainder of said weir plate to receive liquid flowing thereover.

4. In apparatus for forming an airborne curtain of liquid material, including a reservoir having a horizontally disposed liquid flow lip and a subjacent vertically extending flow surface, said flow surface extending downwardly and transposing toward horizontal, with a substantially rigid, foraminous sheet member extending along said liquid flow lip and having an upper portion in contact with the vertically extending flow surface, and the foraminous sheet having a freely hanging subjacent portion, the improvement of a generally horizontally disposed plate positioned in liquid receiving relation beneath the flow surface of the reservoir, said plate having one edge in abutting relation to a median portion of the freely hanging subjacent portion of the foraminous sheet, and

said one edge being lower than the remainder of said plate to receive liquid flowing thereover.

5. In apparatus for forming an airborne curtain of liquid material,

reservoir means for liquid material,

means for flowing liquid material from said reservoir means as an elongated layer,

a flow surface having a vertically extending portion and a subjacent portion transposing toward horizontal,

said vertically extending portion being positioned to receive said elongated layer produced by said reservoir and flow means,

a substantially rigid foraminous sheet member extending along said flow surface and having a portion in liquid-receiving relationship thereto,

said foraminous sheet member having a freely hanging subjacent portion,

a generally horizontally disposed plate positioned in liquid-receiving relationship beneath said portion transposing toward horizontal,

said plate having one edge in abutting relationship to a median portion of the freely hanging subjacent portion of said foraminous sheet,

and said one edge being lower than the remainder of said plate to receive liquid flowing thereover.

6. In combination,

means defining a flow surface for liquid material,

means for delivering a flowing film of liquid to said flow surface,

a relatively rigid foraminous sheet member having a portion extending in liquid-receiving relationship to said flow surface,

said relatively rigid foraminous sheet member having a freely-hanging subjacent portion,

pool-forming means having a portion in pool-forming relationship with said freely-hanging subjacent portion of said relatively rigid foraminous member,

and means for delivering liquid material to said pool-forming means.

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RICHARD D. NEVIUS, *Primary Examiner.*