Nov. 19, 1968

E. WAGNER

3,411,718

ATOMIZER FOR LIQUID

Filed April 18, 1967

5 Sheets-Sheet 1

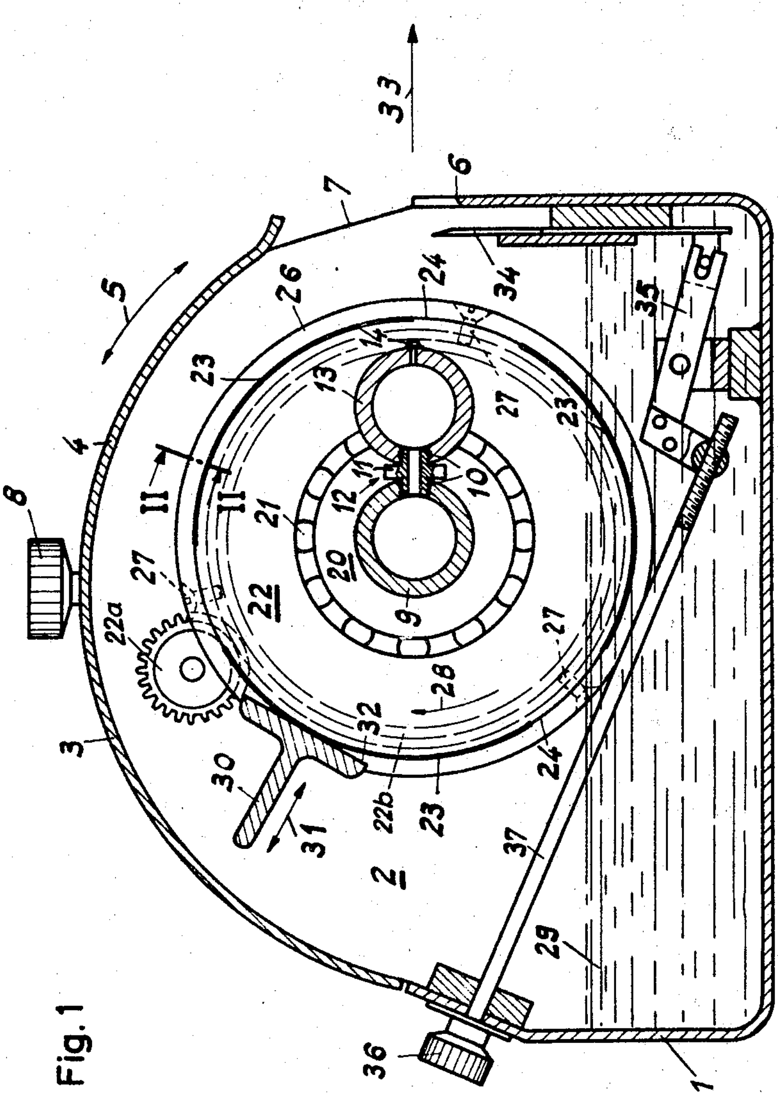

Fig. 1

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Fig. 3

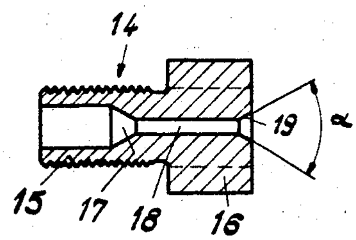
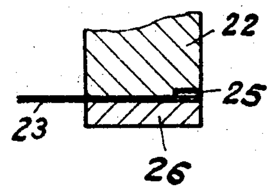


Fig. 2



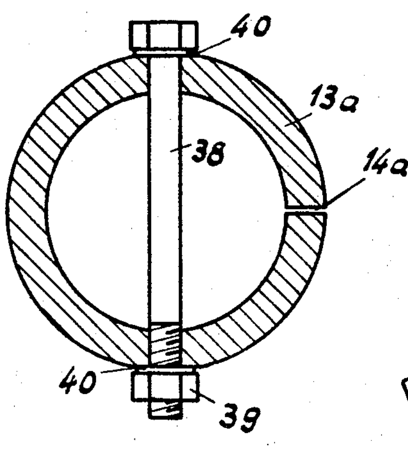
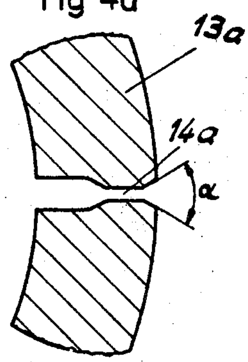


Fig. 4

Fig 4a



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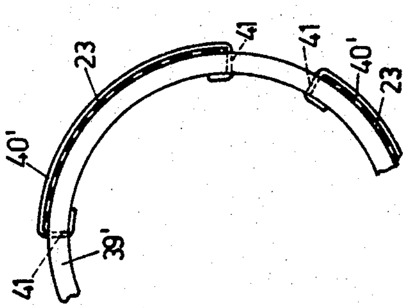

Fig. 6

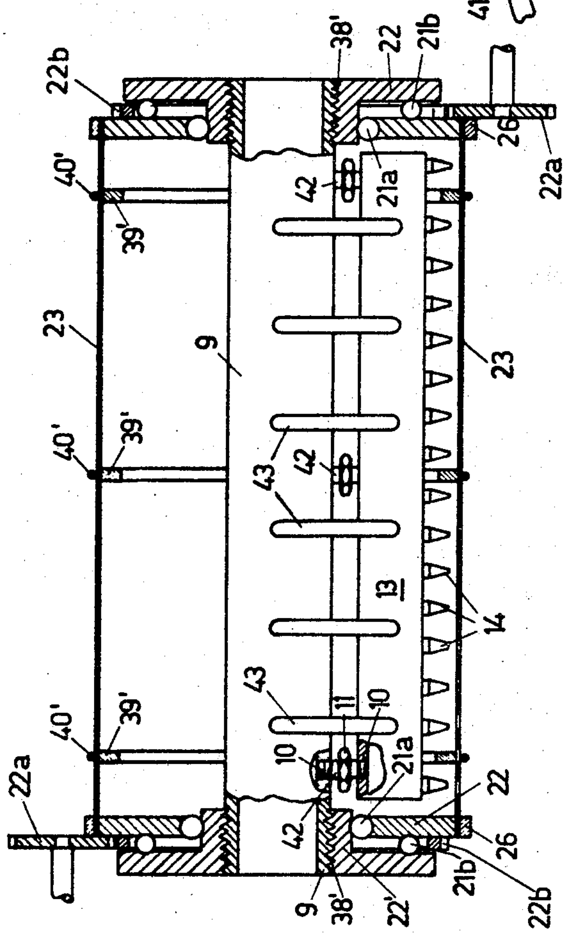

Fig. 5

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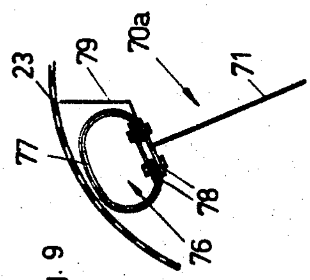

Fig. 9

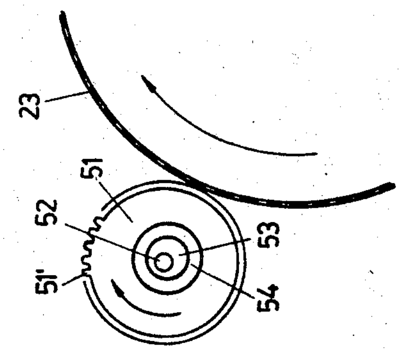

Fig. 8

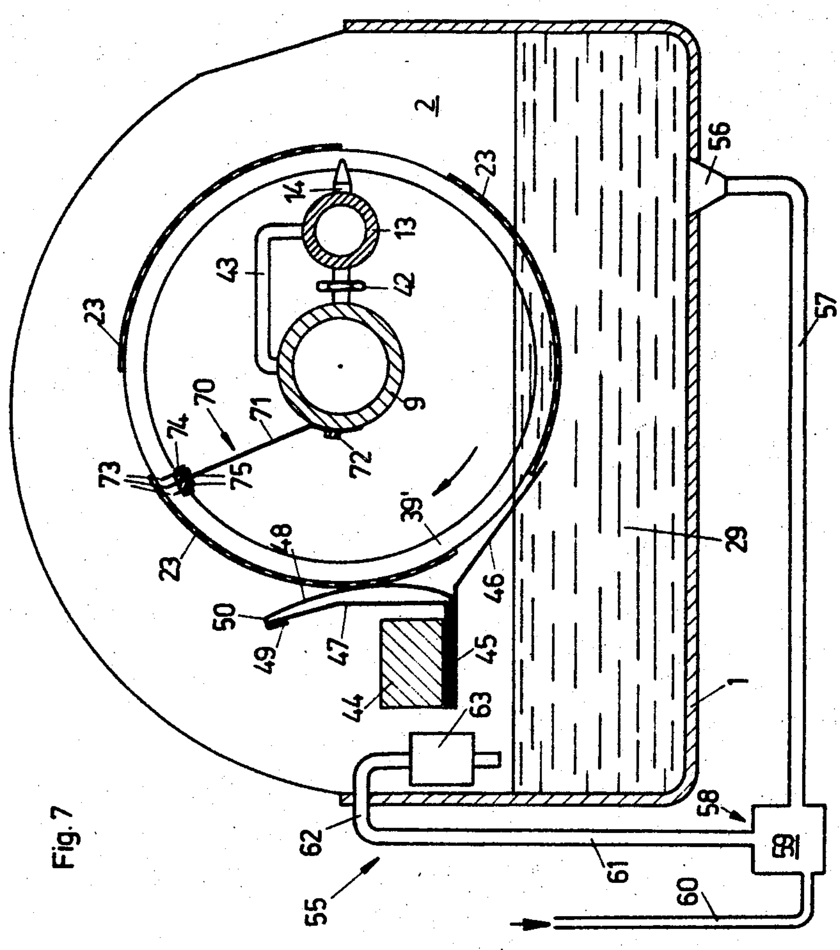

Fig. 7

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Fig. 10

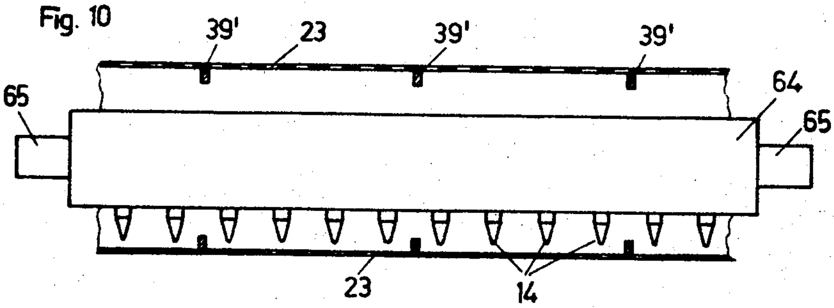
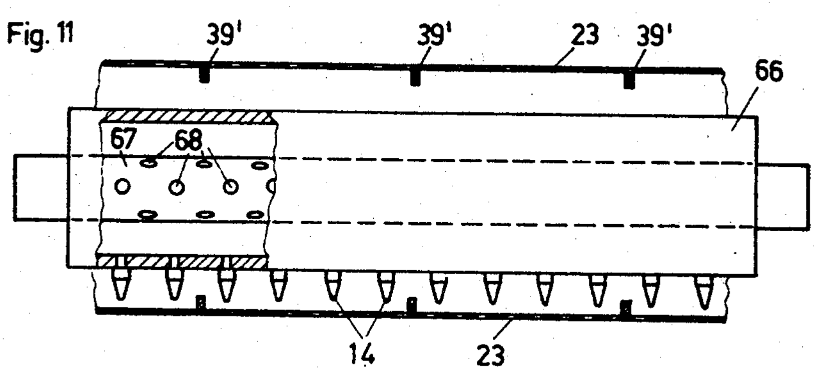


Fig. 11



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United States Patent Office

3,411,718

Patented Nov. 19, 1968

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3,411,718

ATOMIZER FOR LIQUID

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Filed Apr. 18, 1967, Ser. No. 631,796
Claims priority, application Switzerland, Apr. 20, 1966,
5,712/66
18 Claims. (Cl. 239—214.25)

ABSTRACT OF THE DISCLOSURE

An atomizer for moistening printing plates in offset printing having several screen strips freely tensioned between axially spaced coaxial discs in a common cylindrical surface and circumferentially spaced from each other in that surface. When the discs rotate about the axis, the screens pass through water in a tank, and the water film picked up by each screen is atomized by a sheet of air discharged from a manifold pipe near the axis of rotation. Various wiper arrangements are shown for reducing the thickness of the water film and for enhancing its uniformity so as to produce droplets of minimum size.

Background of the invention

This invention relates to equipment for atomizing liquids, and particularly to atomizing equipment suitable for moistening printing plates in offset printing machines.

More specifically, this invention is concerned with improvements in atomizers disclosed in my earlier U.S. Patent No. 2,622,520 and in my Swiss Patents Nos. 290,395 and 297,861.

The atomizing apparatus of my earlier patents has a cylindrically curved screen assembly mounted for angular movement about its axis, and a tank adapted to hold a body of liquid into which the screen assembly is at least partly immersed, and from which it is withdrawn during its movement. The film of liquid thereby retained on the screen assembly is dispersed in a gas by an air jet arrangement which directs a stream of the gas against the film.

While such atomizing apparatus has been used successfully, it is limited in the size and uniformity of the dispersed droplets of liquid. The droplets of the dispersed liquid should be as small as possible and should be uniform in size for complete wetting of the treated printing plates. It is well established that suitable films of water cannot be formed on coarse screens made from heavy wire. It has therefore been necessary to use fine meshed screens made from thin wire which are pliable, limp, and mechanically too weak to be self-supporting. They are reinforced in the known devices by axial reinforcing ribs.

It has been found that the presence of the ribs causes the formation of droplets varying in size, and partly much heavier than would be desirable. The droplet mixture becomes even less uniform when an attempt is made to reduce the average droplet size by increasing the velocity of the air stream directed against the water film on the screen. Attempts to avoid the undesirable effects of the axial ribs by interrupting the air jets whenever a rib passes have not given satisfactory results because the devices necessary for shutting off the air stream in synchronization with movement of the screen assembly is rather complex.

The object of the invention is the provision of an improved atomizing apparatus of the general type described above which delivers a fog of very uniform, extremely fine droplets dispersed in a carrier gas such as air.

Summary of the invention

I have found that the reinforcing ribs of the known

2

devices which cause the afore-described difficulties are unnecessary when the screen elements are tensioned in an axial direction while they are held in a common cylindrical surface. Even screens of finely woven, extremely thin wire can be held in the desired cylindrically curved configuration by axially applied tension. Gaps between circumferentially spaced screen elements cause the stream of atomized liquid and gas discharged by the apparatus of the invention to be interrupted from time to time in a manner normally desired in the moistening of printing plates.

The discharge droplets are made fairly uniform in size by the mere use of screens without axial ribs, and further improvement in this respect is readily achieved by providing wipers on the inner and/or outer faces of the screens which reduce the thickness of the liquid film on the screen and distribute the film uniformly over the screen surface.

The average size of the droplets may be reduced at will by increasing the velocity of the gas stream released against the liquid film up to the speed of sound in air, and also by reducing the size of the opening in the screens and the wire size. If the screen is pliable enough to be deformed by the impinging gas stream, it may be reinforced by circumferential hoops which have a minimal influence on the size and uniformity of the atomized liquid particles.

Other features and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description of preferred embodiments when considered in connection with the attached drawings.

Brief description of the drawing

In the drawing:

FIG. 1 shows an atomizing apparatus of the invention in side-elevational section;

FIG. 2 shows a detail of FIG. 1 on a greatly enlarged scale;

FIG. 3 shows a portion of the apparatus of FIG. 1 in section on the line II—II;

FIG. 4 shows a modified element for use in the apparatus of FIG. 1;

FIG. 4*a* is an enlarged view of the portion of FIG. 4 indicated by a circle;

FIG. 5 shows an atomizing apparatus of the invention similar to that of FIG. 1 in fragmentary plan view, and partly in section;

FIG. 6 illustrates a portion of the apparatus of FIG. 5 in radial section;

FIG. 7 shows the atomizing apparatus of the invention partly illustrated in FIGS. 5 and 6 in side-elevational section;

FIGS. 8 and 9 show modified details for use in the apparatus of FIG. 7 on a larger scale; and

FIGS. 10 and 11 show other modified parts for use in the devices of FIGS. 1 and 7, the views being in fragmentary plan section.

Description of preferred embodiments

Referring now to the drawing in detail, and initially to FIG. 1, there is shown a tank **1** elongated transversely to the plane of FIG. 1 and having two parallel end walls **2** whose top edges **3** are circularly arcuate, only one wall **2** being seen in FIG. 1. A cover **4** which is cylindrically curved may be shifted circumferentially on the edges **3** as indicated by the double arrow **5**, and is secured against axial movement relative to the tank **1** in a conventional manner not shown. In the illustrated operative position, the cover **4** defines an elongated rectangular aperture **7** with the two end walls **2** and the top edge **6** on the front wall of the tank **1**. Handles **8** on the cover **4** permit the width of the aperture **7** to be varied manually between zero and the illustrated dimension.

A feed pipe **9** is fixedly fastened between the end walls **2**. The axial end of the pipe **9** visible in FIG. 1 is closed, and the other end is normally connected to a compressor or other source of air having a pressure of approximately 30 p.s.i.g. A manifold pipe **13** whose axial ends are closed is attached in the tank **2** to the pipe **9** by spacer nipples **12** axially offset along the pipes **9, 13**. The two ends **10** of each nipple have a left-handed an a right-handed thread respectively and engage matingly threaded bores of the pipes **9, 10**. When the nipple is turned by means of an integral hexagonal collar **11** between the two ends **10**, the pipes **9, 13** are moved radially relative to each other.

An axial row of bores in the manifold pipe **13** is provided with nozzles **14** of which one is shown in greater detail in FIG. 3. Threads on the inner end **15** of the nozzle engage mating threads of the manifold pipe, and a hexagonal nozzle head **16** abuts normally against the outer surface of the pipe **13**. The bore of the nozzle has an innermost cylindrical and relatively wide portion which is joined by a conically converging portion **17** to a narrow cylindrical throat **18**. The walls of the outermost bore portion **19** conically diverge from the throat **18** at an angle of about 60°. The nozzles are axially offset from each other by about 0.5 centimeter. The cross section of the throat **18** is selected to discharge air at approximately sonic speed at the available pressure.

Collars **20** fastened on the axial ends of the feed pipe **9** near the two end walls **2** provide inner races for ball bearings **21** which coaxially support annular discs **22**. Three cylindrically curved screens **23** woven from fine wire connect the discs **22** and are axially tensioned. The circumferential width of each screen **23** is approximately 100°, and the screens are uniformly distributed about the common axis of the ball bearings **21** and of the feed pipe **9** so that they define gaps **24** of 20° width therebetween. As is better seen in FIG. 2, the circumferential edges **25** of each screen are folded back on themselves, and they are clamped to the associated disc **22** by a ring **26** attached to the disc by screws **27**. The resilience of the rings **26** may be increased, if desired, by circumferential slots. As will be shown in FIG. 5, the collars **22** are threadedly mounted on the feed pipe **9** so that the tension of the screens **23** may be adjusted by axially shifting the collars on the pipe.

A motor driven pinion **22a** journaled in each end wall **2** meshes with a gear rim **22b** on the associated disc **22**, as is shown in FIGS. 1 and 5 only, to rotate the screen assembly continuously in the direction of the arrow **28** so that the screens **23** travel through water **29** in the tank **1** and past a wiper **30** before they are radially aligned with nozzles **14**. The wiper is a bar of T-shaped cross section which is fixedly mounted between end walls **2**, but is adjustable radially toward and away from the feed pipe **9** as indicated by the double arrow **31**, non-illustrated threaded studs on the ends of the wiper bar being normally secured in slots of the walls **2** by nuts. The outer flange face **32** of the wiper is flat and tangentially engages each screen **23** during the rotary movement of the screen assembly. An excess of water retained in the small openings between the fine wires of the screens **23** is removed from the screen by the wiper **30**, and the remaining amount of water, which is constant regardless of the liquid level in the tank **1** and other process variables, is blown from the screen in the direction of the arrow **33** by air discharged from the nozzles **14**.

The fog of fine droplets is deposited on the printing cylinder of a non-illustrated offset printing machine as explained in more detail in the afore-mentioned earlier patents. While a gap **24** is aligned with the nozzles, the supply of water droplets is interrupted. An infinitely variable speed transmission is interposed between the afore-mentioned drive pinions of the screen assembly and their motor and permits the rotary speeds of the printing cylinder and of the screen assembly to be synchronized in such a manner that the printing plates on the cylinder are moistened, and the fasteners which hold the plates to the cylinders are aligned with the air nozzles **14** in the direction of the arrow **33** while a gap **24** passes over the nozzles.

The screens **23** are mounted on the discs **22** under tension. They may therefore be pliable and made of wires so fine as not to be self-supporting. The size of the drops initially formed in the perforations of the screen between the wires and the velocity of the air impinging on the droplets are the factors which mainly determine the degree of atomization achieved in the discharged fog. Both factors may be given optimum values in the illustrated apparatus. The perforations are uniformly distributed in each screen axially from one disc **22** to the other, and circumferentially from one gap **24** to the other, and its permeability to air is equally uniform. Each screen is free from imperforate sections which would cause the air jets from the nozzles **14** to rebound and to knock water from other sections of the screen before the same reach proper alignment with the nozzles **14**, thereby preventing a uniform and constant supply of moisture.

Several shutters **34**, known in themselves, are mounted on the front wall of the tank **1** along the aperture **7** on vertical guides, and their vertical positions may be adjusted by turning knobs **36** mounted on the outside of the tank on spindles **37** which threadedly engage a nut pivotally mounted on one arm of a rocker **35**, the other arm of the rocker being forked and engaging a pin on the associated shutter **34**. Only one shutter and the associated adjusting mechanism are shown in FIG. 1. The shutters permit the effective length of the aperture **7** to be varied as needed for the size of the printing plates which are to be moistened. The aperture is preferably completely closed by means of the cover **4** while the associated printing machine is being cleaned to avoid contamination of the screens **23**.

A modified manifold pipe **13a** shown in FIGS. 4 and 4*a* avoids the use of separately inserted air nozzles **14**. The pipe **13a** is axially slotted over its entire length, and its edges along the slot **14a** give the slot a converging-diverging section in a radial plane which is identical with or closely similar to the section of the bore in the nozzle **14**, as shown in FIG. 3. The angle x enclosed by the diverging outermost wall portions of the slot **14a** is approximately 60°.

The width of the slot **14a** may be adjusted to obtain the desired sonic speed in the discharged air. Several bolts **38** are axially spaced along the pipe **13a** and pass through paired openings in the pipe which are offset 90° from the slot **14a** in opposite directions. The somewhat resilient pipe may be compressed or released by turning a nut **39** on each bolt **38**, the escape of compressed air along the bolt being prevented by resilient washers **40** under the head of the bolt **38** and under the nut **39**. The washers **40** may be replaced by stuffing boxes in a conventional manner.

The material of the pipe **13a** is preferably selected in such a manner that the slot **14a** is closed by the resilient force of the pipe material when that force is not balanced by adequate internal air pressure.

The arrangement shown in FIGS. 4 and 4*a* is simpler and less costly than the nozzle arrangement illustrated in FIG. 1. A spray pattern which is continuous over the entire length of the aperture **7** is provided by the apparatus of FIGS. 4 and 4*a* in a particulary convenient manner.

A uniform distribution of the atomized water over the length of the aperture **7** is often undesirable, and it is preferred to moisten the axial ends of a printing plate more strongly than the central plate portion. This is readily achieved in the apparatus of FIG. 1 by tightening the nipples **12** near the ends of the pipe **13** more strongly than near the center so that the pipe **13** is bent into an arc whose convex side faces the aperture **7**. The streams of air discharged from the more remote nozzles **14** at the ends of the manifold pipe spread more widely before striking the screens **23**, and thereby drive more water from the screens than the streams of air from the closer adjacent orifices in the pipe center. While the discharge patterns from juxtaposed nozzles **14** overlap to some extent, less water is dislodged from the screens **23** in the areas which are not aligned directly with the nozzle orifices than in those in the direct line of the air stream.

The screens **23** may consist of filamentous material other than metal wires, and such material need not be interlaced or woven. Parallel wires or filaments axially stretched between the discs **22** are quite effective if they are closely spaced so as to retain water therebetween by surface tension until the water is discharged by air blasts.

The modified atomizing apparatus illustrated in FIGS. 5 and 6 is identical with that of FIG. 1 as far as not explicitly shown, the tank **1** and associated elements having been omitted for the sake of clarity.

Flanged bushings **22'** are mounted on threaded end portions **38'** of the feed pipe **9**. The discs **22** are rotatably mounted on the bushings **22'** by means of radial and axial ball bearings **21*a***, **21*b***. Screens **23** are clamped to the discs **22** by means of rings **26** as described above.

The precisely cylindrical contour of the sleeve assembly which enhances the effectiveness of the wiper **30**, not itself shown in FIG. 5 or 6, is maintained by three narrow, circular hoops **39'** of corrosion resistant metal which are radially aligned with the centers of gaps between two adjacent nozzles **14**. The hoops **39'** are fastened to the inner faces of the screens **23** by thin bronze wires **40'** whose ends pass through radial bores **41** of the hoops **39'**. The nozzles **14** are mounted in an axial row on the manifold pipe **13** as described with reference to FIG. 1.

The manifold pipe **13** is attached to the feed pipe **9** by only three solid studs **42** whose ends **10** are provided with right- and left-handed threads respectively and which have a hexagonal collar **12** between the threaded ends so that the shape of the somewhat resilient manifold pipe may be adjusted by tightening or loosening the three studs, a task much simpler than the tightening or loosening of the more numerous nipples **12** partly illustrated in FIG. 1.

Six connecting tubes **43** whose combined flow section is greater than that of the afore-described nipples **12** lead compressed air from the feed pipe **9** to the manifold pipe **13**. The flow resistance of the air ducts in the apparatus shown in FIG. 5 is so much smaller than that of the apparatus of FIG. 1 that an air supply having a pressure of less than 15 p.s.i.g. is adequate for successfully operating the last-described atomizing device.

While the apparatus of FIG. 5 cooperates smoothly with the wiper **30** shown in FIG. 1, the amount of water carried by the screens **23** to the air jets from the nozzles **14** or the slot **14*a*** may be controlled more closely, and the water film distributed more uniformly by the devices shown in FIGS. 7 to 9.

FIG. 7 shows the elements of an atomizing apparatus illustrated in FIG. 5 mounted in a tank **2** substantially identical with that described above with reference to FIG. 1, the cover **4** having been omitted.

A bar **44** connects the end walls **2** above the water level in the tank and carries a sheet metal baffle **45**. An obliquely dependent free edge portion **46** of the baffle **45** is tangential to a cylinder outwardly spaced from the screens **23** by about 2 mm. to provide an approximate control of the amount of water picked up on the outside of the screens **23**.

The external water film is more precisely controlled by a polyvinyl chloride foil **48** mounted on the bar **44** by means of a sheet metal bracket **47** and extending over the full axial length of the screens **23**. The free top edge **49** of the foil **48** is folded over the top edge **50** of the bracket **47**, and the bottom edge of the foil is clamped to the bar **44** between the baffle **45** and the bracket **47**. A convex face of the foil makes approximate line contact with the water film on the screens **23** as they pass the wiper arrangement and is slightly spaced from the screen surfaces by suitably bending the bracket **47**. The very thin water film left on the screens **23** by the wiper foil **48** is readily dispersed into extremely fine droplets by the air jets discharged from the nozzles **14**.

The thickness of the water film is further reduced without impairing the uniform distribution of moisture on the screens **23** by the additional internal wiper assembly **70**. A sheet metal bracket **71** is mounted on the stationary feed pipe **9** by means of screws **72** and carries sets of three wiper blades **73** which are attached to the bracket **71** by means of screws **74**. The wiper blades are made of resilient plastic sheet material, and the blades of each set are circumferentially offset on the bracket **71**, the spacing of their free edges from the passing screens **23** decreasing in the direction of screen movement. Several sets of blades are mounted on the bracket for cooperation with respective screen sections axially bounded by the hoops **39'**, only one wiper section being illustrated in FIG. 7. If so desired, the wiper blades may be perforated for more efficient release of water.

It will be appreciated that the internal wiper assembly **70** may be employed to advantage in cooperation with the wiper **30** or any other external wiper, and that it is operative even when employed without a cooperating external wiper. Similarly, the wiper foil **48** is capable of producing a distribution of water on the screens **23** which is adequate for many purposes without the use of a cooperating internal wiper.

The modified external wiper shown in FIG. 8 consists mainly of a cylinder **51** provided with a partly shown rim of sprocket teeth **51'** at one end of the cylinder which projects axially beyond the associated screens **23**. A chain (not shown) is normally trained over the teeth **51'** to turn the cylinder in the same angular direction as the screen assembly whereby the face of the cylinder adjacent the screens moves against the direction of screen movement and wipes excess water from the screens.

The trunnions **52** of the cylinder **51** are eccentrically journaled in bearing bushings **53** angularly adjustable in sleeves **54** which are attached to the end walls **2** in a conventional manner, not shown. The eccentricity of the trunnions in the bushings **53** is approximately one millimeter so that the distance between the cylinder **51** and the screen surfaces may be adjusted very precisely by turning the bushings in the sleeves **54**.

The modified internal wiper assembly **70*a*** shown in FIG. 9 includes a bracket **71** of the type described above. The bracket carries tubes **76** which extend axially along each screen section bounded by the hoops **39'**. A resilient wall portion of the tube **76** is formed by a resilient strip **77** of plastic foil or sheet whose longitudinal edges are clamped between two sheet metal strips **78** on the bracket **71** which constitute the remaining wall portion of the tube **77**. The strips **78** also carry a supplemental internal wiper blade **79** of resilient plastic sheet material which cooperates with a portion of the screen **23** behind the tube **76** in the direction of screen movement.

Even small particles of solid matter suspended in the water **29** interfere with optimum performance of the wiper arrangements described above. The tank **2** shown in FIG. 7 is therefore equipped with a water purification system **55**. Water is continuously withdrawn from the bottom of the tank through an outlet **56** and drawn to an air-lift pump **58** through an intake pipe **57**. The pump mainly consists of a mixing chamber **59** in which the water is mixed with compressed air supplied by a pipe **60**. The mixture of water and air is lifted in an upright discharge pipe **61** by hydrostatic pressure to a horizontal pipe **62** which passes through the tank wall and carries a filter **63** from which the water is returned to the tank **2**.

The filter **63** retains particles of dust and similar solid material which may enter the tank **2** even when the cover **4** is in its normal position, and has to be cleaned or replaced from time to time in the usual manner. The water level in the tank **2** is maintained by a float valve (not shown), as is conventional. The pipe **60** is preferably connected to the source of compressed air for the pipe **9** by a common valve so that the pump **58** circulates the water **29** through the filter **63** whenever the atomizing apparatus is in operation. The oxygen intimately mixed with the water prevents the growth of microorganisms, such as algae, in the tank **2**.

If the diameter of the screens **23** is very small, it is not always practical to place a feed pipe **9** and a manifold pipe **13**, **13***a* side by side. FIGS. 10 and 11 show modifications of the afore-described devices suitable for use with very slim screen assemblies.

The manifold pipe **64** shown in FIG. 10 is coaxial with the screens **23** which are rotatably supported on reduced axial end portions **65** of the pipe **64** by ball bearings **21** and discs **22** in a manner evident from FIG. 1, but not illustrated in FIG. 10. The end portions **65** are fixedly mounted in the end walls **2**, and one or both may be connected to a source of compressed air for supplying the nozzles **14** which are mounted in bores of the pipe **64**. The precise cylindrical configuration of the screens **23** is maintained by hoops **39'** as described above.

Yet another space-saving support arrangement for the nozzles **14** is shown in FIG. 11. A feed pipe **67** is mounted in the tank **2** in a manner closely similar to the mounting of the pipe **9** in FIG. 1, and supports the screens **23** with their hoops **39'**. A manifold pipe **66**, whose axial ends are sealed, coaxially envelop the major control portion of the pipe **67** which is provided with numerous radial perforations **68** for transmitting air to nozzles **14** mounted in an axial row on the manifold pipe **66**.

While the atomizing apparatus of the invention has been described with reference to the dampening of printing plates, it will be understood that extremely fine droplets of liquids other than water may be suspended in ambient air and driven in a desired direction by the afore-described apparatus.

What is claimed is:

1. In an atomizing apparatus having screen means mounted for angular movement about an axis, a tank adapted to hold a body of liquid, said screen means being immersed in said liquid and withdrawn therefrom during said movement of the screen means, whereby a film of liquid is retained on said screen means, and gas jet means for directing a stream of gas against said film for dispersing the liquid in said gas, the improvement in the screen means which comprises:

(a) a plurality of screen members;

(b) mounting means holding said screen members substantially in a common cylindrical surface about said axis in circumferentially spaced relationship, whereby said screen members define gaps therebetween,

(1) said mounting means including means for axially tensioning each screen member.

2. In an apparatus as set forth in claim **1**, the permeability of each screen member to said stream being substantially uniform in a circumferential direction from one to the other of the two gaps partly defined by said screen member.

3. In an apparatus as set forth in claim **1**, the improvement in the gas jet means which includes nozzle means for discharging a stream of said gas against said film substantially at sonic speed.

4. In an apparatus as set forth in claim **3**, said nozzle means defining a passage having a terminal portion flaring toward said film of liquid at an angle of about 60°.

5. In an apparatus as set forth in claim **1**, the improvement in the gas jet means which includes an axially elongated manifold pipe spaced toward said axis from said surface, said pipe being formed with an axially extending slot, and feed means for feeding said gas under pressure to said pipe for discharge through said slot, said slot being directed toward said film.

6. In an apparatus as set forth in claim **5**, said manifold pipe being of resilient material, and clamping means for compressing said pipe transversely of said slot and for thereby varying the width of the slot.

7. In an apparatus as set forth in claim **1**, the improvement in the gas jet means which includes an axially elongated manifold pipe spaced toward said axis from said surface, nozzle means axially distributed along said pipe for discharging a gas from said pipe in a common direction transverse of said axis, feed means for feeding said gas under pressure to said pipe, and bending means for bending said pipe into an arc, said arc being convex in said common direction.

8. In an apparatus as set forth in claim **7**, said feed means including an axially elongated feed pipe more rigid than said manifold pipe, and said bending means including means including a plurality of axially offset spacing elements interposed between said pipes in threaded engagement therewith.

9. In an apparatus as set forth in claim **8**, said spacing elements being tubular and connecting said pipes for flow o fsaid gas from said feed pipe to said manifold pipe.

10. In an apparatus as set forth in claim **1**, the improvement which comprises wiper means engageable with said film for reducing the thickness thereof and for enhancing the uniformity thereof prior to engagement of the film by said stream of gas.

11. In an apparatus as set forth in claim **10**, said wiper means including a wiper member having a face closely adjacent said surface and substantially tangential thereto.

12. In an apparatus as set forth in claim **10**, said wiper means including a wiper member having a convexly arcuate face opposite said cylindrical surface, and supporting means for supporting said wiper member in a position radially outward of said surface in which said arcuate face makes substantial line contact with said film.

13. In an apparatus as set forth in claim **10**, said wiper means including a wiper member radially inwardly offset from said surface, and mounting means for holding said wiper member in wiping contact with said film.

14. In an apparatus as set forth in claim **1**, said screen members being sufficiently pliable so as not to be self-supporting, the screen means further comprising a plurality of hoop members extending in respective axially spaced circles about said axis, each hoop member being fastened to said screen members.

15. In an apparatus as set forth in claim **1**, the improvement in the gas jet means which comprises a manifold pipe coaxial with said surface, said mounting means rotatably securing said screen members to said pipe, and nozzle means on said pipe for simultaneously discharging said gas from a plurality of axially aligned portions of said pipe in a common radial direction.

16. In an apparatus as set forth in claim **1**, the improvement which comprises a cover on said tank movable between a first position in which said cover and said tank define an aperture, and a second position in which said aperture is closed, said gas jet means being located in said tank for directing said stream against said film in a direction toward said aperture.

17. In an apparatus as set forth in claim **1**, the improvement which comprises a baffle member of sheet material arranged in said tank, a free edge portion of said baffle member being obliquely inclined relative to the horizontal and tangential to a cylinder coaxial with and closely adjacent said cylindrical surface, and a wiper member mounted in said tank for wiping engagement with said screen members, said wiper member being offset from said baffle member in the direction of movement of said screen means.

18. In an apparatus as set forth in claim **1**, filtering means for withdrawing said liquid from said tank, passing the liquid through a filter, and returning the filtered liquid to said tank, said filtering means including an air-lift pump.

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