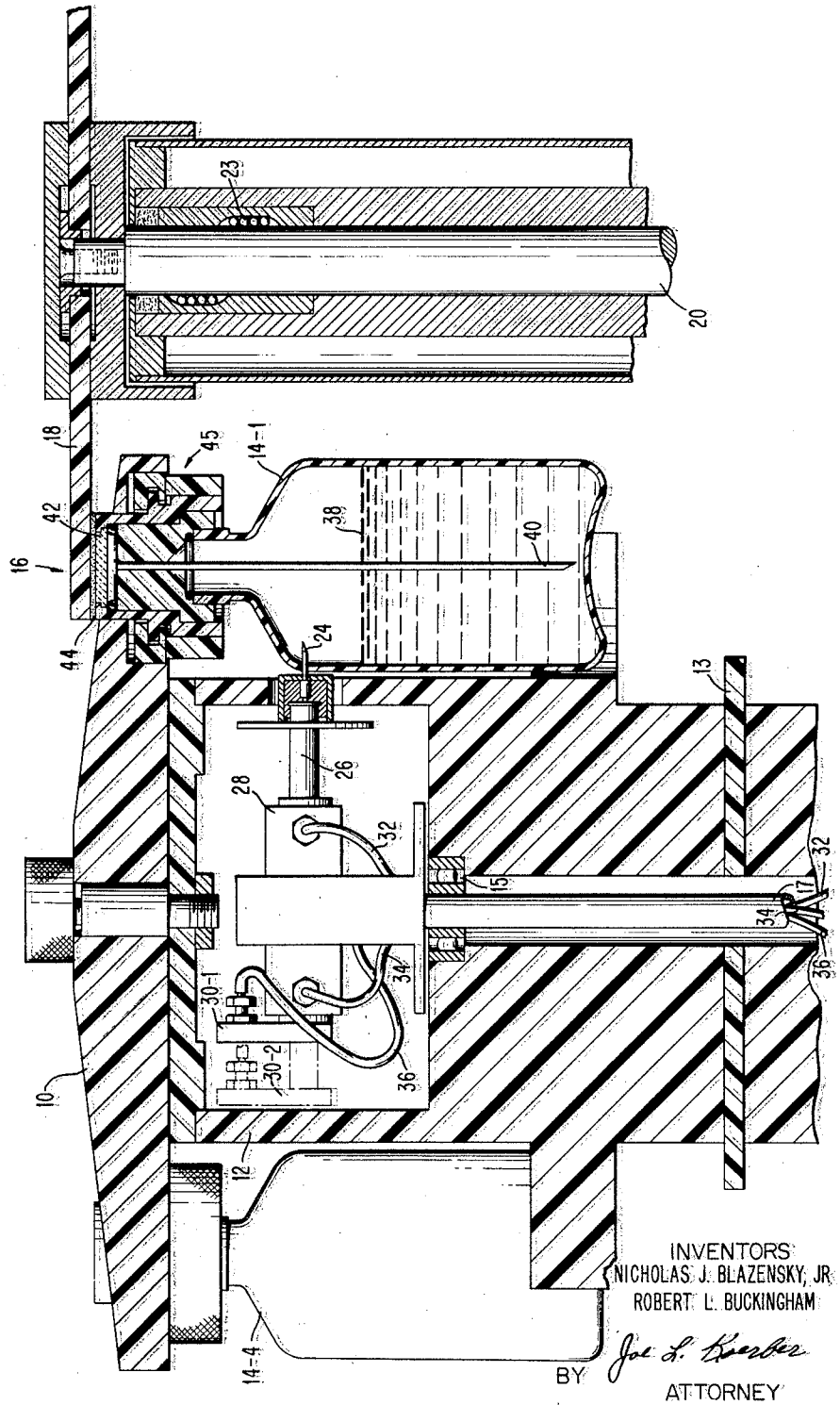
Nov. 24, 1964 N. J. BLAZENSKY, JR., ET AL 3,158,080

LIQUID APPLICATOR

Filed Dec. 27, 1960 3 Sheets-Sheet 1

FIG. 1



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LIQUID APPLICATOR

Filed Dec. 27, 1960 3 Sheets-Sheet 2

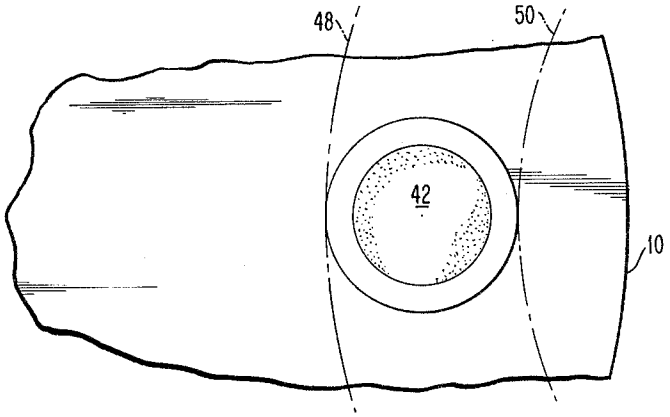


FIG. 4

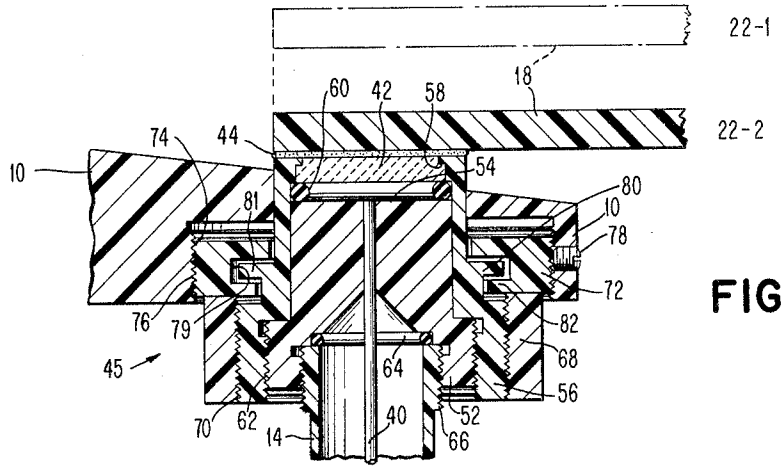


FIG. 3

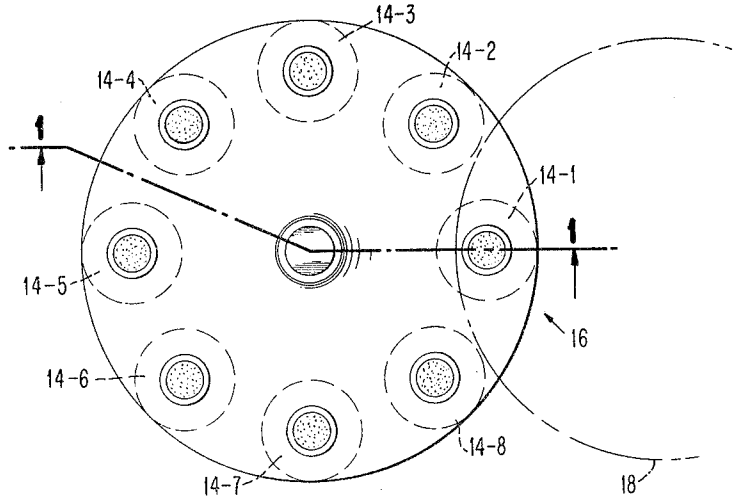


FIG. 2

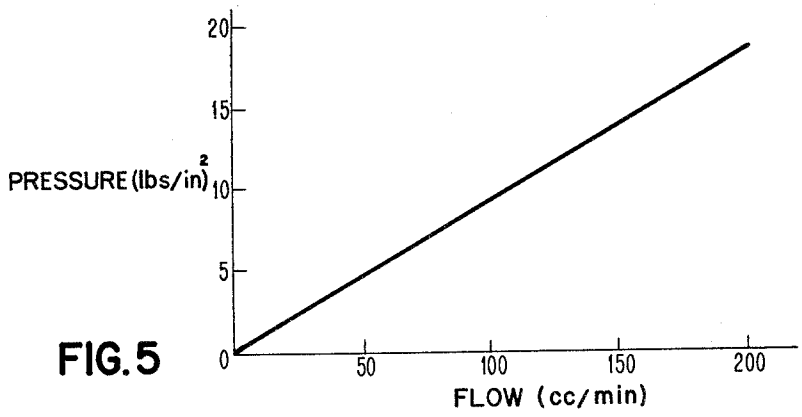


FIG. 5

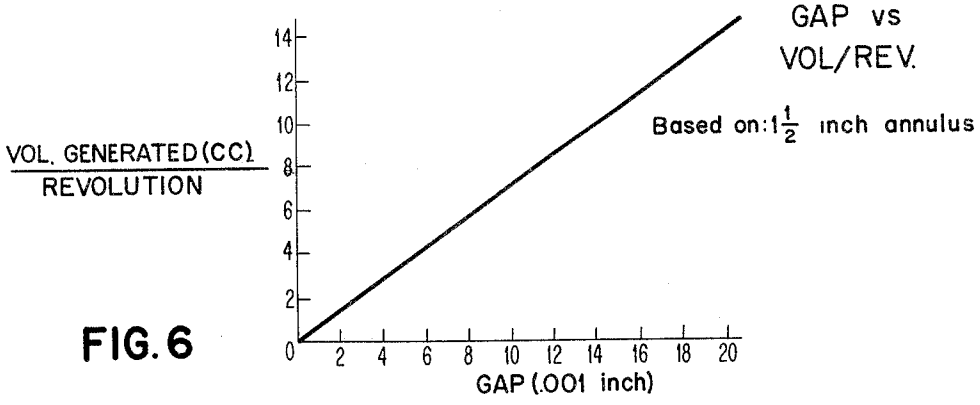


FIG. 6

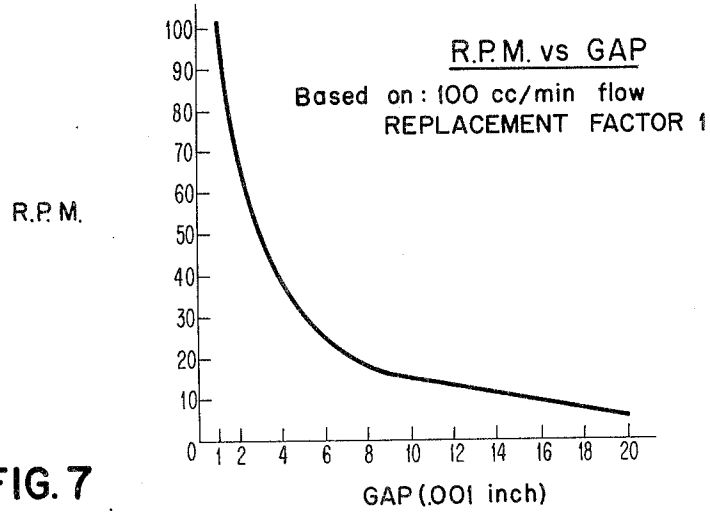


FIG. 7

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3,158,080

LIQUID APPLICATOR

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2 Claims. (Cl. 95—89)

The present invention relates to a device for coating a surface, and more particularly to a device for uniformly applying a minimal amount of filtered fluid to uniformly coat a surface.

In the development of a photographic emulsion which is capable of resolution in the neighborhood of 1000 lines per mm., it is essential that the developing fluids be free of impurities since a very minute impurity particle may be capable of obliterating a significant portion of the image. Developer and hypo (sodium thiosulfate) crystals in particular cause specks to form on the emulsion which impair the image quality. It is therefore necessary to expose and develop such a film in a dust free atmosphere and, in addition, to use only filtered fluids for the various steps of the process to prevent contamination of the emulsion by impurities in the fluids themselves.

In the development of high resolution films, the volume of each of the solutions used should be kept to a minimum, consistent with the satisfactory processing, since the number of foreign particles to which the emulsion is subjected is proportional to the volume of solution which is dispersed on the emulsion.

The use of a filtered fluid is well known in the art. The use of meniscus applicators for supplying fluids to a film during development also is well known. However, the known meniscus type applicators utilizing an elongated meniscus tend to separate into two or more individual meniscuses when a film is moved in contact with the meniscus. The conventional type meniscus applicator may function satisfactorily if a copious flow of fluid is not undesirable. However, where it is desired to have a minimum flow of fluids, the elongated type meniscus is unsatisfactory.

As used herein, a meniscus is defined as the body of fluid formed on the upper applicator surface when liquid is supplied to that surface. This body of fluid (meniscus) is distinguished from the fluid absorbed in the wick or sponge of the type of applicator commonly used to moisten glue such as on stamps and envelope flaps or the liquid overflowing freely from the top of a vertical pipe. This meniscus, when not in contact with a moving surface to be coated, forms a stable body of liquid.

Due to the surface tension, liquids tend to assume a spherical shape. When film is moved transversely to and is in contact with the conventional elongated meniscus, the liquid adheres to the moving film. There is a tendency, due to the cohesive forces of the liquid, for the entire meniscus rather than merely the surface portions to move with the film. Tendency of the meniscus to follow the film results in the meniscus breaking at one or more points and, due to cohesive action, the several individual meniscuses tend to form into spherical shapes and thus leave intervening spaces on the film which are not coated with the liquid. The present meniscus applicator is designed to take advantage of the natural tendency of a liquid to assume a spherical shape.

Accordingly, a primary object of this invention is to provide filtered fluids for the processing of high resolution film.

Another object of this invention is to provide fluids which are filtered immediately prior to being applied to the film.

A further object of this invention is to provide fluid in the form of a meniscus in contact with which the film is moved to obtain uniform coating.

Yet another object of this invention is to provide a circular type meniscus applicator to present a circular meniscus which will not be broken by the movement of film in contact therewith.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings.

In the drawings:

FIGURE 1 is a sectional elevation taken along the line 1—1 in FIGURE 2.

FIGURE 2 is a plan view of the apparatus shown in FIGURE 1.

FIGURE 3 is an enlarged sectional view of the meniscus head.

FIGURE 4 is a plan view of the meniscus head.

FIGURE 5 is a graph of applied pressure versus liquid flow.

FIGURE 6 is a graph of volume of fluid per revolution versus gap.

FIGURE 7 is a graph of r.p.m. versus gap.

In accordance with the concept of contamination free development of photographic film, a photographic disc processor is housed in a stainless steel cabinet (not shown). A top cover is provided as a dust seal and the cabinet is internally pressurized to keep dust out. The necessary solutions for processing are enclosed within the steel cabinet in polyethylene containers on an indexable turntable, and are successively moved to a dispensing station for presentation to the emulsion. Fluid containers are constructed of chemically inert polyethylene materials and after a single use, are discarded. A separate applicator head for each bottle is constructed of chemically inert material such as Lucite. The applicator head assembly serves as a bottle cap for sealing against pressure leaks, as a support for the fluid container, as a support for a filter, and as an adjusting mechanism for locating the top of the applicator head with respect to the photographic emulsion. Each fluid is filtered immediately prior to its presentation to the photographic emulsion. The various fluids are presented to the photographic emulsion on a continuous replacement basis with the expired solution being replaced continually by pressurized solution which is discarded after a single use.

The complete processing of a high resolution emulsion may include the following steps.

(1) Pre-wash. Pre-washing with a solution which may be for example Eastman Kodak Photo-flow, insures uniform wetting with the developer in a subsequent step.

(2) Developer. An appropriate developing solution, for example Eastman Kodak D–19, is applied to develop the photographic image.

(3) Stop bath. The stop bath, for example Eastman Kodak Glacial Aletic Acid, neutralizes the developer, stopping the developing process and dissolving or retarding the formation of calcium scum.

(4) Fixing. The fixing bath, for example Eastman Kodak Rapid Fixer, dissolves the light-sensitive silver haloid, stops developing, and forms complexes which are stable upon dilution so that they will not decompose during washing and thus cause stains.

(5) Hypo clearing rinse. Certain washing aids can be used to make possible more rapid and complete washing after fixing. For example, a 30 second rinse in a 2 percent solution of sodium sulfate may be used.

(6) Washing. The emulsion is washed with distilled water to remove all soluble compounds, in particular, the fixing salts which are contaminated with dissolved silver

compounds in the form of complexes with thiosulfate. Effective washing is especially important where photographs are to be kept as archival records.

(7) Pre-drying. Washing and drying are the most critical operations for the preserving of cleanliness and the shorter these times can be, the less the likelihood of contamination. A thirty second bath in ethyl alcohol, after washing, produces a dry disc in approximately 7 minutes, thus reducing the duration of the critical tacky stage between washing and drying when contamination from the atmosphere is most likely.

(8) Drying. A final drying time of 10 minutes during which the disc is rotated at 300 r.p.m. insures a completely dry emulsion and terminates the disc processing cycle.

Referring to FIGURES 1 and 2, a turntable 10 on a hub 12 is rotatably mounted on a rotatable table 13 and is adapted to receive eight individual fluid containers 14–1 through 14–8. Actually, only seven are used and the eight position is used for loading. The turnable 10 is indexable to present the containers 14 successively to a dispensing station 16, FIG. 2. A bearing 15 permits rotation of the hub 12 around a shaft 17 which is a stationary support and conduit.

A glass disc 18 having a photographic emulsion on the lower side is rotatably mounted on a shaft 20 which may be raised and lowered in a bearing 23 to the positions 22–1 and 22–2, shown in FIGURE 3, by means of an air piston (not shown).

A hypodermic type needle 24 is mounted on a hollow plunger 26 of a double acting gas operated cylinder 28 and may be moved selectively between the positions 30–1 and 30–2, whereby the needle may be withdrawn from one polyethylene container 14 and inserted through the sidewall of the next container 14 which is indexed to the dispensing station 16. Air pressure for operating the cylinder 28 is supplied selectively through tubes 32 and 34.

The pressurizing gas for a container 14, for example nitrogen, is supplied to the needle 24 through the tube 36 and hollow plunger 26. The penetratable wall of the containers 14 allows piercing by the needle 24 and is strong enough to withstand the pressure necessary to cause flow of the solutions. The polyethylene containers are inert to the chemicals used in the developing process.

Prior to the indexing of the turntable 10 to present a new container 14 to the dispensing station 16, the disc 18 is raised from the position 22–2 to the position 22–1 by raising the shaft 20 in the bearing 23. After the new container 14 is indexed to the dispensing station, the disc 18 is again lowered to the position 22–2. When pressure is applied through the needle 24 to the fluid 38, the fluid is forced through a lead tube 40 and a porous filter element 42 to form a meniscus 44 on the upper surface of the applicator head which is generally designated 45. The internal pressure in the container is adjusted to provide the minimal flow of fluid through the filter 42 for complete coating of the portion of the disc 18 which is spanned by the applicator head 45.

Referring to FIGURES 3 and 4, an enlarged sectional view of the head is shown as well as a partial plan view. The portion of the emulsion on the disc 18 which is to be developed is defined approximately by the outer edge 48 of the disc 18 and the dotted line 50. The annulus defined by the lines 48 and 50 varies depending upon which solution is being supplied, since all heads 45 are not of the same diameter.

Cleanliness of solutions coming in contact with the emulsion is of great importance. Satisfactory optical delineation of information marks on the disc requires that no more than 10 percent of an information mark be obscured by foreign material or other defects. Where the smallest mark on the film is of 3.35×10^{-4} inches wide by 3.31×10^{-4} inches, and thus 11.1×10^{-8} sq. inches in area, the equivalent circular area representing 10 percent of the smallest mark has a diameter of 1.19×10^{-4} inches, or approximately 3 microns. Thus a filter retention of particles 3 microns in diameter would just satisfy the 10 percent tolerance.

The filter 42 located in the applicator head is a Selas Micro-Porous Porcelain Disc No. 01 which retains particles 2 microns in diameter. The filter is 30 mm. in diameter by 3/16 inch thick with a 1/16×1/16 inch step machined around the uper edge to allow flush location of the filter with the upper surface of the applicator head as well as to retain the filter.

Applicator Head

The lead tube 40 is fixed in a core section 52 and comes flush with the upper surface 54 of the section 52. A ring section 56 contains an annulus 58 complementary to the machined step in the filter element 42.

In assembling the applicator head, the filter element 42 is placed in the ring section 56 where the top surface of the filter element comes flush with the top of the ring. The meniscus will be formed on the surface formed on top of the ring 56 and the filter element 42. An O-ring 60, for example neoprene, is placed against the bottom side of the filter element and is followed by the core section 52 which is screwed in by threads 62. A second O-ring 64 is inserted in a central aperture of the core section 52, followed by the container 14 which is screwed into place by threads 66. A locking ring 68 is threaded onto the outer portion of the ring 56 by threads 70.

The turntable 10 includes a ring 72 which is screwed into an opening 74 in the turntable 10 by thread 76 and is held in place by a set screw 78. The ring 72 contains a channel 79 formed complementary to two lugs 80 and 81 which are 180 degrees apart on the ring section 56. Two openings (not shown) which are located 180 degrees apart in an annulus 82 forming the lower side of the channel 79 in the ring 72 permit insertion of the assembled applicator head into the ring 72 followed by a quarter turn of the head assembly. The head assembly is locked into place by screwing the locking ring 68 up against the lower side of the ring 72. By means of the threads 76, each ring 72 may be adjusted individually to provide proper spacing between the head assembly and the emulsion.

Each of the several heads is positioned so the outer edge coincides with the outer edge 48 of the disc 18. The diameter of the pre-wash and developer heads is 1.495 inches; the diameter of the stop bath and fixer heads is 1.515 inches; the diameter of the hypo clearing rinse, final wash heads is 1.615 inches; and the diameter of the alcohol head is 1.645 inches. The overlap of dispensing head areas insures adequate processing in the boundary area between the process and the unprocessed emulsion.

The actual volume of each fluid to be used is determined by the rate of flow of the solution and the duration of flow. The disc 18 may be rotated from 0 to 300 r.p.m. by means of a D.C. shunt motor and variable power supply (not shown). The resultant flow of fluids from the containers 14 is directly proportional to the pressure applied to the solution inside the bottle as shown in the graph of FIGURE 5.

FIGURE 6 shows the relationship of the gap between the head 45 and the disc 18 versus the volume per revolution, based on a 1½ inch diameter dispensing head. Experimental results show that a high resolution emulsion plate held horizontally holds a layer of tap water .0045 inch thick on its underside. However, a gap of this dimension is too critical to maintain. FIGURE 7 shows the relationship between disc speed and gap.

Experience has shown that a gap in the order of .014 inch produces a stable meniscus contact with the disc. Thus, for a flow rate of 100 cc. per minute and a replacement factor of 1, a .014 inch gap requires 10 r.p.m. for the disc.

While the invention has been particularly shown and described with reference to a preferred embodiment there-

of, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. In apparatus for applying a coating liquid to a surface by moving said surface past an applicator with a space between said surface and said applicator but with said surface in contact with a coating liquid supplied from said applicator,

an applicator having a horizontal circular upper surface to which said liquid is supplied, and

means for supplying said liquid to said upper surface sufficient to fill said space with a circular meniscus of said liquid forming a stable body having a flattened oval cross-section and to replenish the liquid which is carried away on the coated surface so there is no excess flow from the applicator.

2. In apparatus for applying a coating liquid to a surface by moving said surface past an applicator with a space between said surface and said applicator but with said surface in contact with a coating liquid supplied from said applicator,

an applicator having a horizontal substantially circular upper surface to which said liquid is supplied, and

means for supplying said liquid to said upper surface sufficient to fill said space with a substantially circular meniscus of said liquid forming a stable body having a flattened oval cross-section and to replenish the liquid which is carried away on the coated surface so there is no excess flow from said applicator.

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