

April 19, 1960

K. W. JUDGE

2,933,033

SURFACE APPLICATION PROCESSOR FOR SENSITIZED MATERIALS

Filed Nov. 19, 1954

3 Sheets-Sheet 1

Fig. 1

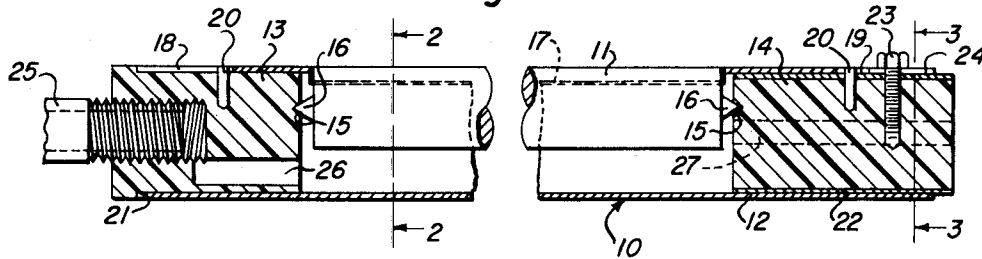


Fig. 2

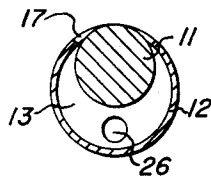


Fig. 3

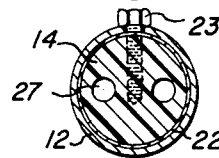
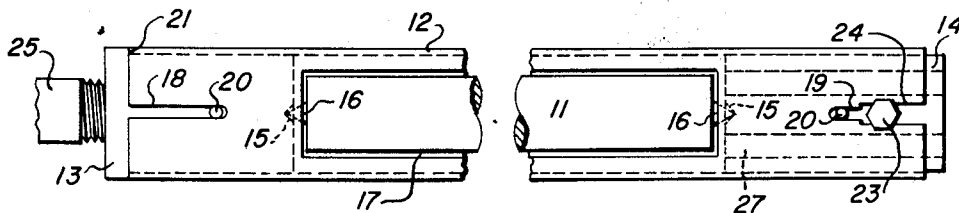


Fig. 4



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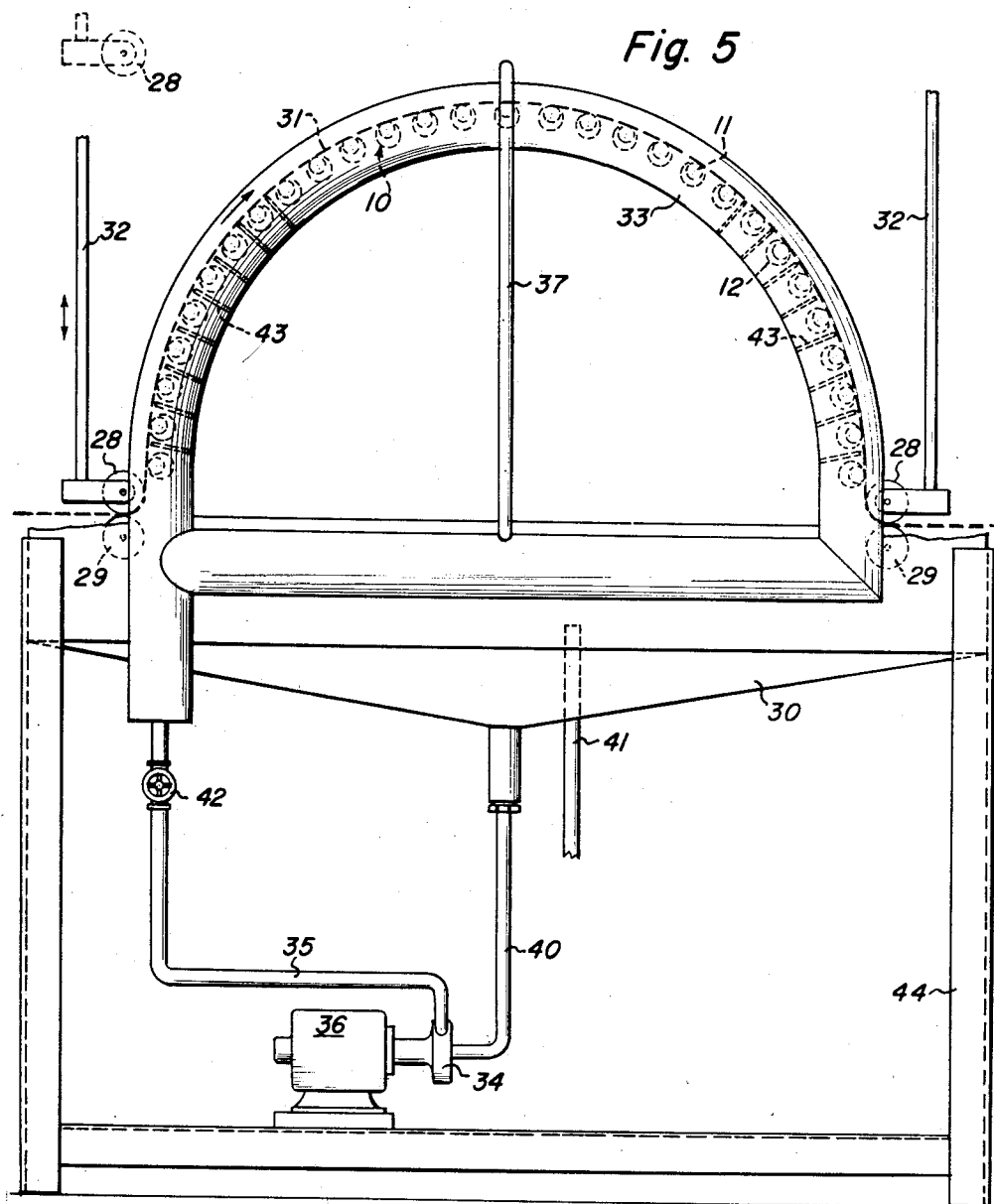
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SURFACE APPLICATION PROCESSOR FOR SENSITIZED MATERIALS

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3 Sheets-Sheet 2



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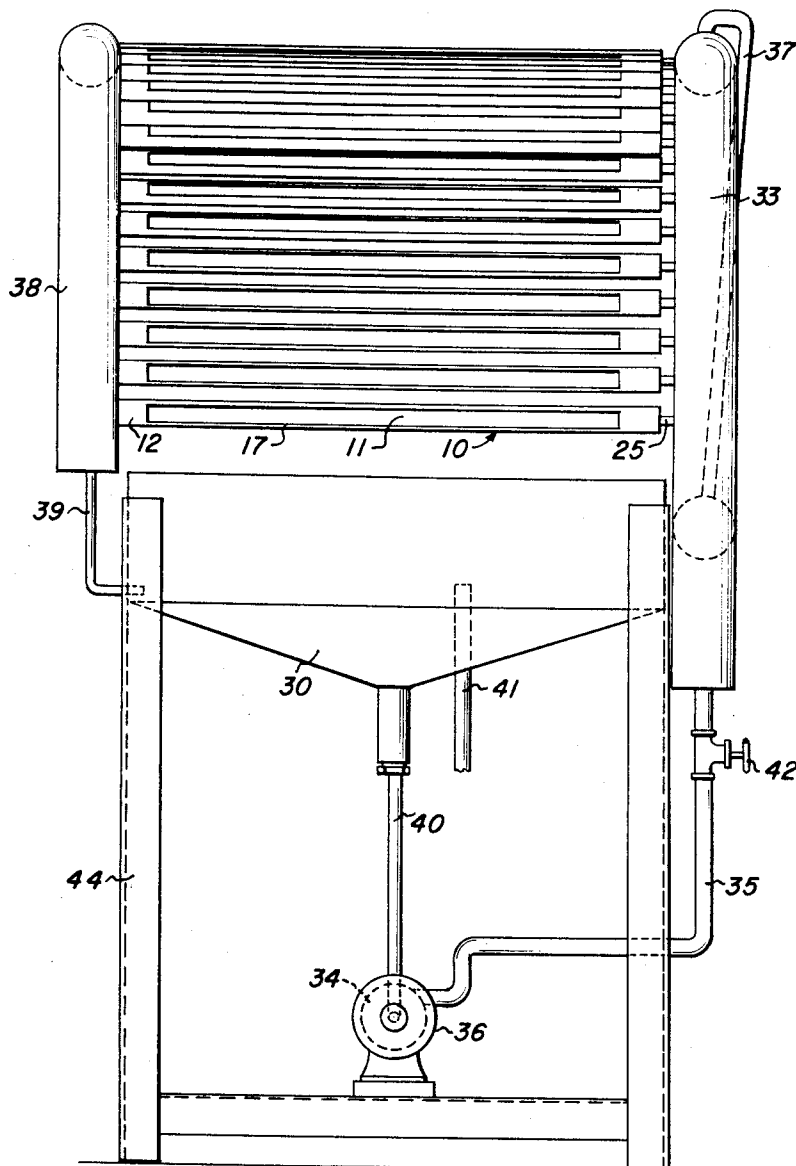
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SURFACE APPLICATION PROCESSOR FOR SENSITIZED MATERIALS

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3 Sheets-Sheet 3

Fig. 6



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SURFACE APPLICATION PROCESSOR FOR SENSITIZED MATERIALS

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Application November 19, 1954, Serial No. 469,887

7 Claims. (Cl. 95—94)

The present invention relates to a processing apparatus for sensitized photographic materials and more particularly to a machine adapted to process sensitized photographic materials in continuous strip form by the surface application of processing liquids to the emulsion surface of such materials. It relates further to a novel surface applicator unit which finds application in the above photographic processing apparatus although its use is not necessarily limited thereto. While the preferred form of the invention will be described in connection with a continuous paper processor, it is to be understood that the invention is equally applicable to film processing. As will be further apparent from the following description, the present invention is particularly well adapted to rapid processing applications, and to installations in which the conservation of space is a factor or in which movement of the apparatus from the conventional horizontal position may be expected, as in a moving vehicle, on shipboard, or in an aircraft.

It is well known that the surface-application type of processor is especially well adapted to the rapid processing of photographic materials since such, by eliminating the complete immersion of the material in a processing bath, shortens the drying time and, therefore, the total time required for the complete processing of the photographic material. The relatively short drying time is made possible because only the emulsion side of the photographic material is thus wetted. The prior art surface application processor, however, generally comprised one or more rollers partially immersed in the treatment bath against which rollers the sensitized material was held by one or more dry rollers. This arrangement possessed several distinct disadvantages. For one, such rollers normally carried thereon only a very thin film of liquid so that only thinly coated emulsions could be processed by these unless a large number of individual rollers were used in combination to transfer the required amount of solution to the material. Such a series of applicator rollers had to be, however, in the same horizontal plane, since the wetting of each roller depended upon the bottom part of each dipping into the bath, thus necessitating a long extended path which the sensitized material had to traverse and a prohibitively long machine if the conservation of space was a consideration. In addition, the dry rollers of the prior art which functioned to press the sensitized material into contact with the applicator rollers were often a source of difficulty since these themselves might be wetted by the applicator rollers before the sensitized material was passed between the rollers and thereafter wet the back of the sensitized material when this was first passed through the apparatus. Then again, such arrangement of applicator and dry rollers usually offered a difficult problem in threading the material or leader into the machine. Moreover, such a machine obviously would not be suitable where the plane of the rollers was likely to be tilted out of the normal horizontal position.

Rapid processing applications very often employ ele-

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vated temperatures for the processing solutions and sometimes highly active solutions are required. Because the life of processing solutions at high temperatures may be quite limited when exposed to aeration during use, the apparatus to be described, it will be noted, is most satisfactory and economical in this respect since it operates with only a small volume of solution. Also, as a result of this small volume, the solution can be brought up to operating temperature in a minimum of time. Moreover, the apparatus embodying the present invention provides excellent processing uniformity because renewal of the solution is enforced at the photographic surface at each roller position as will become apparent.

It is, therefore, an object of this invention to provide an improved processing machine.

It is a further object of this invention to provide an improved processing machine which is especially adapted for rapid processing applications.

It is a still further object of this invention to provide an improved processing machine which may be set up in a relatively small space.

It is a still further object of this invention to provide an improved processing machine whose operation will not be disturbed by its being tilted out of its normal horizontal position as when installed in a moving vehicle, on shipboard, or in an aircraft.

It is a still further object to provide a novel and effective surface applicator unit which is especially adapted for use in the processing of sensitized photographic materials.

It is a still further object to provide a surface applicator of the character described which is relatively simple in construction and whose adjustment and maintenance are correspondingly simple.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings, and it will be understood that many changes may be made in the details of construction and arrangement of parts shown and described without departing from the spirit of the invention as expressed in the accompanying claims. I, therefore, do not wish to be limited to the exact details shown and described as the preferred form only has been shown by way of illustration.

In the drawings:

Fig. 1 is a side view, in section, of a surface liquid applicator embodying certain features of the present invention.

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1.

Fig. 4 is a top view of the surface liquid applicator.

Fig. 5 is a side view of a processing apparatus for sensitized photographic materials which employs therein a plurality of surface applicators according to the present invention.

Fig. 6 is an end view of such a processing apparatus with certain elements omitted therefrom for the sake of greater clarity.

The surface applicator unit which embodies features of the present invention and which is illustrated in Figs. 1 to 4 is especially adapted for use in the processing apparatus shown in Figs. 5 and 6. However, it will be readily apparent that its use is not limited thereto and that it may be employed in other combinations. The surface applicator 10 includes the applicator roller 11 mounted within the tube 12. The roller like the tube is preferably formed of stainless steel or some other material capable of withstanding the processing solutions. The surface of the roller may be smooth or polished or matted or finely grooved to improve its liquid carrying properties. In

the ends of tube 12 are secured closure elements 13 and 14 which also serve as bearings for the roller 11. These are formed of nylon plastic rod and are provided at the inner ends with conical depressions 15 which serve as bearings for the pivots 16 which are integrally formed on each end of roller 11. By virtue of the bearings and pivots the roller 11 is freely rotatable within the tube 12. The latter is also provided with a longitudinal slot 17 which is so dimensioned relative to the roller 11 that the latter projects partly therethrough to substantially fill the slot opening 17 while yet leaving a slight clearance between the sides of the slot and the roller for a purpose to be explained below. To avoid making the roller 11 unduly large in respect to the tube 12 and to obtain the correct clearance between the roller and the slot in the tube, I have found it expedient to mount the roller eccentrically relative to the tube. This may be clearly seen in Figs. 1 and 2.

Tube 12 is adapted to contain a processing solution, the roller 11 rotating therein thus carrying a film of solution from within the tube past the slot opening therein to wet the emulsion surface of the sensitized material which is being drawn over the applicator in contact with said roller. The slot 17 is thus dimensioned so that the roller substantially fills the opening, yet permitting the roller to carry a thin film of solution from within the tube to deposit this upon the sensitized material which contacts said roller as it passes thereover. However, the clearance between the sides of the slot and the roller is such that free flow of liquid from the tube through the slot can be substantially impeded. For such reason the described applicator need not necessarily operate with the slot in the uppermost surface thereof as will become apparent in the description below of a processing apparatus which includes a plurality of such applicators. It will be understood, too, that such applicators will have application in processing apparatus which are subject to any deviation from a conventional horizontal position as in a moving vehicle, on shipboard, or in an aircraft. It will be obvious that any motion of such an installation will not result in splashing or spilling of the processing solution which is thus effectively confined within the tube.

Since the roller 11 is mounted eccentrically relative to the tube 12, the proper orientation of the closure elements 13 and 14 relative to the tube 12 becomes most important in order that the roller 11 will be correctly positioned relative to the slot 17. For this purpose the tube 12 is provided with a pair of aligning slots 18 and 19 and the closure members 13 and 14 each with an aligning pin 20. These will be clearly noted in Figs. 1 and 4 and it will be apparent that the cooperation of the aligning slots and pins precludes relative rotation between the closure elements and the tube and predetermines the relative orientation of these elements 13 and 14 and the tube 12 while permitting these elements to be adjusted longitudinally within the tube in order that the roller 11 may be properly supported in the bearings 15.

Although the roller 11 must be free running, it must be well supported in its end bearings to preclude any transverse or longitudinal motion of the roller within the tube which would necessarily affect the clearance between the roller and the slot opening 17. This is readily accomplished by adjusting the relative longitudinal position of the closure elements 13 and 14 within the tube 12. To facilitate this adjustment the position of the element 13 is preferably predetermined in respect to the tube by the provision of a shoulder 21 on the element 13 which is engaged by the end of the tube 12 as it is slid into position, the aligning slot 18 and pin 20 fixing the relative orientation of the element 13 and tube 12. The closure member 14, however, is capable of longitudinal adjustment within the tube and for this purpose is provided with a metal sleeve 22 to make this member more readily slidable within the tube. Aligning slot 19 and pin 20, however, fix the relative orientation of closure

member 14 and tube 12. Member 14 is thus adjusted longitudinally within the tube until the roller is properly supported in the bearings 15. The lockbolt 23, which is threaded into closure 14 and which slides in slot 24 which slot is somewhat wider than and a continuation of the aligning slot 19, is then driven home until the head makes tight frictional engagement with the outer surface of tube 12 to fixedly secure the closure element 14 therein.

Another feature of the surface applicator is the provision for circulating the processing solution therethrough which obviously compels constant solution renewal at the photographic surface since the roller is constantly being wetted by a circulating solution. The solution is fed into the tube 12 through feed pipe 25, the threaded end of which is threaded into closure element 13. A passage 26 extends from an opening in the wall at the base of the threaded hole in closure element 13 to open into the inside of tube 12, as seen in Fig. 1. It will be apparent that, when the threaded end of feed pipe 25 is turned all the way in, the opening located at the base of the threaded hole in closure member 13 will be entirely closed and no solution will flow from the feed pipe into the tube. However, as the pipe end is backed out, the latter opening will be gradually uncovered and the flow of the processing solution through the applicator can be thus controlled. One or more passages 27 are provided in closure element 14 to expedite the circulation of liquid through the applicator. It will be understood, too, that a certain amount of solution is being carried by the roller 11 through the slot opening for deposit upon the sensitized material.

While I have described above a single surface applicator unit, it will be understood that it is contemplated that such units will find application in photographic processing apparatus employing a plurality of such units. An apparatus of this kind is illustrated in Figs. 5 and 6 and it will be noted that the inherent characteristics of this applicator lend themselves admirably to such application. In this apparatus the surface applicators 10 are arranged in an upwardly bowed path as noted in Fig. 5. This arrangement serves several purposes. It reduces the overall length of the apparatus to make it more compact and reduce the space requirement. It also precludes the need for individual pressure rollers to hold the moving sensitized photographic material in contact with each applicator roller which eliminates the problem of the pressure rollers being wetted by the applicator rollers before the sensitized material is passed through the apparatus, which disadvantage has been previously discussed in connection with prior art machines. It also facilitates the problem of initially threading the sensitized material web through the apparatus.

To hold the sensitized material in contact with the several applicator rollers, hold-down means comprising a pair of engaged rollers 28 and 29 are positioned at each end of the arc defined by the transversely arranged applicators. It will be apparent that by constraining the sensitized material or paper to pass between each pair of rollers 28 and 29 and by maintaining the paper taut the latter will follow the path 31 indicated by the dashed line in Fig. 5 in the direction of the arrow and the paper will be automatically held in contact with each of the plurality of applicator rollers 11 since the applicator tubes 12 are oriented to present the slotted opening 17 in each to the outside of the curved path, as illustrated in Fig. 5. Both of the upper corners of the shallow tank or collecting sump 30 have been cut away in Fig. 5 to better illustrate the paper path 31 through the apparatus. The paper is maintained taut by any variety of conventional web drive which will draw the paper through the apparatus. For this purpose the lower roller 29 at the right-hand side of the apparatus of Fig. 5 may be driven either positively or by a tendency drive, this roller cooperating with the engaged roller 28 to draw therebetween the

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sensitized material which is thus simultaneously pulled through the apparatus and maintained in a taut condition.

To facilitate the initial threading of the sensitized web through the machine, the upper hold-down rollers 28 are mounted on elevating means 32 whereby these may be raised out of contact with the rollers 29 to such a position as illustrated by the dashed-line representation of the roller 28 at the left of Fig. 5. After the rollers 28 are so elevated, the sensitized material or its leader may be passed under the rollers 28 in a horizontal line above the arc of applicators and then lowered into contact therewith by the mere lowering of the elevator means 32 until rollers 28 once again press the sensitized material into engagement with rollers 29.

As has been described, the processing solution is caused to circulate through each of the applicators 10, entering through the individual feed pipes 25. The latter are connected to the header 33 which is maintained substantially filled with solution by the centrifugal pump 34 which pumps solution through the supply pipe 35 into said header. The pump 34 is driven by the motor 36. The header 33 itself comprises two connected sections, the one a curved tubular section which follows the arc defined by the arrangement of applicators, the other a straight, horizontal section extending between the ends of the curved section. In addition, a transparent vertical tube 37 extends from the straight section of the header to the top of the curved section, as is clearly seen in Fig. 6, and serves as a visible indication of the head of solution in the header 33 so that the operator may readily determine that all of the applicator tubes 12, including those at the top of the arc, are receiving an adequate supply of processing solution.

A similar curved tube or pipe 38 is positioned on the outlet side of the applicators 10 and receives the solution passing through the passages 27 which open into the curved pipe 38. The latter is drained at the lower ends by drain pipes 39 which return the solution to the collecting sump 30 which is positioned below the transverse arrangement of surface applicators 10, as may be readily seen in Fig. 6. The collecting sump as well as the other elements of the processor are supported by the frame 44, being secured thereto in any known or conventional manner. The sump itself drains through the vertical pipe 40 into the intake of the centrifugal pump 34 from which it will be obvious that the present system provides continuous circulation of the processing fluids through the apparatus. An open pipe 41 is provided to control the elevation of solution in the sump by draining off the excess when this elevation is exceeded. A valve 42, too, is provided to control the flow of solution through the supply pipe 35. Still other pipes and fittings may, of course, be provided as for the purpose of completely draining the system, additional flow control, or for precautionary and safety measures.

It will be understood that there may be some solution drip especially from those lower applicators on which the head of solution is greatest and in which the slot openings 17 are positioned along the side rather than along the top of the applicator tubes because of their orientation. Such drip is itself not detrimental to operation of the processor especially if it can be prevented from dropping and splashing upon the applicator units below. To this end, a series of shields or deflectors 43 are provided, one being positioned between each applicator and the one immediately above it, as seen in Fig. 5. These are inclined, as illustrated, to conduct the drip away from the lower applicator to drop instead into the collecting sump 30. Since the upper applicator units are not positioned directly above a lower unit, there is no possibility of solution dripping from one of these units upon a lower one and the deflectors are, therefore, omitted from below such applicators. An inspection of Fig. 5 will make it obvious that any drip from these upper units

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would of necessity fall directly into the collecting sump. It may here be noted that the above-described deflectors 43, as well as the hold-down rollers 28 and 29, have been omitted from the end view of the apparatus seen in Fig. 6 in order that these may not obstruct the clarity of other features seen in this view.

As stated above, the amount of excess solution which may drip from any applicator unit depends in part upon the head of solution upon such unit and in part upon the orientation of the unit. In addition it will depend upon the viscosity of the particular processing solution as well as upon the clearance between the roller 11 and the sides of the slot 17 through which the roller projects. Because of the number of variables which must be taken into consideration in determining the desired clearance between roller and slot opening, no specific dimensions have been given. However, such an apparatus as above described, in which this clearance was not greater than 0.01 inch, has been found to operate satisfactorily.

Since, as has been stated, the described apparatus is well adapted for rapid processing applications employing solutions at elevated temperatures, it may be desired to provide heating means in the described processor. This is best done by the insertion of an immersion heater in one of the pipe lines as, for example, in the vertical pipe return 40. It should also be noted that, while the applicator units in the processor have been described as being transversely arranged in an upwardly bowed or arcuate path, they may also be arranged in many other equally acceptable, non-linear, curved or arched paths to obtain the same advantages inherent in the described arrangement. Still another point to be noted is that the apparatus illustrated in Figs. 5 and 6 is intended for the surface application of a single liquid such as developer, or stop bath, or fixer, or stabilizer or rinse. Obviously, several processing units, such as the one described and illustrated in Figs. 5 and 6, may be combined in a predetermined order to each act upon the moving band of sensitized material in the desired manner so that the band of material issuing from the last unit will be completely processed and in fact may be run directly into a drier.

From the foregoing description it will be apparent that I have provided means for obtaining all of the objects and advantages of this invention.

What I claim and desire to secure by Letters Patent of the United States is:

1. A surface liquid applicator for processing photographic material comprising a tube adapted to contain a processing liquid and having a longitudinal slot, a roller rotatably mounted within the tube and projecting partly through said slot to substantially fill the slot opening, the clearance between the sides of the slot and the roller being sufficient to permit the latter to carry as it rotates a film of liquid from within the tube past the slot opening, means secured in each end of the tube functioning simultaneously as closures for the tube and as supports for the ends of said roller, one of said closure means being provided with a threaded opening which extends from the outside part way through the closure means and a second opening in the threaded wall of said threaded opening communicating with a passage extending therefrom to the inside of said tube, and a liquid supply pipe, the end of which is threaded whereby it may be turned into said threaded opening, the distance which it is thus inserted determining the area of the second opening which is covered by the pipe end and, therefore, the rate of flow of liquid into said tube.

2. A processing apparatus for sensitized material comprising a plurality of tubes, each adapted to contain a processing liquid and each having a longitudinal slot therein, a roller mounted within each tube and projecting through the longitudinal slot therein to substantially fill the slot opening while providing a slight clearance between the sides of the slot and the roller, said tubes being arranged transversely along a non-linear path and

being individually oriented whereby the sensitized material traversing said non-linear path makes contact with each roller, hold-down means at the ends of said non-linear path spaced from said rollers and adapted to hold the sensitized material against the rollers as it traverses said non-linear path, and means for moving the sensitized material along the non-linear path.

3. A processing apparatus for sensitized material comprising a plurality of tubes, each adapted to contain a processing liquid and each having a longitudinal slot therein, a roller rotatably mounted within each tube and projecting through the longitudinal slot therein to substantially fill the slot opening, the clearance between the sides of said slot and the roller being sufficient to permit the latter to carry as it rotates a film of liquid from within the tube past the slot opening, said plurality of tubes being arranged transversely along a curved path and being individually oriented whereby the sensitized material traversing said curved path makes contact with each roller, hold-down means at the ends of said curved path, spaced from said rollers and adapted to hold the sensitized material against the rollers as it traverses said curved path, means feeding processing liquid to each of said tubes, and means for drawing the sensitized material through said apparatus whereby the material is caused to follow said curved path.

4. A processing apparatus for sensitized material comprising a plurality of tubes, each adapted to contain a processing liquid and each having a longitudinal slot therein, an applicator roller mounted within each tube and projecting through the longitudinal slot therein to substantially fill the slot opening while providing a slight clearance between the sides of the slot and the roller, said tubes being arranged transversely about an arcuate path and being oriented whereby the sensitized material traversing said arcuate path makes contact with each roller, a sump over which said tubes are so arranged, deflectors positioned between certain of said tubes to intercept any excess liquid which may drip from a tube positioned above it and return such excess liquid to said sump, hold-down rollers located at the ends of said arcuate path spaced from said applicator rollers and adapted to hold the sensitized material against the applicator rollers as it traverses said arcuate path, means for circulating processing liquid between the sump and the plurality of tubes, and means for drawing the sensitized material through said apparatus whereby the material is caused to follow said arcuate path.

5. A processing apparatus for sensitized material comprising a plurality of tubes, each adapted to contain a processing liquid and each having a longitudinal slot therein, a roller mounted within each tube and projecting through the longitudinal slot therein to substantially fill the slot opening while providing a slight clearance between the sides of the slot and the roller, means secured at each end of each tube functioning simultaneously as closures for the tube and as supports for the ends of the roller mounted therein, openings in said closure means, a sump, means including a pump adapted to circulate processing liquid between said sump and each tube through the openings in said closure means, said tubes being arranged transversely above said sump along an upwardly bowed path and being oriented whereby the

sensitized material traversing said path makes contact with each roller, hold-down means at the ends of said path adapted to hold the sensitized material against the rollers as it traverses said path, and means for moving the sensitized material along said path.

6. A processing apparatus for sensitized material comprising a plurality of tubes, each adapted to contain a processing liquid and each having a longitudinal slot therein, a roller rotatably mounted within each tube and being positioned eccentrically relative thereto whereby it projects partly through said slot to substantially fill the slot opening, the clearance between the sides of said slot and the roller being such that the latter will carry as it rotates a film of liquid from within the tube past the slot opening, a sump, said tubes being arranged transversely above said sump along an upwardly bowed path and being oriented whereby the sensitized material traversing said path makes contact with each roller, hold-down means at the ends of said path adapted to hold the sensitized material against the rollers as it traverses said path, means for circulating liquid between the sump and each of the plurality of tubes, and means for drawing the sensitized material through said processing apparatus whereby the material is caused to follow said upwardly bowed path.

7. A processing apparatus for sensitized material comprising a plurality of tubes, each adapted to contain a processing liquid and each having a longitudinal slot therein, a roller rotatably mounted within each tube and being positioned eccentrically relative thereto whereby it projects partly through said slot to substantially fill the slot opening while providing a slight clearance between the sides of the slot and the roller, means secured at each end of each tube functioning simultaneously as closures for the tube and as supports for the ends of the roller therein, a sump, said tubes being arranged transversely above said sump along an upwardly bowed path and being individually oriented whereby the sensitized material traversing said path makes contact with each roller, hold-down means at the ends of said upwardly bowed path spaced from said rollers and adapted to hold the sensitized material against the rollers as it traverses said path, means including a pump for circulating liquid between the sump and each of the plurality of tubes, and means for drawing the sensitized material through said processing apparatus whereby the material is caused to follow said upwardly bowed path.

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