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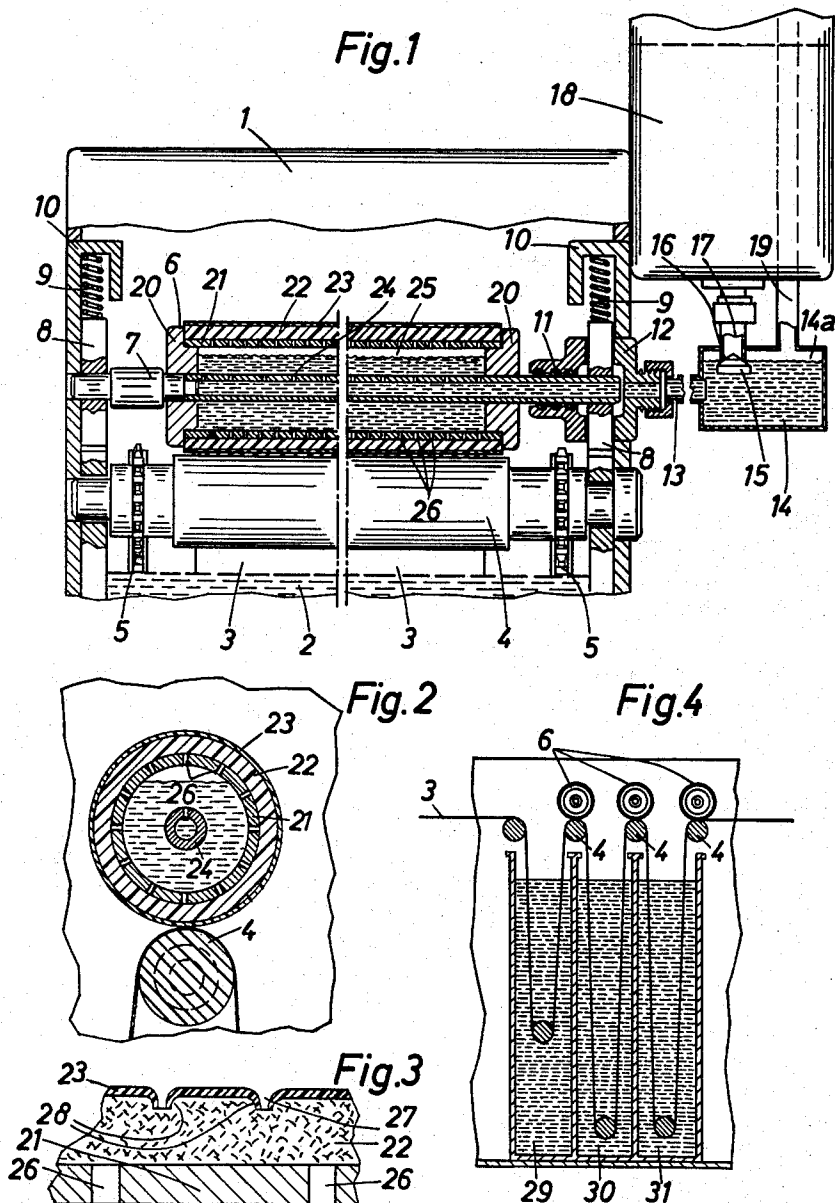
R. SCHWAB ETAL

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PHOTOGRAPHIC DEVELOPING MACHINE

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2 Sheets-Sheet 1



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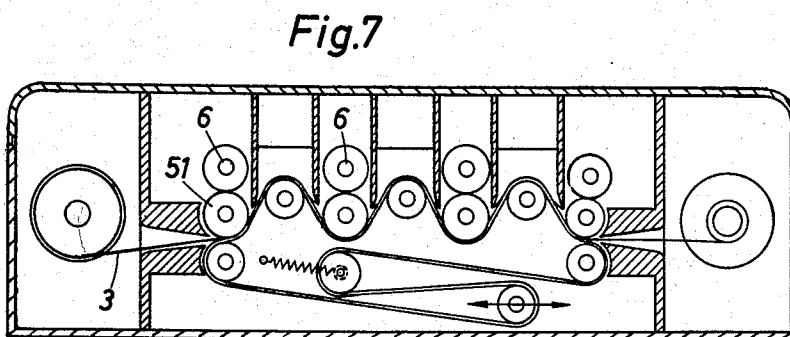
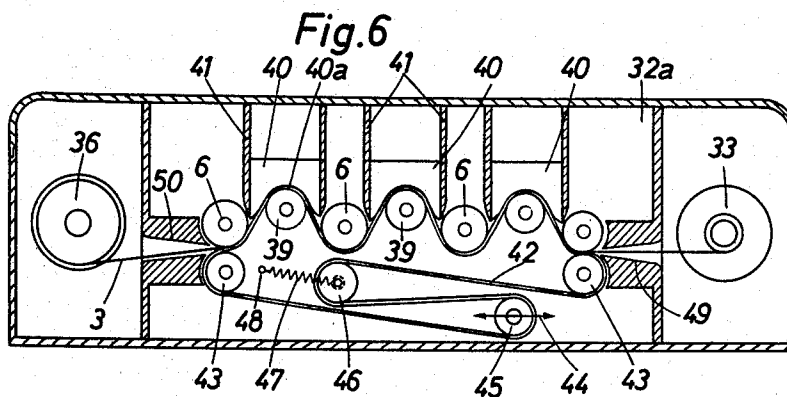
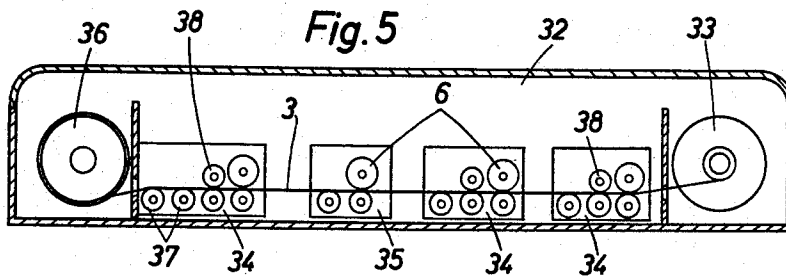
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PHOTOGRAPHIC DEVELOPING MACHINE

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6 Claims. (Cl. 95—89)

The present invention relates to the developing of light-sensitive materials.

In the developing of light-sensitive materials such as photographic printing paper, photographic film, and the like, the light-sensitive material has treating liquids applied thereto. At the present time these treating liquids unavoidably are exposed to the atmosphere and react with atmospheric oxygen so as to become crystallized. The formation of these crystals is a serious drawback in the art inasmuch as they prevent uniform distribution of the treating liquid to the light-sensitive material and thus result in non-uniform developing.

It is accordingly one of the objects of the present invention to provide a structure which exposes very little of the treating liquid to the atmosphere and which enables those crystals which do form to be quickly washed away during a short period of time when the operations are started.

Furthermore, the objects of the invention include the provision of an extremely compact structure capable of being incorporated without difficulty into existing developing machines without increasing the length thereof to provide liquid treatments in addition to those conventionally provided.

Another object of the present invention is to provide a structure which will automatically regulate the flow of treating liquid to the light-sensitive material.

An additional object of the present invention is to provide a structure of the above type which is so reliable in operation that no maintenance or supervision is required.

It is also an object of the present invention to provide a structure capable of accomplishing the above objects and at the same time composed of simple rugged elements which enable the structure of the invention to be provided at an extremely low cost.

Still another object of the present invention is to provide a structure having components capable of being adjusted for controlling the treatment times of the various treating liquids.

With the above objects in view, the invention includes, in a machine for developing light-sensitive materials, a hollow cylinder having a perforated cylindrical wall. A means is provided to support the hollow cylinder for rotary movement about its axis. A layer of felt surrounds and engages the perforated cylindrical wall of the hollow cylinder. A cylindrical, yieldable, perforated, plastic sheet surrounds and engages the layer of felt, so that a treating liquid supplied to the interior of the hollow cylinder will flow through the perforated wall thereof into the layer of felt and from the latter through the perforations of the plastic sheet to the exterior surface of the latter to be applied to light-sensitive material engaging the exterior surface of the cylindrical plastic sheet.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

2

FIG. 1 is a fragmentary transverse view of a developing machine, the section of FIG. 1 extending longitudinally through a treating roll according to the invention to illustrate the details thereof, FIG. 1 also showing diagrammatically a supply means for supplying treating liquid to the treating roll of FIG. 1;

FIG. 2 is a fragmentary view showing in transverse section the treating roll of the invention;

FIG. 3 is a fragmentary longitudinal section, on an enlarged scale as compared to FIG. 1, showing the wall structure of the treating roll of the invention;

FIG. 4 is a diagrammatic illustration of the manner in which the treating rolls of the invention are incorporated into a tank-type developing machine;

FIG. 5 is a diagrammatic illustration of one type of treating roll developing machine according to the present invention;

FIG. 6 diagrammatically illustrates a second embodiment of a roll-type developing machine according to the invention; and

FIG. 7 shows diagrammatically a third embodiment of a roll-type developing machine according to the invention.

Referring to FIG. 1, there is shown therein a conventional tank-type developing machine 1 into which the structure of the invention is incorporated. The machine 1 includes a plurality of baths 2 through which a strip 3, carrying light-sensitive material, is guided. The machine 1 includes a plurality of guide rolls 4 which serve to guide the strip 3 through the several baths 2. The guide rolls 4 are supported for rotary movement by the side walls of the machine, and each guide roll 4 carries adjacent its ends sprocket wheels so that a pair of endless sprocket chains 5 respectively located at both sides of the machine may be guided over these sprocket wheels to turn the guide rolls any one of which may be driven from a suitable motor so as to be rotated and so as to transmit the drive through the chains 5 to the remaining guide rolls, and in this way the strip 3 is transported through the several tanks. An unillustrated conventional bar extends between and is carried by the chains 5 for movement therewith, and this bar carries a conventional clamp which grips an end of the strip 3 to pull the latter through the tanks.

A treating roll means 6 according to the present invention is shown in FIG. 1 located over one of the guide rolls 4 closely adjacent and parallel thereto. The treating roll means 6 includes a hollow cylinder composed of the end walls 20 and the cylindrical wall 21 fixed to and extending between the end walls 20 and formed with the perforations 26 which are distributed throughout the cylindrical wall 21. The end walls 20 are axially bored and a shaft 7 extends fluid-tightly through the axial bores of the end walls 20, and the shaft 7 may be fixed to the end walls 20. The shaft 7 is hollow at its portion extending beyond the left end wall 20 of FIG. 1, and the hollow portion of the shaft 7 within the cylinder 20, 21 is formed with perforations 24.

A means is provided to support the cylinder 20, 21 for rotation about its axis, and this means includes in addition to the shaft 7 the bearing blocks 8 which are formed with bores through which the shaft 7 turnably extends and which support the shaft 7 and thus the cylinder 20, 21 for rotary movement. The side walls of the machine 1 are formed with vertical guide-ways in which the blocks 8 are guided for vertical movement, and springs 9 press downwardly on the blocks 8 to urge them downwardly. The side walls of the machine 1 fixedly carry brackets 10 which engage the upper ends of the springs 9 so as to maintain the latter under compression. With this arrangement the treating roll means 6 is yieldably urged downwardly toward the guide roll 4 shown in FIG. 1, but at the same

3

time the treating roll means can yield upwardly in opposition to the springs 9 when the above-mentioned bar and clamp pass between the guide roll 4 and the treating roll means 6. The connection of the hollow shaft 7 to the right block 8 of FIG. 1 is maintained fluid-tight by a suitable sealing gland 11. A tubular member 12 has at its left end, as viewed in FIG. 1, an annular flange fixed as by welding or the like to the right face of the right block 8 of FIG. 1 in a fluid-tight manner, and this flange of the tubular member 12 surrounds the open end of the hollow shaft 7. The tubular member 12 is connected fluid-tightly to a flexible conduit 13 so that the member 12 can move vertically with the right block 8 of FIG. 1.

A supply means is provided for supplying treating liquid to the interior of the cylinder 20, 21, and this supply means includes in addition to the hollow interior of shaft 7 and its perforations 24 and in addition to the tubular member 12 and the conduit 13, a chamber 14 and a tank 18 communicating with the chamber 14 through the conduit 17 which is fixed to the tank 18 and the chamber 14. Any suitable structure such as the side wall of the machine 1 supports the tank 18. A valve means cooperates with the supply means for automatically regulating the flow of treating liquid to the treating roll means 6, and in the illustrated preferred example this valve means takes the form of a float valve 15 guided for vertical movement coaxially with the tube 17 by an unillustrated conventional guiding structure and cooperating with the valve seat 16 formed by the bottom end of the conduit 17. When the treating liquid which flows from the tank 18 through the conduit 17 into the chamber 14 reaches in the latter, and thus in the cylinder 20, 21, the level shown in FIG. 1 the float valve 15 engages the seat 16 to close the conduit 17 and thus terminate the flow of treating liquid from the tank 18. As the treating liquid is consumed its level in the chamber 14 and cylinder 20, 21 will become lower so that the valve 15 will move down and additional treating liquid will flow from the tank 18. The space 14a above the liquid in the chamber 14 communicates through a vertically extending tube 19 with the outer atmosphere.

The treating roll means 6 includes in addition to the hollow perforated cylinder 20, 21 a layer of felt 22 which surrounds and engages the perforated cylindrical wall 21 and which extends between the end walls 20 which are fixed to the cylindrical wall 21, this layer of felt 22 being, for example, a material known under the trade name Vlieselin. A yieldable cylindrical plastic sheet 23 surrounds and engages the layer of felt 22 and is formed with perforations 27 distributed throughout the cylindrical sheet 23.

The treating liquid, which may be a regenerating or recovery liquid, which reaches the interior of the hollow shaft 7 flows through the perforations 24 thereof into the interior of the cylinder 20, 21 and through the perforations 26 of the cylinder 21 into the layer of felt 22. From the latter the liquid flows through the perforations or holes 27 to the exterior surface of the cylindrical plastic sheet 23. The perforations 26 are uniformly distributed over the cylindrical wall 21 and have a size of between 0.3 and 3 mm. A size of approximately 1 mm. is preferred. The perforations 27 are uniformly distributed over the sheet 23 and have a size of between 0.05 and 0.5 mm., and in this case a size of 0.1 mm. is preferred. The parts 7, 20 and 21 may be made of known plastic materials which are insensitive to the particular treating liquid. The cylindrical sheet 23 may be made from a plastic material selected from the group consisting of Cellit, i.e. cellulose acetate, polypropylene, and polycarbonate, and has a thickness of between 0.05 and 0.5 mm., a thickness of 0.10 mm., being preferred. This particular material while being strong and wear-resistant is at the same time extremely flexible and can adapt itself to any configuration. Thus, the above-mentioned bar and clamp can engage the sheet 23 and deform the same without causing any injury to the sheet 23. The size of the interstices in the layer

4

of felt and of the perforations or holes 27 are suited to the viscosity of the particular treating liquid. The perforations or holes 27 are formed by inwardly struck portions of the sheet 23 which form the short tubular inwardly directed projections 28 shown in FIG. 3 defining perforations or holes 27. The tubular projections 28 extend into the layer of felt 22 to fix the latter to the sheet 23. The springs 9 and blocks 8 cooperate with the roll 4 to provide a radial pressure on the treating roll means 6 to press at least the treating liquid in the perforations or holes 27 out of the latter so that the treating liquid becomes distributed along the exterior surface of the sheet 23 to be received from this exterior surface by the light-sensitive layer engaging this surface.

As may be seen from FIG. 4, the several guide rolls 4 are arranged so as to form a guide means guiding the strip 3 along the path indicated diagrammatically in FIG. 4. A plurality of treating tanks 29-31 and treating roll means 6 are distributed along this path with the plurality of treating roll means 6 alternating along the path of movement of the strip 3 with the tanks 29-31 so that before moving from one tank to the next the light-sensitive layer carried by the strip 3 will engage a treating roll means 6. The several tanks 29-31 may respectively contain a developing bath, a hypo or fixing solution, and a rinsing solution. The roll means 6 between the tanks 29 and 30 may apply a short stop treating liquid, the roll means 6 between the tanks 30 and 31 may apply a hardening solution, and the roll means 6 shown at the right in FIG. 4 may apply a wetting agent. A tank-type developing machine which conventionally can provide only three treatments can thus be easily converted with the structure of the invention so as to provide three further treatments. It is only necessary to mount the several treating roll means 6 in the manner described above and shown in FIG. 1 in order to convert a conventional tank-type developer to the structure shown diagrammatically in FIG. 4.

FIG. 5 diagrammatically illustrates a roll-type developer constructed according to the present invention and guiding the strip 3, which carries the light-sensitive layer, along a straight line from the supply spool 33 to the take-up spool 36 which may be driven in any suitable way to pull the strip 3 from the supply roll unto the take-up spool. The light-sensitive layer carried by the strip 3 is located at the upper side of the substantially straight portion of the strip 3 extending between the spools 33 and 36. Along the path of movement of the strip 3 are arranged three roll assemblies 34 which are adjustably movable in any suitable way along the path of movement of the strip 3 and a fourth roll assembly 35 which is stationary. Each of the roll assemblies 34, 35 includes a plurality of guide rolls 37 engaging the underside of the strip 3 and at least one treating roll means 6 having the structure described above and communicating in the same way with the supply means for the treating liquid. The assemblies 34 may include additional pressure rolls 38. Of course, the treating rolls 6 of the several assemblies are urged downwardly by the spring means 8, 9 described above. The several assemblies 34 are supported by unillustrated horizontal guides which support the several assemblies 34 for horizontal shifting movement independently of each other, these assemblies then being releasably fixed in their adjusted positions, so that in this way it is possible to regulate the distance between all of the roll assemblies and thus regulate the treating time of the treating liquids.

According to the embodiment of the invention diagrammatically illustrated in FIG. 6, the roll-type developing machine 32a includes a plurality of treating roll means 6 which are yieldably urged downwardly in the manner described above in connection with FIG. 1 but which cannot move to the right or left, as viewed in FIG. 6. A plurality of guide rolls 39 alternate with the treating rolls 6, and each guide roll 39 is supported for rotary movement by a carriage or slide 40. Each slide 40 has

5

at its ends downwardly directed ears which turnably carry the guide roll 39, and the bottom face 40a of each slide portion is spaced slightly from the surface of the guide roll 39 over approximately the upper half thereof in the manner shown diagrammatically in FIG. 6. Stationary guides 41 cooperate with the slides 40 to guide the latter for vertical movement so that it is possible to adjust the elevations of the guide rolls 39, and the slides 40 may be releasably fixed in any suitable way at their adjusted elevations.

An endless belt 42 is guided around the rolls 6 and 39 as well as around a pair of rolls 43 having stationary axes. The belt 42 also passes around a guide roll 45 which is horizontally shiftable so that it can be adjustably fixed in a desired horizontal position, and the belt is also guided around a horizontally shiftable roll 46 urged to the left, as viewed in FIG. 6, by one or two springs 47 connected to the shaft which carries the roll 46 and to a stationary bar 48 so that the spring means 47 maintains the belt 42 tensioned while at the same time it is possible to move the rolls 39 vertically while the belt 42 yields. By adjusting the vertical positions of the rolls 39 it is possible to control the several treatment times. A guide 49 guides the strip 3 with the upwardly directed light-sensitive layer carried thereby from the supply spool 33 to the belt 42 while a guide 50 guides the strip from the last treating roll means 6 to the take-up spool 36. The roll 45 may be shifted to adjust the tension of the spring means 47 so that there is a sufficient amount of the belt 42 to accommodate any desired elevations of the rolls 39. The guides 41 in addition to guiding the slides 40 also guide the strip 3. The belt 42 may be driven in any suitable way and instead of the mechanical guides it is possible to provide other devices for causing the strip 3 to cling to the belt 42 so as to move therewith.

The developing machine illustrated diagrammatically in FIG. 7 is identical with that of FIG. 6 except that the treating roll means 6 include in addition to the structure described above distributing rolls 51 which engage frictionally the outer plastic perforated sheets 23 to receive the treating liquid therefrom and to transfer the treating liquid with even greater uniformity to the light-sensitive material.

The above-described structure of the invention is primarily intended for the development of photographic paper. It can also be used, however, in the same way for the development of film and is suitable for black-and-white or color developing processes, and in particular for reversal development.

As compared to conventional tank-type developing machines, the manufacturing cost of roll-type developing machines according to the invention is reduced by approximately 50%. All of the rolls occupy only a small amount of space and are easily accessible. Above all, the consumption of treating liquids is relatively small. Only fresh solutions are applied to the light-sensitive material so that the developing and treatment is always uniform. Servicing and checking of the installation for proper operation is practically unnecessary.

Instead of an automatic float valve means, which is preferred, it is also possible to use a known metering device which delivers an amount of treating liquid according to the speed of movement of the paper.

It will be noted that in the case of FIGS. 1 and 4 where a conventional tank-type machine has been converted to use the treating roll means of the invention, these treating roll means do not require any additional drives.

The liquid in the layer of felt 22 distributes itself approximately circularly about the perforations or holes of the sheet 23 and after a relatively small number of revolutions of the treating roll means 6 the treating liquid is distributed substantially uniformly over the exterior surface of the plastic sheet 23. This distribution is dependent upon the size and number of perforations

6

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of developers differing from the types described above.

While the invention has been illustrated and described as embodied in photographic developers, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. For use in a machine for developing light-sensitive materials, in combination, a hollow cylinder having a cylindrical wall formed with perforations having a diameter of between 0.3 and 3 mm.; means supporting said cylinder for rotation about its axis; a layer of felt covering said cylinder wall; and a cylindrical, plastic, yieldable sheet surrounding and engaging said layer of felt and having inwardly extending, short tubular portions extending into the layer of felt and defining perforations which pass through the plastic sheet and having a diameter of between 0.05 and 0.5 mm., so that a treating liquid supplied to the interior of said cylinder will flow through the perforated wall thereof to the layer of felt and from the latter through the perforations in said plastic sheet to the exterior surface thereof to be applied to a light-sensitive material engaging said sheet.

2. For use in a machine for developing light-sensitive materials, in combination, a hollow cylinder having a perforated cylindrical wall; means supporting said cylinder for rotation about its axis; a layer of felt covering said cylindrical wall; and a yieldable, cylindrical plastic sheet pierced with holes and surrounding and engaging said layer of felt and having inwardly extending, short tubular portions extending into the layer of felt and defining perforations which pass through the plastic sheet, said plastic sheet being made from a plastic material selected from the group consisting of cellulose acetate, polypropylene, and polycarbonate, said sheet having a thickness of between 0.05 and 0.5 mm., whereby a treating liquid supplied to the interior of said cylinder will flow through the perforated wall thereof into the layer of felt and from the latter through the perforated, cylindrical, plastic sheet to the exterior surface thereof to be applied to a light-sensitive material engaging the exterior surface of said sheet.

3. For use in a machine for developing light-sensitive materials, in combination, a hollow cylinder having a perforated cylindrical wall; means supporting said cylinder for rotation about its axis; a layer of felt covering said cylindrical wall; and a yieldable, plastic, cylindrical sheet surrounding and engaging said layer of felt and having inwardly extending, short tubular portions extending into the layer of felt and defining perforations which pass through the plastic sheet so that a treating liquid supplied to the interior of said cylinder will flow through the perforated cylindrical wall thereof into said layer of felt and from the latter through the tubular portions of said sheet to the exterior surface thereof to be applied to light-sensitive material engaging the exterior surface of said sheet.

4. For use in a machine for developing light-sensitive materials, in combination, a hollow cylinder having a perforated cylindrical wall; a hollow perforated shaft extending coaxially through and carrying said cylinder; a layer of felt surrounding and engaging said cylindrical

7

wall of said cylinder; a yieldable, plastic, cylindrical sheet surrounding and engaging said layer of felt and having inwardly extending, short tubular portions extending into the layer of felt and defining perforations which pass through the plastic sheet; and supply means communicating with the interior of said shaft for supplying thereto a treating liquid which flows through the perforations of said shaft into said cylinder and through the perforated wall thereof into said layer of felt to flow from the latter through the perforations in said plastic sheet to the exterior surface thereof to be applied to light-sensitive material engaging said exterior surface of said plastic sheet.

5. For use in a machine for developing light-sensitive materials, in combination, a hollow cylinder having a perforated cylindrical wall; a hollow perforated shaft extending coaxially through and carrying said cylinder; a layer of felt surrounding and engaging said cylindrical wall of said cylinder; a yieldable, plastic, cylindrical sheet surrounding and engaging said layer of felt and having inwardly extending, short tubular portions extending into the layer of felt and defining perforations which pass through the plastic sheet; supply means communicating with the interior of said shaft for supplying thereto a treating liquid which flows through the perforations of said shaft into said cylinder and through the perforated wall thereof into said layer of felt to flow from the lat-

8

ter through the perforations in said plastic sheet to the exterior surface thereof to be applied to light-sensitive material engaging said exterior surface of said plastic sheet; and automatic valve means cooperating with said supply means for regulating the flow of treating liquid from said supply means to said shaft.

6. The combination of claim 5 and wherein said automatic valve means is a float valve means.

References Cited by the Examiner

UNITED STATES PATENTS

989,685	4/11	Zittle et al.	118—258
1,147,161	7/15	Goldsmith	118—244 XR
1,570,857	1/26	Perkins	118—258
1,847,833	3/32	Horst	95—94
2,125,206	7/38	Stobb	118—258 X
2,217,552	10/40	Horton	29—115
2,464,040	3/49	Huebner	118—258
2,781,192	2/57	Gilfillan.	
2,926,628	3/60	Black et al.	118—244
2,928,329	3/60	Limbach	95—94

FOREIGN PATENTS

821,088 9/59 Great Britain.

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