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Schranz et al.

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[54] **APPARATUS FOR DEVELOPING EXPOSED LIGHT-SENSITIVE SHEETS**

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[51] **Int. Cl.**.....**G03d 5/06**

[58] **Field of Search** ...95/89 R, 89 A, 94 R; 118/110, 118/118, 119

[56] **References Cited**

UNITED STATES PATENTS

3,313,913	4/1967	Limberger	95/89 R X
3,465,663	9/1969	Calder	95/89 A
3,330,196	7/1967	Chen et al.	95/89 R
3,477,356	11/1969	Ray et al.	95/89 R X

FOREIGN PATENTS OR APPLICATIONS

1,066,913	4/1967	Great Britain	95/94 R
387,781	2/1933	Great Britain	95/94 R
371,276	3/1907	France	95/94 R

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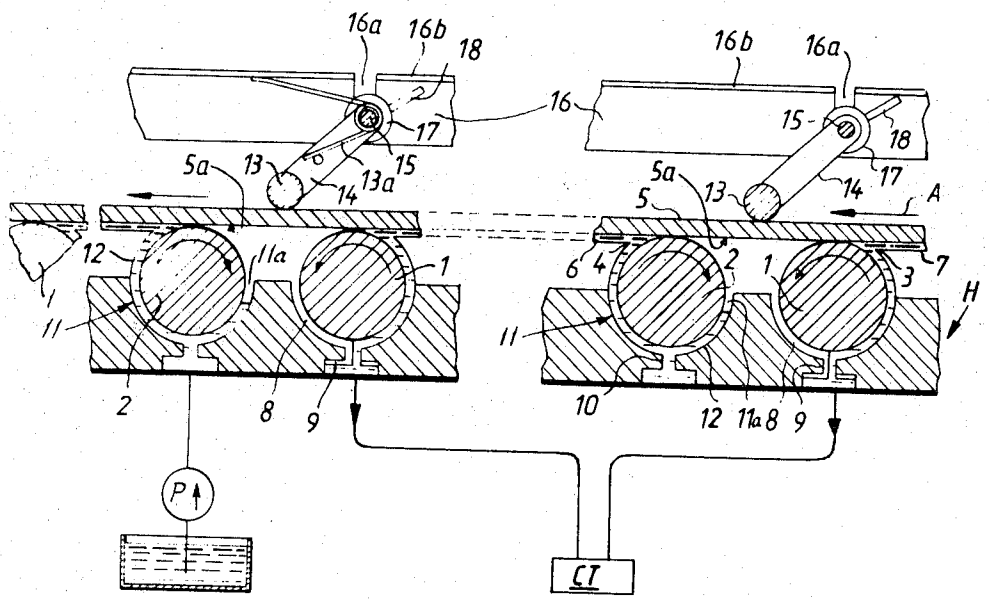
[57] **ABSTRACT**

A developing apparatus for light sensitive emulsions at the undersides of sheets which are transported in a horizontal plane has alternating liquid applying and liquid removing rollers which respectively coat the undersides of sheets with layers of a liquid developer and remove such layers from the sheets. The sheets are biased against the rollers by idler rollers which rest by gravity on the upper sides of the sheets. The liquid applying and liquid removing rollers rotate in opposite directions at peripheral speeds which exceed the forward speed of the sheets by at least 10 percent.

19 Claims, 3 Drawing Figures



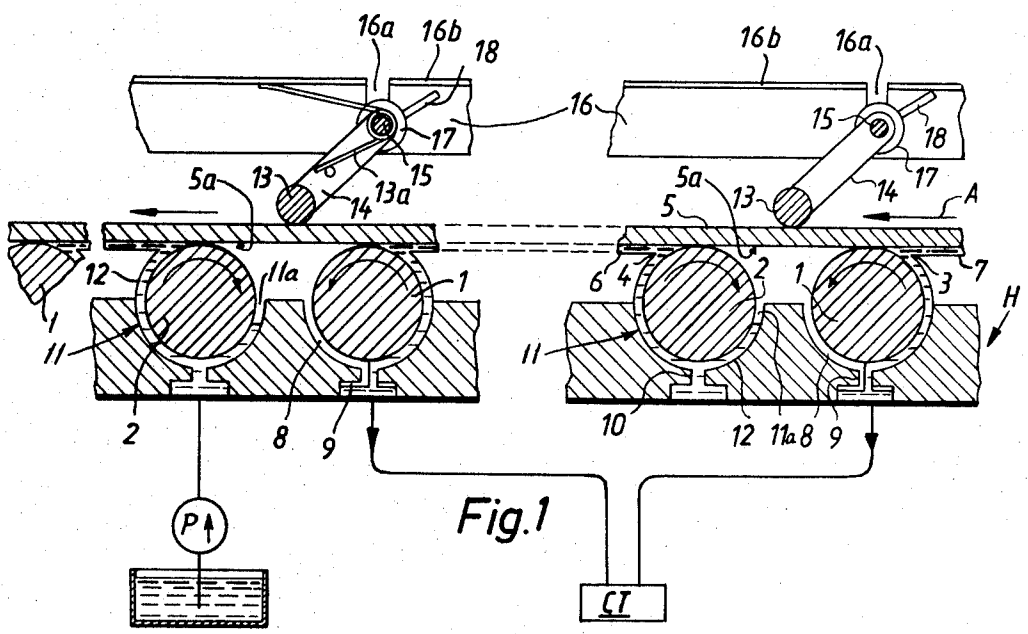


Fig.1

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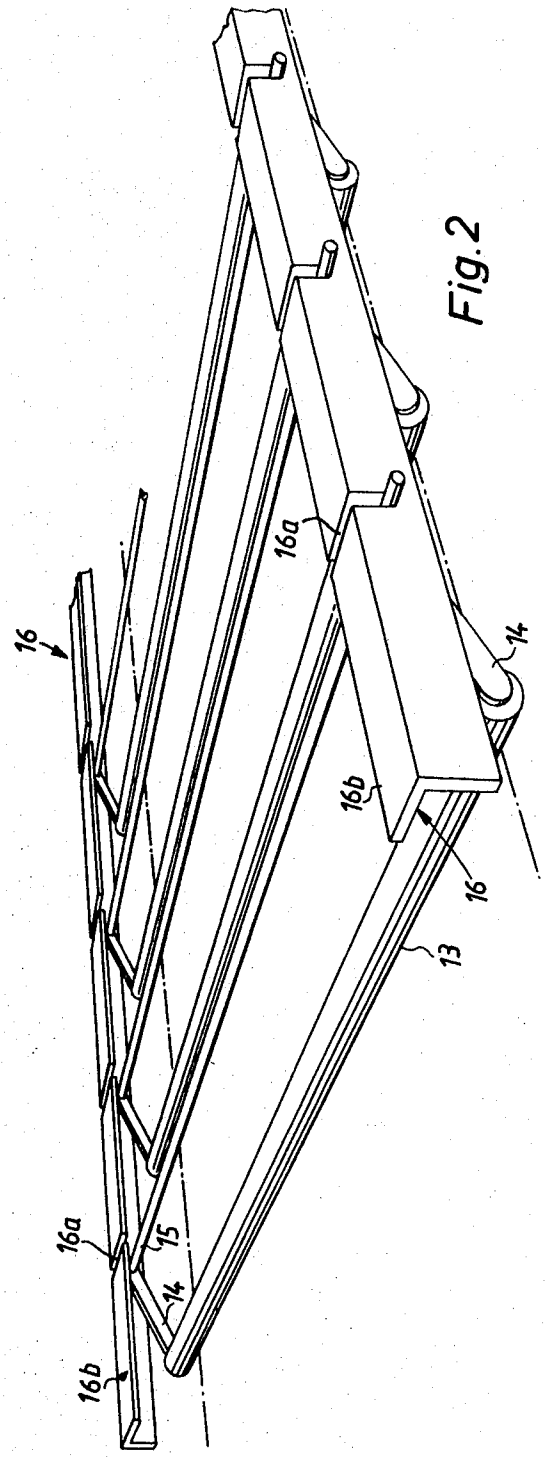

Fig. 2

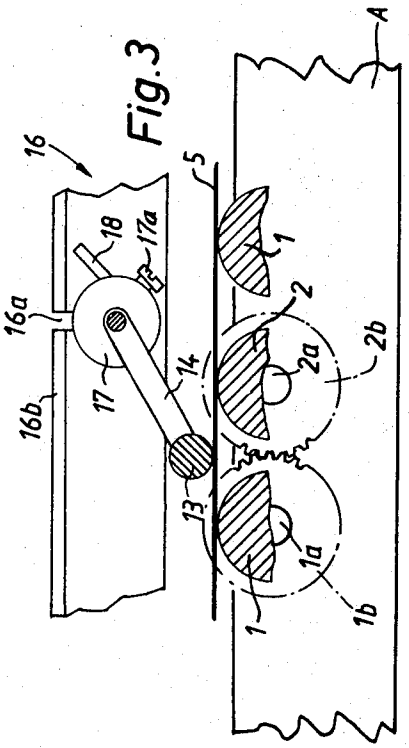

Fig. 3

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APPARATUS FOR DEVELOPING EXPOSED LIGHT-SENSITIVE SHEETS

CROSS-REFERENCE TO RELATED APPLICATION

The apparatus of the present invention can be utilized in machine of the type disclosed in the commonly owned copending application Ser. No. 157,572 filed July 5, 1971 by Wolfgang Hunicke et al. and entitled "-Machine for Wet Treatment of Elongated Strip-Shaped Carriers for Light Sensitive Material."

BACKGROUND OF THE INVENTION

The present invention relates to improvements in apparatus for controlled application of liquids to travelling sheets, and more particularly to improvements in liquid treatment of sheets which carry films, layer or coats of light sensitive material. Still more particularly, the invention relates to improvements in apparatus which can be used for controlled developing of light sensitive materials on photographic films or analogous sheet-like carriers.

It is already known to transport sheets which carry emulsions of exposed light sensitive material through a developing apparatus at a constant speed and to contact the exposed light sensitive material with a liquid which is being applied by one or more roller-shaped members. Such roller-shaped members can be driven to rotate in or counter to the direction of transport of the sheet. An advantage of such apparatus is that the consumption of liquid developing agents is much lower than in earlier apparatus wherein the entire sheet is caused to pass through a liquid bath. Moreover, the intervals which are required for the drying of sheets are much shorter than in apparatus wherein the entire sheet is dipped into a developing solution. Still further, such apparatus are much more economical in connection with those treatments which necessitate contacting each successive sheet with a fresh developing liquid, for example, in a relatively small developing plant wherein a fresh supply of developing agent is used for each of a succession of sheets. Also, the liquids are subjected to a desirable agitating or stirring action prior to application to the exposed emulsion.

A drawback of presently known apparatus wherein the application of one or more types of liquid treating media to light sensitive materials which are provided on the surface of travelling sheets is carried out by means of rollers is that the consumption of liquid agents is still too high, especially in relatively large continuously operating developing apparatus. Furthermore, the recovery of liquids which are removed from the sheets is costly, incomplete and non-uniform.

SUMMARY OF THE INVENTION

An object of the invention is to provide a compact, simple, inexpensive and versatile apparatus which can be used for developing of exposed light sensitive emulsions on travelling sheets, such as panels or photographic film, webs or strips of photographic film or the like.

Another object of the invention is to provide a developing apparatus which can process large quantities of light sensitive material per unit of time with a high degree of uniformity, which consumes relatively small quantities of developing and other liquid treating agents, and which can be used for carrying out simple or complicated treatments of exposed light sensitive materials, such as the treatment of black-and-white or color films and/or others.

A further object of the invention is to provide novel means for removing liquid treating media from light sensitive materials on sheets which travel through a developing apparatus of the type wherein the liquid is applied to light sensitive material by means of one or more rollers.

An additional object of the invention is to provide the apparatus with novel means for regulating the consumption of developing and/or other liquid agents in a simple and time-saving manner.

Another object of the invention is to provide a developing apparatus which insures that the reproducibility, color brilliancy and/or gradation of developed films is superior to that of films which are treated in conventional apparatus.

The improvement resides in a combination which is embodied in an apparatus for treating sheet-like materials with liquids, particularly for treating exposed light sensitive emulsions with a developing agent, wherein the sheet-like materials are conveyed in a predetermined (preferably horizontal) plane and at a predetermined (preferably constant) speed. The combination comprises a source of liquid adjacent to one side of the plane for the sheet-like material (preferably adjacent to the underside of such plane), at least one rotary roller-shaped applicator member dipping into the source and contacting one surface of the travelling sheet-like material to transfer to such surface a layer of liquid, at least one rotary roller-shaped liquid removing member located past the one applicator member and having a peripheral surface contacting the one surface of sheet-like material to remove at least some of the liquid layer, and drive means for rotating the removing member at a peripheral speed which deviates from (and preferably exceeds) the speed of sheet-like material.

The combination preferably further comprises one or more idler rollers or analogous biasing means engaging the other surface of sheet-like material to urge the latter against the roller-shaped members.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims.

The improved developing apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary longitudinal vertical sectional view of a developing apparatus which embodies the invention;

FIG. 2 is a fragmentary perspective view of the upper portion of the developing apparatus shown in FIG. 1; and

FIG. 3 is an enlarged view of a detail in the apparatus of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates a sheet 5 which is transported along a substantially straight path located in a horizontal plane and in the direction indicated by arrow A. The sheet 5 is assumed to be transported lengthwise at a constant speed by being attached to a suitable conveyor, not shown, or by a pair of advancing rolls at the discharge end of the apparatus. The underside of the sheet 5 is provided with a thin film of light sensitive material which was exposed to light and is to be treated in order to develop the latent image. The lower surface of the right-hand portion of the sheet 5 is coated with a layer 7 of a liquid developing agent which overlies the light sensitive material and was applied thereto by a roller-shaped applicator member (not shown) similar to the applicator members 2. At least the major part of the liquid layer 7 is removed from the lower surface of the travelling sheet 5 by a roller-shaped removing member 1 which is driven to rotate in a counterclockwise direction, as viewed in FIG. 1. The members 1 and 2 are rotatably mounted in a common bearing block 1A and are driven at identical speeds but in opposite directions by a drive including the shafts 1a, 2a and mating gears 1b, 2b (see FIG. 3).

It is preferred to employ roller-shaped members 1, 2 of relatively small diameters (preferably in the range between 1–5 centimeters). This is advisable in order to avoid undue lengthening of the path for the sheet 5 because the distances between the points of contact between the lower surface of the sheet 5 and the peripheral surfaces of adjoining roller-shaped members 1, 2 can be held to a minimum. Note the short uncoated portions 5*a* of the lower surface of the sheet 5 between the right-hand and left-hand members 1, 2 of FIG. 1. On the other hand, the distance between an applicator member 2 and the next-following liquid removing member 1 (as considered in the direction of travel of the sheet 5) can be selected at will in order to insure satisfactory treatment of the light-sensitive material by the developing liquid. Thus, the distance between the right-hand applicator member 2 and the left-hand liquid removing member 1 of FIG. 1 can be a multiple of the length of an uncoated portion 5*a*. The number of applicator members 2 and liquid removing members 1 depends on quantities of liquid which must be applied to the underside of the sheet 5 in several stages for completion of the chemical process. In many instances, a single application or two successive applications of liquid will suffice to complete the developing treatment.

Another advantage of roller-shaped members 1, 2 with relatively small diameters in the range between 1–5 centimeters is that the height of the developing apparatus can be reduced to a minimum, for example, to about three times the diameter of a member 1 or 2. The members 1, 2 respectively extend into a trough-shaped source 8 of developing liquid 12 and into a trough or collecting receptacle 11. The troughs 8 and 11 are preferably bounded by concave surfaces having their centers of curvature located on the axes of the respective roller-shaped members 1 and 2. The troughs 11 for the members 2 receive fresh developing liquid 12 by way of supply channels 10, preferably from a common main source, not shown. The troughs 8 for the members 1 communicate with evacuating channels 9 which deliver the removed liquid to a common collecting tank CT. The layer of liquid 12 which is applied by the right-hand applicator member 2 of FIG. 1 is shown at 6. Portions of troughs 8 for the liquid removing members 1 are empty. The volume of the space in the trough 11 which is filled with developing liquid 12 is relatively small; this is desirable especially if the developing apparatus comprises a single applicator member 2 or a small number of applicator members 2 because the volume of liquid 12 in the trough 11 should be small in relation to the volume of liquid which is supplied to the trough 11 per unit of time. This reduces the likelihood of high concentrations of reaction products which would necessitate a regeneration of the liquid 12. As a rule, the difference between the radius of the applicator member 2 and the radius of curvature of the concave surface surrounding the trough 11 is very small, for example, between 0.5–5 millimeters.

The liquid-removing action of the roller-shaped members 1 is enhanced considerably if the lower surface of the travelling sheet 5 is biased against such members with a relatively small force which cannot result in damage to the light sensitive emulsion. The biasing means of the illustrated apparatus comprises several idler rollers 13 which are rotatable in pairs of inclined arms 14 and are pivotable with the respective arms 14 about the axes of rigid horizontal shafts 15 so that their peripheral surfaces rest on the upper surface of the sheet 5 only by gravity. One idler roller 13 can be provided for each pair of roller-shaped members 1, 2 and each idler roller 13 is preferably located substantially midway between the associated roller-shaped members 1 and 2 (see FIG. 1). As best shown in FIG. 2, the end portions of shafts 15 extend beyond the respective arms 14 and are inserted into open slots 16a provided in a pair of parallel L-shaped rails 16 which form part of a supporting frame for the idler rollers 13 and are detachably supported by the side walls (not shown) of the housing H. The idler rollers 13 constitute an optional feature of the developing apparatus because, in many instances, the weight of the travelling sheet 5 suffices to insure satisfactory removal of liquid layers 7, 6 . . . by the roller-shaped members 1. In some instances, the idler rollers 13 can be biased against the upper surface of the sheet 5 by suitably dimensioned springs (e.g., by torsion springs one of which is shown at 13*a* in FIG. 1). The bias of the peripheral surfaces of idler rollers 13 against the upper surface of the sheet 5 should be selected with a view to avoid undesirable flexing of the sheet during travel along the roller-shaped members 1, 2. The axes of the members 1 and 2 are preferably parallel to the axes of the idler rollers 13 and to the axis of shafts 15 as well as to the plane of the sheet 5; this insures a highly desirable uniform application of liquid layers 7, 6 by the members 2 and uniform removal of such layers by the peripheral surfaces of the members 1.

In most instances, the bias of the idler rollers 13 against the upper surface of the travelling sheet 5 is very small. Thus, such bias should be small enough to avoid any changes in the area of contact between the lower surface of the sheet 5 and the peripheral surfaces of the roller-shaped members 1 and 2 in response to

fluctuations in tensioning of the sheet 5 by the conveyor means which moves the sheet in the direction indicated by the arrow A, even if such tensioning fluctuates within a very wide range. This reduces the likelihood of non-uniform treatment of different portions of light sensitive emulsion at the underside of the sheet 5.

The developing apparatus is further provided with stop means which prevents the idler rollers 13 from pivoting all the way into engagement with the peripheral surfaces of adjoining roller-shaped members 1 and 2. Such stop means may include disks 17 (see particularly FIG. 3) which can be separably or adjustably attached to the shafts 15 by screws 17*a* and cary projections 18 which are normally spaced from the horizontal flanges 16*b* of rails 16. The projections 18 move into abutment with the adjacent flanges 16*b* when the sheet 5 is removed from the developing apparatus and in response to slight pivotal movement of idler rollers 13 in a counterclockwise direction, as viewed in FIG. 3. Thus, the projection 18 engage the flanges 16 before the idler rollers 13 can contact the adjacent roller-shaped members 1 or 2. Each shaft 15 can carry a single disk 17 or a pair of such disks. Though the drawing shows that the idler rollers 13 are located between the associated roller-shaped members 1 and 2, it is equally within the purview of the invention to place the idler rollers upstream of the members 1, downstream of the members 2, or to provide additional idler rollers some of which are mounted in a manner and shown in the drawing and the others of which are mounted downstream of the members 2 or upstream of the members 1. It was found that the mounting of idler rollers 13 in a manner as shown in the drawing is particularly suited to insure that the sheet 5 is not deflected from its plane, especially if each roller-shaped applicator member 2 is closely adjacent to a member 1. The biasing action of idler rollers 13 is beneficial to the liquid-removing action of members 1 and also to the liquid applying action of members 2; it was found that the thickness of applied liquid layers 6, 7 is more uniform if the sheet 5 is biased against the members 2 with a relatively small force of unchanging magnitude.

The peripheral surfaces of roller-shaped members 1 and 2 are preferably smooth in order to avoid scratching of or other damage to light sensitive material at the underside of the sheet 5. In some instances, the peripheral surfaces of the members 1, 2 can be provided with channels or grooves which must be machined therein with a view to avoid damage to the light sensitive material and to insure satisfactory distribution of freshly applied liquid 12 (members 2) and uniform removal of liquid (members 1). At least those portions of the roller-shaped members 1 and 2 which are adjacent to the respective peripheral surfaces preferably consist of a hydrophobic material, such as tetrafluorethylene, which can be finished to a high degree of smoothness so that the slippage between the peripheral surfaces of the members 1, 2 and the sheet 5 does not adversely affect the light sensitive material.

The liquid removing and liquid applying characteristics of the roller-shaped members 1 and 2 depend to a certain extent on the configuration of menisci 3 and 4 which are respectively formed upstream of the line of contact between the sheet 5 and the member 1, and downstream of the line of contact between the sheet 5 and member 2 (see FIG. 1). The development of menisci 3, 4 and the opposite sides of lines of contact between the members 1, 2 and the sheet 5 is due to the fact that the members 1, 2 rotate in opposite directions. The light sensitive material at the underside of the sheet 5 rests directly on the peripheral surfaces of the members 1, 2 or is separated therefrom by a very thin film of liquid. The meniscus 3 represents a pileup or accumulation of liquid upstream of the zone where the liquid is being removed from the sheet 5 by the member 1 for transport into the trough 8. The meniscus 4 constitutes an accumulation of liquid which is being transferred to the sheet 5 by the member 2 to form the layer 6. The idler rollers 13 contribute to the formation of menisci 3 by biasing the sheet 5 against the members 1. That portion of the layer 7 which is removed by the right-hand liquid removing member 1 flows along the right-hand portion of the member 1 and enters the respective trough 8 to be evacuated by way of the corresponding channel 9. The peripheral speed for the members 1 should not substantially exceed the forward speed of the sheet 5 in order to insure that the separated liquid can flow along the periphery of the member 1 counter to the direction of rotation of this member and into the trough 8. Satisfactory results were achieved with liquid removing members 1 whose peripheral speed exceeds the forward speed of the sheet by at least 10 percent, for example, by 10–50 percent. Measurements of the quantities of liquid which was removed from a trough 11 for the formation of layers 7 and 6 and of the quantities of liquid which was removed by the next-following members 1 have shown that the members 1 are capable of removing almost the entire layer 6 or 7. This surprising efficiency of the removing members 1 is highly desirable in many types of developing operations wherein the light sensitive material must be repeatedly contacted with a fresh developing liquid.

The quantity of spent developing 12 depends almost entirely on the quantity of sheet material which is transported through the developing apparatus of the present invention. The quantity of spent liquid is approximately proportional to the speed and width of the sheets 5. The circulation of developing liquid 12 is reduced to zero when the sheet 5 is removed from the apparatus.

The consumption of developing liquid 12 further depends on the nature of photographic material which is being processed, on the composition of developing liquid, on the viscosity of developing liquid, on the pressure which is applied by the idler rollers 13 or by analogous biasing means, and on the number of liquid applying members 2 and liquid removing members 1 per unit length of the apparatus. The consumption of developing liquid increases with increasing bias of the rollers 13, with increasing viscosity of developing liquid and with increasing number of roller-shaped members 1 and 2. Therefore, the consumption of developing liquid can be regulated with a high degree of accuracy in response to appropriate changes in one or more of the just outlined parameters.

The optimum utilization of developing liquid 12 depends on the distance between a preceding liquid applying member 2 and the next-following liquid remov-

ing member 1, i.e., on the length of liquid layers 7 and 6. As a rule, the length of the foremost layer (7) or layers is less than the length of the next-following layer (6) or layers because the effect of developing liquid upon the light sensitive material is much more pronounced immediately after the material enters the apparatus, i.e., the reaction between the developing liquid and the light sensitive material is more rapid. Furthermore, the light sensitive material is capable of absorbing greater quantities of developing liquid immediately after it enters the apparatus. As the developing process progresses, the intervals which are required for complete exhaustion of the liquid layer in contact with the light sensitive material become longer. Thus, the extent to which the developing liquid is utilized for the purposes of developing the latent image depends on the selection of those portions of the sheet which are covered with developing liquid during transport form preceding liquid applying members 2 to the next-following liquid removing members 1. Of course, the length of layers 7, 6, etc., also depends on the temperature in the interior of the apparatus, on the quantities of developing liquid which is being applied by the members 2, and on the capacity of light sensitive material to absorb the liquid.

Such construction of the drive means (including the parts 1*a*, 2*a*, 1*b*, 2*b*) for the members 1, 2 that the members are rotated at identical speeds is preferred in many instances because the drive means is much simpler than if each of the members 1, 2 were to be driven at a different speed. As a rule, the drive means will employ a common drive shaft which can transmit torque by way of one or more worms or worm wheels. A worm or a worm wheel can be provided directly on the drive shaft.

In order to insure that the apparatus becomes fully effective without excessive delay even after relatively long periods of idleness, it may embody a pump or the like to circulate a relatively small quantity of developing liquid 12 through the trough or troughs 11 for the liquid applying members 2. This prevents oxidation of developing liquid 12 in the troughs 11 and insures that a sheet 5 which is introduced into the apparatus after an extended period of idleness is immediately contacted by a developing liquid whose chemical action upon the light sensitive emulsion is fully effective. Such circulation of developing liquid 12 in each trough 11 (see the pump P of FIG. 1) can be insured by feeding the liquid into the troughs 11 and by providing in these troughs overflow openings 11*a* for automatic evacuation of developing liquid at the same rate at which the liquid is being fed through the respective supply channels 10. If the apparatus was idle for an extended period of time, the introduction of fresh developing liquid 12 which is to react with the light sensitive material may be preceded by the circulation of a cleaning or washing liquid which is introduced by way of the supply channels 10 and overflows from the troughs 11 to insure a thorough and reliable cleaning or washing action.

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 which fairly constitute essential characteristics of the generic and specific aspects of our contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

We claim:

1. In an apparatus for treating sheet-like materials with liquids, particularly for treating exposed light sensitive emulsions with a developer, wherein the sheet-like materials are moved in a predetermined plane and at a predetermined speed, a combination comprising a source of fresh liquid adjacent to one side of said plane; a rotary roller-shaped applicator member dipping into said source and contacting one surface of the material moving in said plane to transfer to such surface a layer of said liquid, said applicator member being driven to rotate counter to the direction of movement of sheet-like material in said plane; a rotary roller-shaped liquid removing member located past said applicator member and having a peripheral surface contacting said one surface of the material moving in said plane to remove at least some of said liquid layer from said one surface; biasing means for urging the sheet-like material in said path against at least one of said roller-shaped members; and drive means for rotating said liquid removing member in the direction of movement of sheet-like material in said plane and at a peripheral speed which is greater than said predetermined speed.

2. A combination as defined in claim 1, wherein said biasing means comprises at least one yieldably mounted idler roller.

3. A combination as defined in claim 1, wherein said drive means is arranged to rotate said liquid removing member at a peripheral speed which is greater than said peripheral speed by at least 10 percent.

4. A combination as defined in claim 1, wherein at least one of said roller-shaped members has a smooth peripheral surface.

5. A combination as defined in claim 1, wherein the diameter of at least one of said roller-shaped members is between 1–5 centimeters.

6. A combination as defined in claim 1, wherein at least that portion of said liquid removing member which is adjacent to said peripheral surface thereof consists of hydrophobic material.

7. A combination as defined in claim 6, wherein said hydrophobic material is tetrafluorethylene.

8. A combination as defined in claim 1, further comprising at least one additional source adjacent to said one side of said plane and located past said liquid removing member, an additional roller-shaped applicator member dipping into said additional source and contacting said one surface to transfer thereto an additional layer of liquid, an additional roller-shaped liquid removing member located past said additional applicator member, and common collecting means for liquid which is removed from said one surface by said liquid removing members.

9. A combination as defined in claim 8, wherein said one surface is located at the underside of said sheet-like material and said common collecting means communicates with troughs for collection of liquid which is removed by said liquid removing members.

10. A combination as defined in claim 1, wherein said source comprises a trough bounded by a concave

surface having its center of curvature on the axis of said applicator member and containing a supply of liquid.

11. A combination as defined in claim 10, wherein the difference between the radius of curvature of said concave surface and the radius of said applicator member is a small fraction of said last mentioned radius.

12. A combination as defined in claim 1, further comprising troughs for said roller-shaped members, at least one of said troughs being provided with overflow opening means, and means for circulating liquids through said one trough so that such liquids overflow by way of said opening means.

13. A combination as defined in claim 1, wherein said one surface is located below said other surface and said biasing means comprises at least one idler roller which rests on said other surface under the action of gravity.

14. A combination as defined in claim 1, further comprising at least one additional source of said liquid located past said liquid removing member, an additional roller-shaped applicator member dipping into said additional source and contacting said one surface to transfer thereto a second layer of said liquid, and an additional roller-shaped liquid removing member located past said additional applicator member and having a peripheral surface contacting said one surface to remove therefrom at least some of said second liquid layer, and drive means for rotating said additional liquid removing member at a peripheral speed which is greater than said predetermined speed.

15. A combination as defined in claim 14, wherein said first mentioned and said additional liquid removing members are respectively located at predetermined distances from said first mentioned and said second applicator members.

16. In an apparatus for treating sheet-like materials with liquids, particularly for treating exposed light sensitive emulsions with a developer, wherein the sheet-like materials are moved in a predetermined plane at a predetermined speed, a combination comprising a source of liquid adjacent to one side of said plane; a rotary roller-shaped applicator member dipping into said source and contacting one surface of the material moving in said plane to transfer to such surface a layer of said liquid, said one surface being located below the other surface of the material moving in said plane; a rotary roller-shaped liquid removing member located past said applicator member and having a peripheral surface contacting said one surface of the material moving in said plane to remove at least some of said liquid layer from said one surface; yieldably mounted biasing means for urging the sheet-like material in said path against at least one of said roller-shaped members, said biasing means comprising at least one idler roller which rests on said other surface under the action of gravity, said idler roller being pivotable about an axis which is at least substantially parallel to its own axis; stop means for limiting the extent of pivotal movement of said idler roller; and drive means for rotating said liquid removing member at a peripheral speed which deviates from said predetermined speed.

17. A combination as defined in claim 16, wherein said applicator member rotates counter to the direction of movement of sheet-like material in said plane.

18. A combination as defined in claim 16, wherein said idler roller is disposed between said roller-shaped members and said stop means is arranged to maintain said idler roller out of contact with said roller-shaped members in the absence of sheet-like material in said plane.

19. A combination as defined in claim 16, wherein the peripheral speed of said liquid removing member at least approximates the peripheral speed of said applicator member.

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