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PATENT SPECIFICATION

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(54) IMPROVEMENTS IN AND RELATING TO APPARATUS
 FOR PROCESSING PHOTOGRAPHIC MATERIALS

(71) We, AGFA-GEVAERT AKTIENGESELLSCHAFT, a body corporate recognised under German Law, of Leverkusen, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 The invention relates to apparatus for processing photographic materials and more particularly to apparatus for wet processing photographic material.

15 In processing apparatus having a tank of processing liquid, the level of the liquid in the tank has previously been regulated by an overflow and a device for topping-up the level of the tank when the level began to drop. A difficulty arises however in maintaining the liquid in the processing tank at the desired level with the required degree of accuracy. This is of particular significance when the quantity of processing liquid carried along or washed out by the photographic material, which is to be processed, is influenced by the height of the liquid level in the tank. The length of the immersion path, and thus the developing time, is dependent on the level of liquid in the case of oblique immersion.

30 The known, relatively simple, devices for topping-up whilst maintaining a particular level, such as stopcock watering devices or float valves, have a certain range of fluctuation of the set levels, caused by the surface tension of the liquid and the inertia of the regulating systems. These arrangements do not keep the liquid level at a constant height with the required degree of accuracy.

40 The invention provides apparatus for processing photographic material which comprises a main tank for processing liquid, one or more auxiliary tanks, the main tank being arranged such that liquid overflows from the main tank to the auxiliary tank, or to one of the auxiliary tanks, when the liquid

in the main tank reaches a predetermined overflow level, means for transferring processing liquid to the main tank from the auxiliary tank, or from one of the auxiliary tanks, at such a rate that, in operation, the level of liquid in the main tank is prevented from dropping below the said overflow level, and means for supplying additional processing liquid to the auxiliary tank from which, in use, liquid is transferred to the main tank, when the level of liquid in that auxiliary tank has fallen below a predetermined level.

The said additional processing liquid is, of course, liquid which can be supplied to the auxiliary tank from which in use liquid is transferred to the main tank, in addition to any processing liquid which may be supplied to the auxiliary tank owing to overflow from the main tank.

With the apparatus of the invention, it is possible to maintain the level of the liquid in the main tank constant as accurately as required without any considerable extra expenditure.

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Preferably, the auxiliary tank into which liquid from the main tank is arranged to overflow and the auxiliary tank from which, in use, liquid is transferred to the main tank, are the same. With this arrangement, liquid overflowing from the main tank into the auxiliary tank is recirculated to the main tank. Since additional processing liquid is supplied to the auxiliary tank when the level of liquid in the auxiliary tank has fallen below a predetermined level, the liquid in the auxiliary tank remains in operation, substantially at that predetermined level. The additional liquid therefore makes up for losses in processing liquid which occur during processing, or which may be caused by evaporation, and regenerates the used processing liquid.

The liquid supply means, or topping-up device, preferably takes the form of a

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poultry watering device. The topping-up device can keep the level in the said auxiliary tank from which liquid is transferred to the main tank, which level is preferably lower than the level in the main tank in operation, at a height the accuracy of which has practically no effect on the level in the main tank. Furthermore, the surface of the liquid in the auxiliary tank from which liquid is transferred to the main tank can be relatively small so that small changes in the volume of liquid in the main tank lead to large changes in the level of the liquid in the auxiliary tank. The volume of fresh liquid added can therefore correspond much more precisely to the actual liquid requirements. In addition, the fresh liquid that is added can be mixed in the auxiliary chamber with processing liquid from the main tank before entering the main tank.

Depending on the type of transferring means, which is preferably arranged to transfer liquid to the main tank at an approximately constant rate, the level in the auxiliary tank from which liquid is transferred to the main tank may have a slight influence on the pumping capacity of the transferring means, but when the auxiliary tank from which, in use, liquid is transferred to the main tank, and the auxiliary tank into which liquid from the main tank is arranged to overflow, are the same, with sufficiently wide construction of the overflow as a weir, in one form of the invention, there is practically no influence on the liquid level in the processing tank.

The main tank is advantageously formed with a weir or spill-way over part of its width arranged to allow processing liquid to overflow into the auxiliary tank. When the apparatus is to be used on a continuous basis, and it is wished to discharge a quantity of liquid corresponding to the through-put of photographic material as a function of the liquid level, the uppermost edge of the weir or spill-way advantageously extends in the direction in which the photographic layer supports are passed through the apparatus and can be inclined, preferably together with the main tank, with respect to the horizontal in order to adjust the different quantities of liquid to be discharged for different types of photographic material.

Apparatus for processing photographic material constructed in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a plan view of the apparatus with parts of the apparatus removed.

Figure 2 is a longitudinal section through the apparatus of Figure 1, taken along the line II—II in Figure 1 but with the parts replaced; and

Figure 3 is a further longitudinal section through the apparatus of Figure 1, taken along the line III—III.

Referring to the accompanying drawings, in Figure 1, processing apparatus, indicated generally by the reference numeral 1, contains a tank 2 for wet processing of photographic material. In the tank 2 there may be arranged, for example, pairs of rollers (not shown) which guide the photographic material along a predetermined path through processing liquid in the tank 2 and at the end squeeze off any excess liquid. Apparatus of this type is shown, for example, in British Patent Specification No. 1328871. This Patent Specification also shows that the outflow of processing liquid corresponding to the quantity of photographic material put through can be increased if the leading or trailing edge of a sheet pushes a wave of liquid out of the main tank. This is of advantage in maintaining constant activity of the liquid in the processing tank, since the quantity of liquid which has flowed out is replaced by fresh regenerating liquid. The quantity of liquid carried with the photographic material thereby depends to a great extent on the height of the liquid level in the main tank 2.

In the left-hand portion of the processing apparatus 1, which is substantially in the form of a solid block formed with apertures, a receiving aperture 3 is provided for a topping-up device in the form of a bottle; a circulating device in the form of a blade wheel pump 4 is also provided. In addition, the block has a guide for a discharge hose 5 and apertures 7 to accommodate pairs of transport rollers. The precise construction of the parts mentioned is apparent from Figures 2 and 3, and from the following description.

In Figure 2 a bladewheel 6 of the pump 4 is attached to an axle 5 which is rotatably supported in an aperture 1a at the bottom of the housing and in a further guide 9a. At its upper end, the axle 5 carries a bevel gear 8 which, when the developing apparatus 1 is inserted in a machine frame (not shown), comes into engagement with a corresponding bevel gear, which is, for example, driven together with the drive members for the transport rollers. The outer portion of the bladewheel 6 is covered over by a block 10 formed with ribs 9 carrying the bearing 9a, but in the centre of the block 10 an aperture 10a is provided which allows liquid from above to have access into the blade chambers of the bladewheel. In Figure 1 a channel 11 can be seen which connects the pump chamber tangentially with the main tank 2. When the bladewheel 6 rotates in the direction indicated by the arrow 12, therefore, liquid is drawn from an auxiliary tank 13 situated above the pump 4 and is fed

into the tank 2 through the channel 11.

In the tank 2, further means to guide the flow can be provided which produce a flow approximately in the lower part of the tank 2 as far as the end of the latter, then deflect the flow upwards, where a backflow forms as far as an overflow at the edge of a weir or spill-way 14.

Figure 2 also shows a topping-up bottle 15 which is inserted, with its opening downwards, into the receiving chamber 3. The opening of the bottle is closed by a valve 16 which is inserted into the neck of the bottle by means of a ring 17. The valve is formed by a disc 18 which under the action of a spring 19 normally rests against shoulders 20 of the ring 17, thus closing the bottle, but by means of a pin 23 fixed to the housing or secured to the disc as shown in Figure 2, the disc 18 can be pushed upwards when the bottle 15 is inserted into the receiving chamber 3 until liquid can emerge downwards from the bottle through apertures 21. This bottle 15 works according to the principle of the stopcock feeder device as a level regulator for the auxiliary tank 13, and the level indicated by the reference numeral 22 coincides with the underside of the ring 17. When the bottle with the ring 17 is placed on ribs 24 in the receiving aperture 3, the valve 16 is opened and liquid flows out of the bottle for as long as air can flow through into the bottle beneath the ring 17. When the supply of air into the bottle is interrupted by the level of the liquid in the auxiliary tank, the liquid in the bottle 15 is prevented from running out by the vacuum obtaining therein.

Figure 3 shows the emptying arrangement for the main tank 2. An angled hose connecting piece 25 is secured to the base of the tank 2 and has a hose 26 connected to it. The end of the hose 26 fits into a square guide member 27, which can be guided along a slot 28 in the block and be held by the block so that the end of the hose 26 is held in an upright position above the level of the processing liquid in the tank 2. In order that the guide member 27 can be locked in position, it is formed with a projecting grip portion 27a, which when the guide member 27 is pushed along the slot 28, slides over guiding edges 29 and 30 of the block and locks in position at the end of the edges. Thus, the guide member 27 can only be released for movement back into a lower position by first being raised. In order to empty the tank 2, the member 27 is brought into its lower, horizontal, position, so that the liquid can run out. When discharging is completed, the guide member with the hose is returned to the position shown in Figure 3 in which the end of the hose lies above the liquid level in the tank 2. This arrangement offers the additional advantage that when

the guide member 27 is not in the operating position, the processing apparatus 1 cannot be inserted in the machine frame, since the guide member with hose projects beyond the space available for the processing apparatus.

The method of operation of the apparatus described is as follows:—

In the initial state, that is to say, in the rest state of the pump 4, the processing tank 2 and the auxiliary tank 13 have the same liquid level, that is to say, at least up to the lower end of the ring 17. When the apparatus is set in operation, the pump 4 starts up, together with the transport rollers which are not shown. The starting-up of the pump 4 causes liquid to be conveyed from the auxiliary tank 13 into the processing tank 2 and the level there, indicated by the reference numeral 30, reaches the level of the weir or spill-way 14. With the given pump capacity, a further rise in level is then practically impossible, since the liquid flows away over the spill-way. At the same time, however, the level in the auxiliary tank has fallen, due to the raising of the level in the processing tank 2, so that air can flow into the bottle 15 and an equal volume of liquid flows out of the bottle, until the opening of the ring 17 is closed again by the rising liquid.

A photographic layer support conveyed through this processing tank now soaks up liquid with its emulsion and possibly with the material supporting the emulsion, and as it passes through, carries liquid out of the tank. In addition, by means of the measures described in British Patent Specification No. 1328871, it can remove further liquid from the tank. The removal of the liquid from the tank 2 leads to another drop in the level in the auxiliary tank, since the level in the tank 2 is kept at a constant height by means of the pump 4 and the overflow 14. The level in the auxiliary tank is then raised by means of liquid flowing in from the bottle 15, and by means of the inflow of the topping-up liquid into the pump intake chamber together with the flow of liquid coming from the spill-way 14, thorough mixing of these two liquid components is achieved. The supply of liquid from the bottle 15 at the same time cancels out the chemical depletion of the liquid in the tank 2, so that the activity of this bath remains constant to a great extent.

At the end of operation, the roller and pump drive is switched off. The levels in the auxiliary tank and the tank 2 then settle to the same height between the marks 22 and 30. The drop in relation to the operating level in the tank 2 offers the advantages that an overflow of liquid is made more difficult even if the whole apparatus is moved, and that any crystallisation which might occur during the break in operation takes place at

a level which is washed over during operation, so that the crystals are dissolved. The rise in level in the auxiliary tank during the non-operational phase of the apparatus reliably prevents the wasteful flowing of processing liquid from the topping-up bottle during the stoppage.

When the material being processed passes through the tank 2 in the direction along which the edge of the spill-way 14 extends, then the height of the liquid level in the tank may be easily adjusted by inclining the spill-way 14, most simply by inclining the tank 2, with respect to the horizontal, so that the overflow level of liquid in the tank is changed, thus regulating the amount of processing liquid carried out of the tank by the material being processed. When dealing with layer supports which have a different processing liquid consumption, this is a simple possibility for adaption.

The apparatus described can be filled with developer, fixer, activator, stabiliser, or other processing liquids.

WHAT WE CLAIM IS:—

1. Apparatus for processing photographic material which comprises a main tank for processing liquid, one or more auxiliary tanks, the main tank being arranged such that liquid overflows from the main tank to the auxiliary tank, or to one of the auxiliary tanks, when the liquid in the main tank reaches a predetermined overflow level, means for transferring processing liquid to the main tank from the auxiliary tank, or from one of the auxiliary tanks, at such a rate that, in operation, the level of liquid in the main tank is prevented from dropping below the said overflow level, and means for supplying additional processing liquid to the auxiliary tank from which, in use, liquid is transferred to the main tank, when the level of liquid in that auxiliary tank has fallen below a predetermined level.

2. Apparatus as claimed in claim 1, wherein the capacity of the auxiliary tank from which, in use, liquid is transferred to the main tank is less than the capacity of the main tank.

3. Apparatus as claimed in claim 1 or claim 2, wherein the auxiliary tank into which liquid from the main tank is arranged to overflow and the auxiliary tank from which, in use, liquid is transferred to the main tank are the same.

4. Apparatus as claimed in any one of claims 1 to 3, wherein the means for supplying processing liquid to the auxiliary tank from which, in use, liquid is transferred to the main tank, comprises a container for processing liquid having an opening pointing downwards into the auxiliary tank so arranged as to maintain the level of the liquid in the auxiliary tank at the level of the opening.

5. Apparatus as claimed in claim 4, wherein the container is removable and is provided with valve means, the arrangement being such that the valve means allows liquid to pass through the opening when the container is in position in the apparatus and prevents liquid passing through the opening when the container is removed from the apparatus.

6. Apparatus as claimed in any one of claims 1 to 5, wherein the means for transferring processing liquid from the auxiliary tank to the main tank is a bladewheel pump.

7. Apparatus as claimed in claim 6, wherein the bladewheel pump is arranged to be driven by drive means situated above the level of the processing liquid.

8. Apparatus as claimed in claim 7, wherein the pump comprises a bladewheel and a vertical axle on which the bladewheel is mounted and which is arranged to be driven by the drive means so as to rotate the bladewheel.

9. Apparatus as claimed in any one of claims 1 to 8, wherein the overflow level of the main tank is above the level of the liquid in the auxiliary tank from which liquid is transferred to the main tank, during operation of the transferring means.

10. Apparatus as claimed in any one of claims 1 to 9, wherein the main tank is formed with a weir or spill-way over part of its width arranged to allow processing liquid to overflow into the auxiliary tank.

11. Apparatus as claimed in claim 10, wherein the uppermost edge of the weir or spill-way extends in the direction in which photographic material are passed through the apparatus and can be inclined with respect to the horizontal.

12. Apparatus as claimed in claim 11, wherein the main tank can be inclined to the horizontal.

13. Apparatus as claimed in any one of Claims 1 to 12, wherein the main tank is provided with a drainage outlet to which a hose is connected, and means are provided for holding the end of the hose in an upright position, during operation of the apparatus, in such a manner that the end of the hose lies above the level of the processing liquid in the main tank.

14. Apparatus as claimed in claim 13, wherein means for holding the end of the hose in an upright position comprises a guide member secured to the hose which can releasably engage a bearing block containing the auxiliary tank into which liquid from the main tank is arranged to overflow and from which, in use, liquid is transferred to the main tank.

15. Apparatus substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

a level which is washed over during operation, so that the crystals are dissolved. The rise in level in the auxiliary tank during the non-operational phase of the apparatus reliably prevents the wasteful flowing of processing liquid from the topping-up bottle during the stoppage.

When the material being processed passes through the tank 2 in the direction along which the edge of the spill-way 14 extends, then the height of the liquid level in the tank may be easily adjusted by inclining the spill-way 14, most simply by inclining the tank 2, with respect to the horizontal, so that the overflow level of liquid in the tank is changed, thus regulating the amount of processing liquid carried out of the tank by the material being processed. When dealing with layer supports which have a different processing liquid consumption, this is a simple possibility for adaption.

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2. Apparatus as claimed in claim 1, wherein the capacity of the auxiliary tank from which, in use, liquid is transferred to the main tank is less than the capacity of the main tank.

3. Apparatus as claimed in claim 1 or claim 2, wherein the auxiliary tank into which liquid from the main tank is arranged to overflow and the auxiliary tank from which, in use, liquid is transferred to the main tank are the same.

4. Apparatus as claimed in any one of claims 1 to 3, wherein the means for supplying processing liquid to the auxiliary tank from which, in use, liquid is transferred to the main tank, comprises a container for processing liquid having an opening pointing downwards into the auxiliary tank so arranged as to maintain the level of the liquid in the auxiliary tank at the level of the opening.

5. Apparatus as claimed in claim 4, wherein the container is removable and is provided with valve means, the arrangement being such that the valve means allows liquid to pass through the opening when the container is in position in the apparatus and prevents liquid passing through the opening when the container is removed from the apparatus.

6. Apparatus as claimed in any one of claims 1 to 5, wherein the means for transferring processing liquid from the auxiliary tank to the main tank is a bladewheel pump.

7. Apparatus as claimed in claim 6, wherein the bladewheel pump is arranged to be driven by drive means situated above the level of the processing liquid.

8. Apparatus as claimed in claim 7, wherein the pump comprises a bladewheel and a vertical axle on which the bladewheel is mounted and which is arranged to be driven by the drive means so as to rotate the bladewheel.

9. Apparatus as claimed in any one of claims 1 to 8, wherein the overflow level of the main tank is above the level of the liquid in the auxiliary tank from which liquid is transferred to the main tank, during operation of the transferring means.

10. Apparatus as claimed in any one of claims 1 to 9, wherein the main tank is formed with a weir or spill-way over part of its width arranged to allow processing liquid to overflow into the auxiliary tank.

11. Apparatus as claimed in claim 10, wherein the uppermost edge of the weir or spill-way extends in the direction in which photographic material are passed through the apparatus and can be inclined with respect to the horizontal.

12. Apparatus as claimed in claim 11, wherein the main tank can be inclined to the horizontal.

13. Apparatus as claimed in any one of Claims 1 to 12, wherein the main tank is provided with a drainage outlet to which a hose is connected, and means are provided for holding the end of the hose in an upright position, during operation of the apparatus, in such a manner that the end of the hose lies above the level of the processing liquid in the main tank.

14. Apparatus as claimed in claim 13, wherein means for holding the end of the hose in an upright position comprises a guide member secured to the hose which can releasably engage a bearing block containing the auxiliary tank into which liquid from the main tank is arranged to overflow and from which, in use, liquid is transferred to the main tank.

15. Apparatus substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.



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