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(54) APPARATUS FOR THE WET TREATMENT OF  
 PHOTOGRAPHIC EMULSION SUPPORTS

(71) We, DURST AG., A body corporate organised according to the laws of Italy, of 39100 Bozen, Gerbergasse 58, Italy, 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:—

The invention relates to apparatus for the wet processing of photographic materials in the form of an emulsion on a support, in which the latter are moved by transport rollers through at least one treatment bath.

In known equipment of this kind, the photographic materials to be treated are normally guided through several treatment baths, transport being undertaken by pairs of rollers between which the materials pass. In the majority of wet treatment processes it is necessary that the treatment baths have a particular temperature, which is normally above room temperature and which is maintained by means of a heating and temperature-regulating device. For the baths to be at an even temperature and for intimate mixing of the treatment baths, a pump is used, which is normally electrically driven. However, by raising the temperature of the treatment bath, relative to the ambient temperature and by circulation of the treatment baths by means of the pump, oxidation of the same is accelerated, and the period of use greatly reduced. In order to economise on power, and to avoid the tendency of the treatment baths towards oxidation, known devices are provided with removable covers, which, in addition to restricting the quantity of oxidising air above the baths, serve to protect the emulsion from the incidence of light, which means that it is possible to treat the materials in an undarkened room. However, even the volume of air which is present above the treatment baths in this process is sufficiently high for oxidation to continue at an unsatisfactory rate. Also, when a cover is used, the exchange of air occurring at the inlet and outlet apertures for the materials and likewise promoting oxidation of the treatment baths, cannot be prevented.

An object of the invention is to provide an apparatus of the kind initially mentioned, in which oxidation of the treatment baths is reduced as compared with formerly known apparatus.

The invention provides apparatus for the wet processing of photographic materials in the form of an emulsion on a support, which apparatus comprises a vessel for containing treatment liquid and a plurality of transport rollers each of which, in operation, is so arranged that it is partially immersed in the liquid, contacts the photographic materials as they are fed through the treatment liquid and is so driven that it tends to advance the materials through the treatment liquid, and a cover means which, in operation, is in contact with the non-immersed portion of each of the said transport rollers along a substantial part of their lengths to reduce the exposure, by the said rollers, of treatment liquid to the atmosphere or is in contact with the liquid film that is carried round by each of the said transport rollers over a substantial portion of the area of the film.

The invention also provides a method for wet processing photographic materials in the form of an emulsion on a support, which method comprises transporting photographic materials through a vessel containing treatment liquid by transport means including a plurality of transport rollers each of which is so arranged that it is partially immersed in the liquid and contacts the photographic materials as they are transported through the treatment liquid, driving the said transport rollers in such a direction that they each tend to advance the materials through the treatment liquid, wherein a cover means is arranged in contact with the non-immersed portion of each of the said transport rollers along a substantial part of their lengths to reduce the exposure, by the said rollers, of treatment liquid to the atmosphere or is arranged in contact with the liquid film that is carried round by each of the said transport rollers over a substantial portion of the area of the film.

In accordance with the invention, a large

part of the surface of the treatment baths may be covered in such a way that that part can no longer come into contact with the surrounding air. It is especially advantageous that the transport rollers, which play a large part in the oxidation of the treatment baths (basically because they have a new film of liquid after each revolution and because this liquid film comes into contact with the surrounding air), can be covered up over a large area in this way, which results in the oxidation being greatly reduced as compared with known apparatus.

The reduction of the amount of air that can come into contact with the bath liquid and in consequence the reduction of the oxidation can be achieved in three ways: first, the cover means may be so arranged and shaped that, in use, non-immersed parts of two partially immersed rollers that are spaced apart in the direction of transport or the liquid film thereon, also contacts the cover means; second, the cover means may have a recess complementary in shape to a partially immersed roller and so arranged that the non-immersed part of each roller, or the liquid film thereon, contacts the surface of the recess; third the cover means may be partially immersed in the bath, thus preventing access of air to that part of the bath.

In the case of the first way, air cannot flow in the direction of transport between the said two partially-immersed rollers and the cover means. The cover means may contact the said two rollers (or the liquid film) over portions that are recessed and complementary in shape to those rollers, to further reduce oxidation. There may be further partially immersed rollers between the said two partially immersed rollers, and the cover means may have further recessed portions complementary in shape thereto. The cover means may be partially immersed in the bath in spaces between the partially immersed rollers. The part(s) of the cover means that is immersed in the treatment baths prevents air from entering the liquid in that region. Preferably the cover means is immersed between adjacent transport rollers in the direction of transport of the emulsion carriers. In such a zone of the treatment bath, the flow of liquid as a result of its being pumped, may be at its strongest and oxidation would therefore, without the cover means, proceed at its most intense rate.

The immersed parts of the cover means may form guides for the materials. This is an advantage of the provision of cover means, and is especially useful between adjacent rollers in the direction of film transport.

In addition, the cover means of the apparatus according to the invention may also act as a splash guard to prevent even small amounts of one treatment bath entering an adjacent bath when liquid is added to that

bath, which is particularly important if one of the baths has to be replenished, or replaced before the others.

The cover means may further provide an effective protection against liquid being displaced from one bath to another; this often occurs when the condensation forming inside a cover for the baths trickles along the inner surface of the cover as a result of any slight slope of the apparatus caused by an uneven base, and drops into adjacent baths.

Apparatus and a method of wet processing of photographic materials will now be described, by way of example, with reference to the accompanying drawing, which shows a schematic sectional representation of a part of an apparatus.

A container 1 (only partially shown) accommodates several, for example, three, liquid containers, which serve to hold treatment baths, of which a first liquid container is shown as a whole, and given reference numeral 2, and a second is only shown partly, and is given the reference numeral 3. Container 1 may be closed by means of a removable cover 4 (only partially shown), which cover has an inlet slot 5 through which the emulsion supports to be treated can be introduced into the first liquid container 2 in the direction of the arrow F. Each liquid container has a row of transport rollers, which are rotated in the direction of the arrows, preferably by a drive means operated by an electric motor (not shown), whereby the emulsion supports are moved through the treatment bath to be found in each liquid container. The filling height is indicated by the dotted lines 6 and 7.

If, for example, the apparatus illustrated is to be used to develop colour photographic paper prints, the liquid container 2 contains a developing bath, liquid container 3 a stop bath, and a third liquid container which is adjacent to the latter but is not shown, contains a bleach-fixing bath.

When the emulsion supports are introduced, these are first of all picked up by a pair of intake rollers 8 and guided via a guide means 9 and a transport roller 10 to a further pair of transport rollers 11. From the transport rollers 11, the emulsion supports pass to a third pair of transport rollers 12 and continue via a guide means 13 and a transport roller 14 to a fourth pair of transport rollers 15, which lift the emulsion supports from the first liquid container 2 and convey them to the pair of intake rollers 16 provided in the next liquid container 3, in which they are transported further in a similar manner.

As they are moved through the various liquid containers the emulsion supports are acted on by the treatment baths contained therein. In order to increase the effectiveness of the treatment baths, or to ensure in them an even distribution of temperature and intimate mixing, the said baths may be circulated

by means of a pump which is not shown. This should preferably cause liquid to flow between the pairs of transport rollers 11 and 12, transversely of the direction of movement of the emulsion supports.

Directly above the transport rollers which are in contact with the treatment bath there is arranged a protective cover 17, shaped in such a way that it partially surrounds the surfaces of the transport rollers concerned and is immersed in the treatment bath between at least some of the transport rollers. The protective cover 17 may be attachable to the side-walls (not shown) of the liquid container, but preferably it rests directly on the transport rollers that it covers; in the case shown, it rests on the transport rollers 10, 11, 12 and 14. As a result, the film of liquid which was otherwise brought into contact with the surrounding air by these transport rollers when they were rotated, and which as a result of being renewed on each immersion in the treatment bath, contributed very considerably to the oxidation of the bath, is largely sealed-off from the surrounding air. The film of liquid on the non-immersed part of the rollers 10, 11, 12, 14 is in contact with the respective part-cylindrical recesses in the cover 17. The air present between the rollers 10 and 11, and between the rollers 11 and 12, and the cover 17 tends not to be exchanged by fresh air since this would require an air flow in the direction of the axes of the rollers. The cover 17, which is uniform in section perpendicular to the plane of the drawing, may extend over the whole length of the respective rollers and may abut the respective walls of the bath at opposite extremities (the rollers may also abut those walls at each end). This produces a closed space bounded by the rollers on two sides the container walls on two sides, the cover on top and the treatment tends to be trapped in the spaces between the roller and the cover: both on the bottom which prevents the access of fresh air to the treatment bath, thereby reducing oxidation. Even if the rollers do not abut the container walls the oxidation of the treatment bath is reduced compared to the situation without the cover 17. In principle, only the end portions of the cover need be in contact with the rollers in such a manner that air flow in the direction of the axes of the rollers is prevented.

The tendency of the treatment bath towards oxidation is reduced further by the fact that the surface of the bath between the transport rollers 10, 11, 12 and 14 can no longer come into contact with the surrounding air. This covering is especially effective in the region between the pairs of transport rollers 11 and 12, if the flow caused by the circulating pump already mentioned is in operation, since, as a result of the circulation of the bath, oxidation is particularly pronounced in this area when the surface of the treatment bath is open.

In the areas mentioned between the transport rollers in which the protective cover 17 is immersed in the treatment bath, the cover can also be designed as an auxiliary guide for the moving emulsion supports. In addition, there may also be provided, on a part of the surface of the protective cover 17 that is immersed, a number of guide ribs 18 which prevent the emulsion supports from coming adjacent to the surface.

The protective cover 17 is preferably basin-shaped. When it is this shape, it forms an effective splash guard if, for example, the treatment bath in the liquid container 3 is poured in after that in liquid container 2, or is changed before it. A splash guard of such a type is an advantage because a treatment bath can become unstable as a result of the addition of very small amounts of a different treatment bath.

The protective cover 17 also provides a similar protection against displacements of the treatment bath, which occur because condensed treatment liquids, which trickle along the inner surface of the cover 4 when it is at a slight angle to the horizontal, may drop into a different treatment bath.

Of course, a protective cover corresponding to the protective cover 17 can also be provided for all the other treatment baths, although it is only shown for the treatment bath contained in the liquid container 2. It is also obvious that this type of protective cover can be used not only in an apparatus with the combination of transport rollers shown, but also in any apparatus for the wet treatment of photographic emulsion supports that uses transport rollers.

When the apparatus is cleaned, the protective cover 17 is removed from its support. In order to facilitate removal a handle may be provided, for example, a hand-hole (not shown) at the edge of the protective cover.

As an example, the diameter of the rollers may be about 18 m.m. and the inside diameter of the part-cylindrical portions of the cover that rest on the rollers may be about 19 m.m. In principle, the inside diameter of the part-cylindrical portions must be greater than that of the rollers by twice the thickness of the film of liquid. However, the inside diameter of the recesses could be less than the diameter of the rollers, in which case the cover would prevent the contact of the surrounding air with a portion of the rollers, since the covers would touch the rollers along the generatrices of the part-cylindrical recesses at two points along the section, thereby preventing the exchange of air between the rollers and the cover.

#### WHAT WE CLAIM IS:—

1. Apparatus for the wet processing of photographic materials in the form of an emulsion on a support, which apparatus comprises a vessel for containing treatment liquid

- and a plurality of transport rollers each of which, in operation, is so arranged that it is partially immersed in the liquid, contacts the photographic materials as they are fed through the treatment liquid and is so driven that it tends to advance the materials through the treatment liquid, and a cover means which, in operation, is in contact with the non-immersed portion of each of the said transport rollers along a substantial part of their lengths to reduce the exposure, by the said rollers, of treatment liquid to the atmosphere or is in contact with the liquid film that is carried round by each of the said transport rollers over a substantial portion of the area of the film.
2. Apparatus as claimed in claim 1, wherein the parts of the cover means that contact, in operation, the roller or the liquid film thereon are complementary in shape to the surfaces of the said transport rollers.
3. Apparatus as claimed in claim 1 or claim 2, wherein the cover means is so arranged as to be partially immersed, in operation, in the treatment liquid.
4. Apparatus as claimed in claim 3, wherein the immersed parts of the cover means form guides for the photographic materials.
5. Apparatus as claimed in claim 4, wherein the immersed parts are provided with guide ribs.
6. Apparatus as claimed in any one of claims 1 to 5, wherein the cover means is basin-shaped.
7. Apparatus as claimed in any one of claims 1 to 6, wherein the cover means has a hand-hole.
8. Apparatus for the wet processing of photographic materials in the form of an emulsion on a support substantially as hereinbefore described with reference to, and as shown in, the accompanying drawing.
9. A method of wet processing photographic materials in the form of an emulsion on a support, which method comprises transporting photographic materials through a vessel containing treatment liquid by transport means including a plurality of transport rollers each of which is so arranged that it is partially immersed in the liquid and contacts the photographic materials as they are transported through the treatment liquid, driving the said transport rollers in such a direction that they each tend to advance the material through the treatment liquid, wherein a cover means is arranged in contact with the non-immersed portion of each of the said transport rollers along a substantial part of their lengths to reduce the exposure, by the said rollers, of treatment liquid to the atmosphere or is arranged in contact with the liquid film that is carried round by each of the said transport rollers over a substantial portion of the area of the film.
10. A method as claimed in claim 9, wherein the parts of the cover means that contact the said transport rollers or the said liquid film are complementary in shape to the surfaces of the said transport rollers.
11. A method as claimed in claim 9 or claim 10, wherein the cover means is partially immersed in the treatment bath.
12. A method as claimed in claim 11, wherein the immersed parts of the cover means form guides for the photographic materials.
13. A method for the wet processing of photographic materials in the form of an emulsion on a support substantially as hereinbefore described with reference to the accompanying drawings.

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