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METHOD OF TREATING PHOTOGRAPHIC MATERIAL

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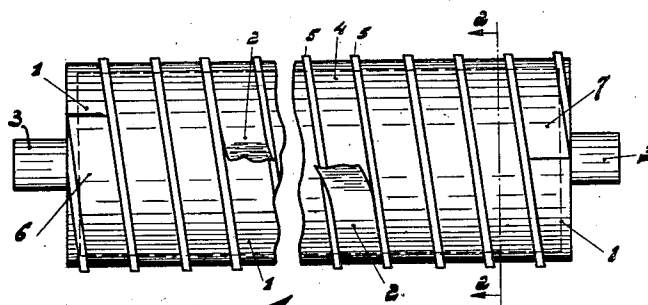


Fig. 1

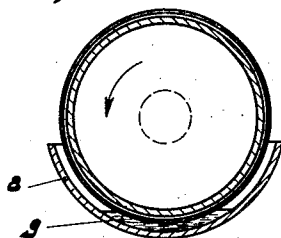


Fig. 2

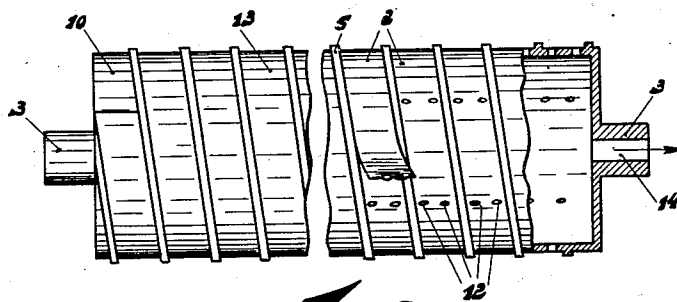


Fig. 3

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METHOD OF TREATING PHOTOGRAPHIC MATERIAL

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6 Claims. (Cl. 95—88)

Our invention relates to a method of developing and subsequently treating band-shaped photographic material to obtain photographic contrasts.

As is well known, the use of water-containing developers with certain photographic materials has the disadvantage that the materials are deformed in an undesired manner, e. g. some materials elongate when moistened and contract when dried. This difficulty is particularly prevalent and is of a serious nature when the materials are formed either entirely or partly of regenerated cellulose, for instance thin layers of superficially-saponified acetyl cellulose.

To avoid this difficulty it has been proposed to effect the development and subsequent treatments entirely by a so-called dry treatment, for instance by development with ammonia.

The main object of our invention is to overcome the above difficulties in order to make possible to obtain satisfactory development of photographic material of the above type by a liquid treatment.

A further object is to employ liquid developing procedures with photographic material which otherwise is not well adapted for such treatments and which had to be developed by a dry treatment.

Another object is to provide an economical commercial method of developing photographic material by "physical development."

Further objects and advantages will appear as the description progresses.

In accordance with the invention, we produce images on band-shaped material of the above-mentioned type with a liquid treatment, by subjecting the exposed material to the development and subsequent treatments while it is wound in a single layer upon a supporting member without spaces between the surfaces of the supporting member and material. For example, we partly surround the supporting member with a receptacle containing a small amount of the liquid developer.

Our method is particularly advantageous with "physical development," i. e. a development in which all the metal required for building up the contrast is not present, as such or in the combined state, at the area of the image prior to development. This physical development is effected by a metal salt which is capable of being reduced to a metal in an aqueous solution, such as salts of mercury, silver, gold or platinum, and, as is well known, these developers contaminate rapidly and can generally be used only once. Our in-

vention makes it possible to use such developers in an efficient manner and thus to carry out such development economically on a commercial basis. More particularly the method of the invention makes it possible to so correlate the quantity of developer and the concentrations of the ingredients with respect to the amount of photographic film to be developed, that losses are reduced to a minimum. By making the developing receptacle of a certain size and shape with respect to the supporting member on which the exposed photographic material is wound rigidly, the amount of the developer used can be very small compared with the surface area of the material to be developed.

In order that the invention may be clearly understood and readily carried into effect, we shall describe the same more fully with reference to the accompanying drawing, in which:

Figure 1 is a side-view of a film-supporting member for use in carrying out the invention.

Fig. 2 is a sectional view taken along line 2—2 of the film support of Fig. 1 and shows the support partly immersed in a receptacle containing a developing liquid, and

Fig. 3 is a partly-sectionized side-view of another type of film support.

In Fig. 1 the reference numeral 1 indicates a cylindrical film support which is hollow and has closed ends provided with projections 3 for rotatably mounting the support. The cylindrical surface of support 1 is provided with a helical groove 4 separated by a rib 5 of small thickness, for instance about 1 mm. An exposed film 2 is disposed in groove 4, and the width of the groove is substantially the same as that of the film.

In carrying out the method of the invention, the exposed film 2 is wound upon the support 1 so that there is a uniform tension in all parts of the film, and the ends 6 and 7 of the film are secured to the support by suitable clips (not shown). A receptacle 8 (see Fig. 2) is then placed beneath support 1, so as to closely embrace the lower portion thereof. A suitable developing liquid 9 is then placed in the receptacle, and support 1 is rotated as indicated by the arrow.

In some cases it is important that the interval between the time at which the film first contacts the liquid and the time at which the film becomes entirely moistened thereby is so small as to avoid local differences in the film; i. e. small compared with the time period which may be called critical for the beginning of development. This may be insured in the case described by rotating the

support at a sufficiently high speed while the developer is being placed in the receptacle.

The particular method described above is especially adapted for developing a metal image by means of a physical developer, for example developing a film of regenerated cellulose sensitized by means of a diazonium compound.

There are cases for which another variation of the method is better suited, for example cases in which a so-called aerial fog is set up when the film is separated from the air by only a thin layer of developer. For instance it is known that this aerial fog is readily produced when certain silver bromide emulsions are chemically developed with a chemical developer containing hydroquinone as the main reducing agent. In such cases we prefer to place the support with the film thereon in a receptacle which closely embraces the support and which contains the developer, so that the entire support with the film is immersed at once. If desired, the film-supporting member may be rotated or agitated to assist in uniform development.

When the development is completed, the developer is removed from the receptacle and may be replaced by other baths, for instance a stop bath, fixing bath, rinsing bath, glycerol bath or the like, and then the film is dried while on the support, for example by means of heated air or by heating the support with steam.

In cases in which the photographic material has only a tendency to contract, it always engages the surface of the support without intermediate space so that it retains the same form and dimensions it had prior to development. This is of great advantage, particularly for films having a photographically-formed sound track, because deformations of such a film would cause distortion in the sound reproduced therefrom.

Fig. 3 illustrates an embodiment of the invention which is adapted for use in those cases in which the film material tends to stretch during certain stages of development or after-treatment. In this case we use a hollow cylindrical support 10, which is similar to that of Fig. 1, and has a groove 2 which is provided at regular spacings with small apertures 12.

As described above, an exposed film 13 is placed in the groove 2 and covers the apertures 12. Sub-atmospheric pressure is then produced within the support, for example by exhausting the latter through a passageway 14 in the projection 3. As a result, the film is at all times firmly held against the surface of the groove. Development and after-treatment, as described above, are then carried out. If the film stretches when moist, the portions thereof which cover the apertures 12 remain in place, and when the film is dried the film contracts and regains its tautness so that undesired shifting does not occur.

According to another embodiment of the invention, which is very advantageous in cases in which the photographic material is relatively elastic, we stretch the film prior to and/or during the winding operation to such a degree that when it is moistened it remains taut on the surface of the supporting member, although there is a decrease in the tension in the film. In other words we give the film such a high tension that it will still be in tension when it is in its moistened condition. Thus film material having a tendency to stretch upon moistening is nevertheless fixedly positioned against the supporting member by the contractive force exerted by the tension remaining in the film after the moistening thereof. This

makes it unnecessary, also when using films subject to stretching by liquid treatment to provide apertures in the surface of the supporting member or to provide means for producing a suction.

The supporting members 1 and 10 are, of course, made of a material which is not corroded by the baths used, such as stainless steel, and their size depends upon the length of the bands to be developed. Thus, for example, it will be possible for a film 100 meters long and 7 mm. wide to be developed on a cylindrical support whose diameter and height are each about 50 cm.

As stated above, our method makes it possible to use in a very economical manner, those developers which can be used only once. For example when using our method, it was necessary to use only about 150 c. c. of a physical developer containing 2% metol, 4% tartaric acid and 0.6% silver nitrate in order to develop to a blackening of 3.2 and throughout its width, 22 meters of a regenerated cellulose film having a width of 7 mm. and which contained a latent image, but did not contain any silver salts. Thus, the developer contained 575 mg. of silver as a nitrate. Since the covering capacity, i. e. blackening per mg. of silver per square decimeter, of a silver image is about 0.1 (Handbuch der wissenschaftlichen und angewandten Photographie, vol. 5, Meidinger, "Die theoretischen Grundlagen der photographischen Prozesse," page 77, 1932), we may assume that the film, which had surface area of $220 \times 0.07 = 15.4$ square decimeters and a blackening of 3.2, contained about

$$15.4 \times \frac{3.2}{0.1} = 500$$

mg. of silver. Thus about 500/575 of 85% of the silver was used, which is a very efficient utilization.

It should be noted that the above-mentioned economical use of developers, which is of particular importance for physical developers, can be obtained with films which are subject to deformation due to the liquid treatment, as well as with films which are not. For example, our method of physical development may also be used advantageously with photographic material which is not deformed by liquid treatment, such as Celluloid films provided with a silver bromide emulsion, sensitized paper or the like.

It should be mentioned that the resistance to deformation of superficially-saponified acetyl cellulose layers depends upon their total thickness and also upon the thickness of the saponified surface layer. Furthermore, in comparison with films having supports which consist entirely of regenerated cellulose, superficially-saponified acetyl cellulose layers of corresponding thickness are less likely to be deformed when subjected to a liquid treatment. Because of this, supports of superficially-saponified acetyl cellulose have advantages over supports constituted entirely of regenerated cellulose.

Thus, our invention makes it possible to use physical development economically with sufficiently deformation-proof and less deformation-proof supports which consist of superficially-saponified acetyl cellulose while at the same time preventing deformation of the supports.

Although we have described our invention with reference to specific examples and applications, we do not desire to be limited thereto because obvious modifications will appear to one skilled in this art.

What we claim is:

1. A method of producing contrasts on band-shaped photographic material having a supporting layer of regenerated cellulose, comprising the steps of winding the material in a single layer on a support with its surface in intimate contact with the surface of the support, fixedly positioning the material relative to the support so as to prevent relative movement between the material and the support when the material is subjected to a liquid treatment, and subjecting the wound material to a liquid treatment.

2. A method of producing contrasts on band-shaped photographic material having a supporting layer subject to deformation by liquid treatment, comprising the steps of winding the material in a single layer on a support with its surface in intimate contact with the surface of the support, and subjecting the material to a liquid treatment while fixedly holding the material against the surface by suction.

3. A method of producing contrasts on band-shaped photographic material having a supporting layer of superficially saponified acetyl cellulose, comprising the steps of winding the material in a single layer on a support with its surface in intimate contact with the surface of the support, fixedly positioning the material relative to the support so as to prevent relative movement between the material and the support when the material is subjected to a liquid treatment, and subjecting the wound material to a liquid treatment.

4. A method of producing contrasts on band-shaped photographic material having a supporting layer which is subject to elongation when treated with a liquid, comprising the steps of

winding the material in a plurality of single layer turns about a support with the surface of the material in intimate contact with the surface of the support, fixedly positioning the material relative to the support so as to prevent relative lateral movement between the material and the support when the material is subjected to a liquid treatment, and developing the photographic material in a liquid developing solution while so positioned on the support.

5. A method of producing contrasts on band-shaped photographic material having a supporting layer which is subject to elongation when treated with a liquid, comprising the steps of winding the material in a plurality of single layer turns on a support while giving the material a tension greater than the loss in tension due to liquid treatment, and developing the photographic material in a liquid developing solution while so-positioned on the support.

6. A method of producing contrasts on band-shaped photographic material having a supporting layer which is subject to elongation when treated with a liquid, comprising the steps of stretching the material to such an extent that it remains in tension when subjected to a liquid treatment, winding the so-stretched material in a plurality of single layer turns on a support with the surface of the material in intimate contact with the support, and developing the photographic material in a liquid developing solution while so-positioned on the support.

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