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METHOD OF AND APPARATUS FOR TREATING PHOTOGRAPHIC BATHS

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Fig. 1.

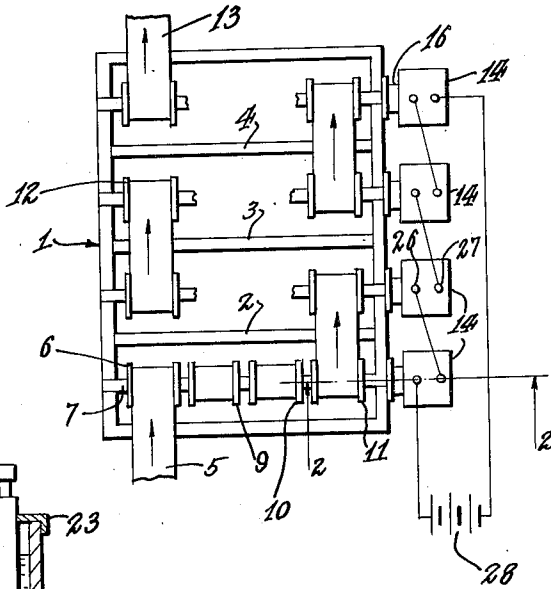


Fig. 2.

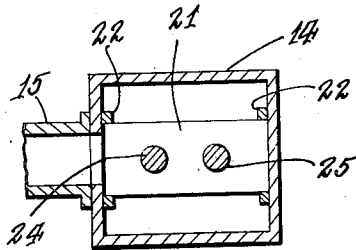
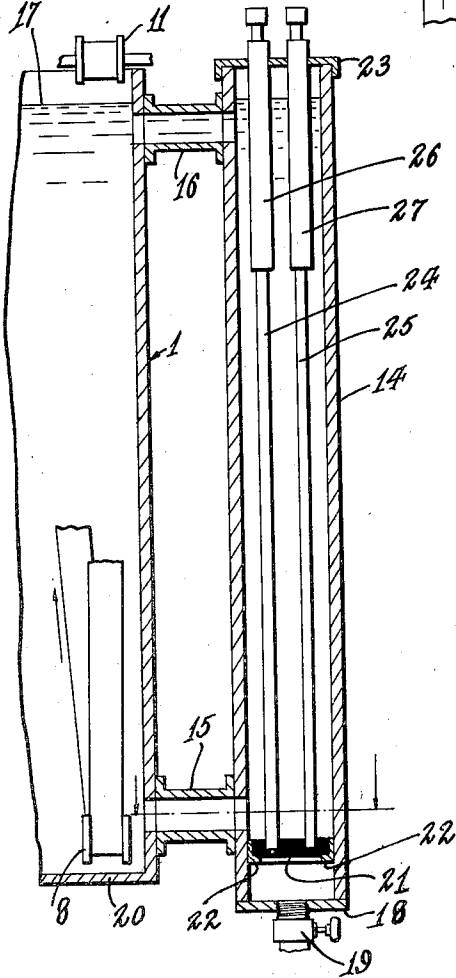


Fig. 3

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METHOD OF AND APPARATUS FOR TREATING PHOTOGRAPHIC BATHS

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This invention relates to a method of maintaining photographic fixing baths in proper condition for use. The invention particularly relates to a simple but effective method of continuously treating photographic fixing baths during use so as to maintain the effective strength of the baths at a predetermined or desirable concentration and/or condition.

The invention is particularly adapted for the treatment of fixing baths employed during the developing and fixing of continuous strips of film, such as motion picture film. The invention also relates to an apparatus by means of which the method may be carried out.

It is well known that photographic fixing baths become exhausted from continued use, such exhaustion being caused generally by the formation of sodium silver thiosulphate, thus reducing the quantity of active sodium thiosulphate in the bath. Furthermore, developer and developer oxidation products accumulate in the bath so that the exhausted fixing bath is a relatively complex solution.

At the present time motion picture studios and other large users of fixing solutions periodically drain the fixing tanks so as to remove the exhausted or partially exhausted solution, and refill such tanks with fresh solution. As the solution ages or becomes exhausted the speed of fixation decreases and, therefore, it is necessary to change the speed of the continuous film passing through the bath. Such changes are controlled with difficulty, inasmuch as in normal practice of developing and fixing continuous films, in which a continuous strip of film passes successively through developing and fixing baths, washers and driers, it is necessary to simultaneously change the temperature conditions in the driers and the strength of other solutions with which the film is treated.

Attempts have been made in the past to take the exhausted solution removed from the fixing tanks and recover the silver therefrom. The recovery methods employed heretofore did not permit the reuse of the fixing solution and necessitated the handling of large volumes of fixing solution.

An object of this invention is to disclose

and provide a method whereby photographic fixing baths may be maintained normal during use and continuously treated to remove silver dissolved in such solutions from the film being treated.

Another object of this invention is to disclose and provide a method whereby the characteristics of the fixing bath may be maintained substantially uniform for long periods of time, thereby permitting a fixing bath to be employed in the treatment of very large quantities of film.

Another object is to disclose and provide a method whereby circulation of the fixing bath through a treating cell or conduit is induced by a change in specific gravity effected in such cell or conduit.

Another object is to disclose and provide an apparatus whereby fixing baths may be treated for the removal of silver therefrom in a continuous manner, during the use of the fixing bath in the treatment of film.

Another object is to disclose and provide a device whereby silver present in partially exhausted fixing solutions may be removed therefrom, and the desilvered fixing solution displaced by partially exhausted solution in an automatic and continuous manner.

Other objects, uses and advantages of this invention will be in part obvious from the subsequent disclosure, and in part more fully defined hereafter.

In describing the invention, reference will be had to the appended drawing, in which:

Fig. 1 is a plan view, somewhat diagrammatic in form, of a 4-cell fixing tank for the treatment of continuous motion picture film, each of said cells being provided with a device arranged in accordance with this invention, for the continuous treatment of the fixing solution in each of said cells.

Fig. 2 is an enlarged vertical section of a portion of the device shown in Fig. 1.

Fig. 3 is an enlarged horizontal section taken along plane 3—3 of Fig. 2.

As shown in the drawing, the fixing and developing tank 1 may be divided by transverse partitions 2, 3 and 4 so as to form four cells which are normally filled with the fixing solution. The continuous film which it is de-

sired to treat may be passed through these cells successively. For example, the film may enter the first tank as indicated at 5, and pass over a spool or roller 6, suitably journaled on a shaft 7 mounted above the tank 1. The film 5 may pass downwardly into the first cell of the tank 1, then under a roller 8 rotatably mounted near the bottom of the tank 1, and then upwardly so as to pass over a roller 9 also mounted on the shaft 7. The film 5 thus passes down into the tank and then up over rollers 9, 10 and 11 and finally discharges from the first cell of the tank 1 over the partition 2 onto a similar arrangement of rollers and shafts in the second cell, from which in turn it is discharged onto roller 12 into the third partition, and the operation again repeated until the finally developed and fixed film is discharged at 13.

Although the developing tank 1 is shown here as including four cells, and an arrangement is shown whereby the continuous film passes over four rollers in each of said partitions or cells, it is to be understood that the number of individual cells in a developing tank or the number of times that the film is dipped into the fixing solution may be correspondingly varied, depending upon the capacity of the machine, the quantity of the film which it is desired to treat, and the type of film which is being treated.

The apparatus by means of which the method of this invention may be carried out comprises a conduit 14 connected to the top and to the bottom of the fixing tank 1. For example, the conduit 14 may be connected to the bottom of the tank 1 by means of a coupling 15 and to the top of the tank 1 by means of a coupling 16. The coupling 16 should be perfectly positioned immediately beneath the normal level of fixing solution in the tank 1, such level being indicated by the line 17.

The lower portion of conduit 14 is preferably provided with a closure 18 and a valved outlet 19. Preferably, a quick opening flush valve is employed at such outlet, and such closure member 18 and valve port 19 are positioned below the level of the bottom 20 of tank 1.

The conduit 14 may be provided near its bottom with a spacer plate 21 suitably supported, as upon brackets 22 attached to or made a part of the conduit 14. The spacing plate 21 should be of smaller area than the cross sectional area of the conduit 14 so as to permit the fixing solution to pass beneath it, and if desired through the valved port 19.

The conduit 14 may be provided with a cap plate 23, said cap plate having a pair of spaced apertures adapted to receive electrodes 24 and 25. The lower ends of electrodes 24 and 25 are preferably received in depressions or cavities formed in the spacing bar 21 by means of which the electrodes 24 and 25 may

be maintained in spaced relation within the conduit 14.

The upper portions of the electrodes 24 and 25 (which may be of circular cross section) may be covered by means of closely fitting sleeves 26, and 27, such sleeves being preferably made of non-metallic, acid resisting material, such as a phenol condensation product.

When a developing tank such as the tank 1 divided into four cells is employed, four units of the character shown in Fig. 2 are also employed, thereby providing a conduit 14 for each one of the cells of the developing tank 1.

The electrodes 24 and 25 of the battery of conduits 14 may be connected in series, as shown in Fig. 1, and supplied with current from a suitable source such as, for example, the battery 28. It is to be understood that instead of a battery, any source of substantially direct current may be employed, as for example, a generator.

I have found that partially exhausted fixing baths are of higher specific gravity than a fresh fixing bath. In other words, after the solution in the tank 1 has been used in the fixing of photographic film, the relatively inert or used fixing solution will settle to the bottom of the tank 1. Such solution will also be found in the lower portion of the conduit 14. The silver present in the solution may thus be removed therefrom in the conduit 14, by electrolytic precipitation on the cathode 25.

Upon the removal of silver from the solution in this manner, the solution becomes of lighter specific gravity and is thus displaced upwardly by used solution from the bottom of tank 1. In this way, circulation is established through the conduit 14, used fixing solution (containing silver) entering through the connection 15 into the bottom of the conduit 14, whereas the de-plated and revived fixing solution is discharged from the conduit 14 through the connection 16 to the upper portion of the tank 1.

I have found that the rate of circulation thus established is sufficient to maintain a constant current of exhausted fixing solution entering the conduit 14, and in this manner the fixing solution may be constantly treated for the recovery of dissolved silver, without the necessity of withdrawing the entire solution from the tank 1 and without the necessity of making up new solutions at short intervals.

Fixing tanks provided with the device described hereinabove are capable of employing a single charge of fresh fixing solution for a period of time ten times greater than the normal period of time in which a solution becomes exhausted, and incapable of being commercially employed, as a photographic fixing solution.

The electrodes 24 and 25 may be made of

carbon, gold, platinum, silver or monel metal and the area of such electrodes may be regulated by means of the non-metallic sleeves 26 and 27. A certain amount of anode mud or slime may form in the bottom of the conduit 14, and periodically such mud or slime may be removed by opening the flush valve 19. The anode may be covered with a porous membrane such as cloth so as to retain any slime liberated by the anode, thus preventing such anode mud from being carried over into tank 1.

The current density which I have found to be most desirable is between 8 and 10 amperes per square foot of cathode area; the voltage is preferably regulated to below about 1 volt but above about $\frac{1}{10}$ th volt.

By employing four conduits 14 in which the electrodes are connected in series, as shown in Fig. 1, a six volt generator of a type commonly employed on automobiles may be used as the source of current, inasmuch as the resistance of the circuit under such conditions is sufficient to produce the desirable potential and current densities for efficient operation.

The silver from the fixing solution is deposited upon the cathode in a dense and smooth plating and the plated cathodes may be periodically removed from the conduits 14 and the silver recovered therefrom. Naturally, the area of the cathodes is dependent somewhat upon the quantity of film being treated in the tank and the amount of silver placed in solution. For example, when 1000 feet of motion picture film is being treated per hour, about 1.6 ounces of silver may be recovered per hour.

It will thus be seen that a very efficient method of maintaining fixing baths in operative condition has been disclosed, together with an apparatus which is extremely simple in construction and which obviates the necessity of periodically removing the exhausted fixing solution from the developing tanks. Furthermore, the provision of pumps, tanks and other equipment is rendered unnecessary, inasmuch as circulation is induced by the constant de-plating of the solution and the change in the specific gravity thereof effected thereby.

Although a specific construction has been shown and described in detail, it is to be understood that numerous changes and modifications may be made therein without departing from the invention, which is of the scope of the appended claims.

I claim:

1. A method of maintaining photographic fixing baths in effective condition while in use, comprising connecting top and bottom portions of a fixing bath with a conduit, continuously removing silver present in such fixing solution in such conduit by electro-plating; and permitting the desilvered fixing solution to be displaced upwardly in such

conduit by fixing solution from the bottom of said bath.

2. In a method of maintaining photographic fixing baths free from sodium silver thiosulphate while in use, the steps of maintaining top and bottom portions of a fixing bath in communication with an electrolytic cell, continuously removing silver from such fixing solution in said cell by electro-plating, and maintaining circulation through such cell by permitting the desilvered fixing solution to be displaced upwardly in such cell by fixing solution from the bottom of the fixing bath.

3. In an apparatus for continuously removing silver from solution in fixing baths, the combination of a fixing tank through which film may be passed, a substantially vertical conduit, pipe means connecting the upper portion of the fixing tank with the upper portion of such conduit, pipe means connecting the lower portion of said fixing tank with the lower portion of said conduit, spaced electrodes in such conduit extending longitudinally thereof, and a valved port in the bottom of said conduit.

4. An apparatus for continually removing silver from solution in fixing baths, comprising in combination with a fixing tank through which film may be passed, a conduit, pipe means connecting the upper portion of said tank with the upper portion of said conduit, pipe means connecting the lower portion of said tank with the lower portion of said conduit, a valved port in the bottom of said conduit, spacing means positioned near the bottom of said conduit and adapted to receive electrodes, a cover plate for said conduit, electrodes passing through said cover plate and supported on said spacing means, and non-metallic protecting means carried by said electrodes.

5. An apparatus for continually removing silver from solution in fixing baths, comprising in combination with a fixing tank through which film may be passed, a conduit, pipe means connecting the upper portion of said tank with the upper portion of said conduit, pipe means connecting the lower portion of said tank with the lower portion of said conduit, a valved port in the bottom of said conduit, spacing means positioned near the bottom of said conduit and adapted to receive electrodes, a cover plate for said conduit, electrodes passing through said cover plate and supported on said spacing means, non-metallic protecting means carried by said electrodes, and means for supplying uni-directional current to said electrodes.

Signed at Los Angeles, Calif., this 13th day of March, 1930.

CARL E. BALASSA.