Feb. 1, 1938. V. KRUPA 2,106,751

FILM PROCESSING

Filed Sept. 26, 1935 2 Sheets-Sheet 1

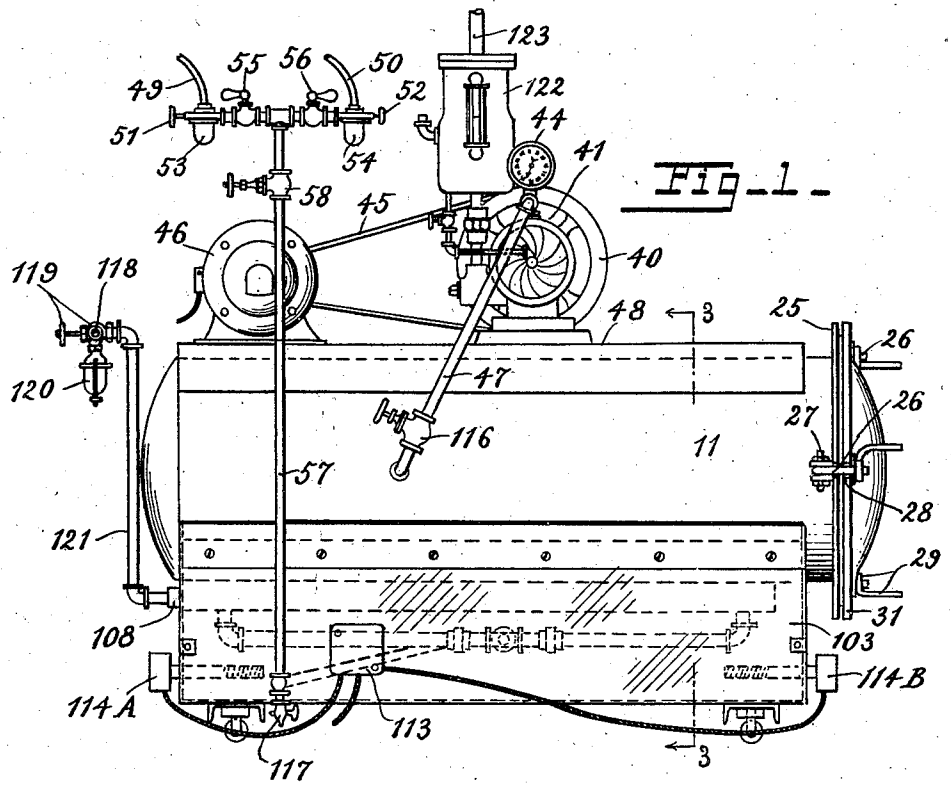


Fig-1-

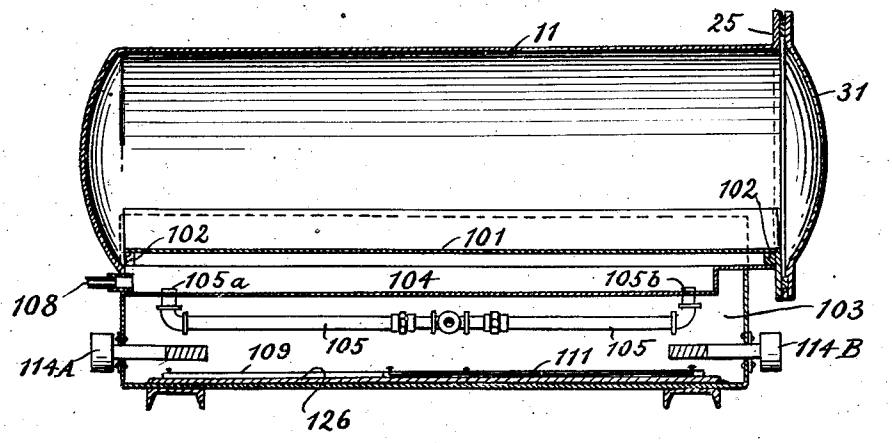


Fig-2-

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Fig. 3.

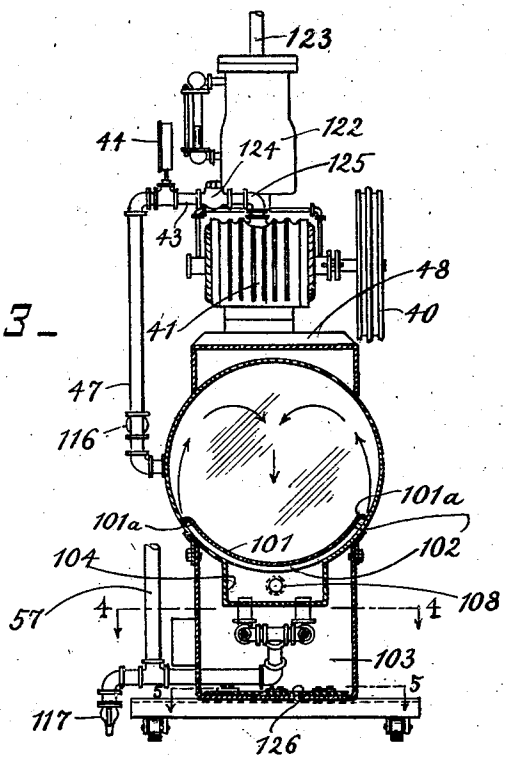


Fig. 4.

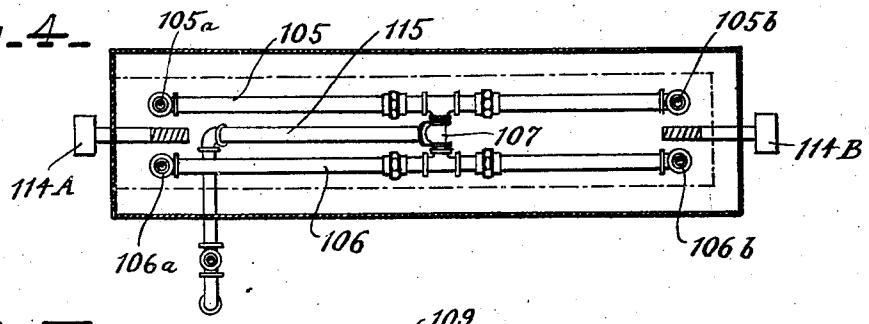
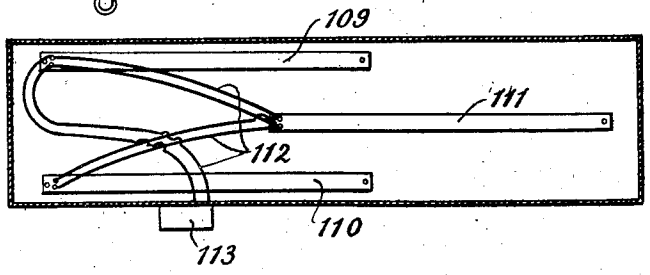


Fig. 5.



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UNITED STATES PATENT OFFICE

2,106,751

FILM PROCESSING

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Application September 26, 1935, Serial No. 42,256

3 Claims. (Cl. 95—88)

My invention relates to novel apparatus for and methods of treating gelatinous bodies, generally speaking, and more particularly, treating the emulsion of exposed and developed motion picture films, thereby increasing their durability and extending their usefulness.

As is well known, these films in service are subject to considerable wear, not only in actual usage, but also in being subjected to widely varying climatic conditions with the result that films in their original finished condition rapidly deteriorate.

I have discovered that by suitable treatment which renders the soluble colloids, composing the film emulsion insoluble in ordinary media, I can overcome the above-mentioned drawback and lengthen the life of the film.

In my co-pending application, Serial No. 701,119, filed December 6, 1933, for "Film processing" issued as Patent Number 2,067,933, of which this application is a continuation in part, I have described a method of treating the emulsion of an exposed and developed film by successive absorption of two heated gases under vacuum, the first one of which rendered the colloids in the film insoluble while the second gas acted as a fixing agent for said insoluble colloids.

The present invention concerns several improvements over the former method and apparatus as well, as summarized and set forth in detail hereinafter.

The treatment of the colloidal film with gaseous media is augmented and supplemented by the separate introduction of a gaseous medium which acts as a lubricant for the emulsion, after the latter has been rendered insoluble and fixed by the first two gases, as will be hereinafter described. But the improvements introduced concern also certain details of the apparatus itself which not only affect the supplementary treatment of the films by the third or subsequent gas or vapors, but will also advantageously modify the initial stages of the treatment as originally disclosed.

These mechanical improvements have for their general aim a more even distribution and equalizing of temperature of the gaseous active media and in addition thereto, an improved control of the conditions under which the treatment of the film in its different stages proceeds.

Accordingly, one object of my invention is to provide an improved general method of and apparatus for treating exposed and developed photographic films and gelatinous bodies.

Another object is to provide a novel method of and apparatus for a supplementary treatment of exposed and developed photographic films whose gelatinous emulsion has previously been rendered insoluble and fixed by appropriate gaseous agencies.

A further object, corollary with the last named is to provide adequate means for introducing at least one auxiliary gaseous medium into the container wherein the preliminary treatment of the films as described, took place.

Still a further object is to provide means whereby said gaseous media can be introduced separately from each other, but in any desired sequence.

A further object is to provide a gas which will affect the nitrocellulose or cellulose acetate base of the film and tend to soften it.

Another object of my invention is to provide a novel apparatus and improved means adapted to evenly distribute the gaseous agents over the films to be treated and to equalize their impact upon the latter, as far as temperature of these gases and their local quantity is concerned.

Still another object of the invention in compass with the last named objects is to provide means whereby the application and the thermal and atmospheric pressure conditions of the operative gaseous media can be accurately controlled.

Other objects will become apparent from the more detailed description of the improved method and apparatus which follows, in connection with the accompanying drawings, in which:

Figure 1 is an elevational side view of the improved form of apparatus for carrying out the complete process, including the described additional treatment of the films.

Figure 2 is a longitudinal cross-sectional view of the apparatus shown in Figure 1.

Figure 3 is a transverse section along the line 3—3 of Figure 1.

Figure 4 is a horizontal cross-section taken along the line 4—4 of Figure 3 showing the distributing piping in the heating chamber.

Figure 5 is a horizontal cross-section along line 5—5 of Figure 3 indicating the heating units and their connections in a more or less diagrammatical way, in the form of a wiring diagram.

Similar characters indicate similar parts throughout the different views. Moreover, since the apparatus shown is, at least in principle, partly a repetition of the similar apparatus illustrated in Pat. No. 2,067,933, mentioned before, to which reference is made, equivalent or identical elements described therein are designated by the same numerals for easier recognition and

comparison, while entirely novel parts or elements are designated by new numerals characterized by counting them from above 100.

Referring more specifically to Figures 1 and 3, the new apparatus comprises in general the cylindrical tank or container 11 which, as described in the prior application, is destined to receive successive charges of chemical gases or vapors for treating exposed and developed films. These films are stacked in a well known manner upon a rack or cradle not shown in this case, but fully described and illustrated in Figures 3 and 4 of my prior application.

Contrary to the former arrangement, however, this semi-circular cradle is not supported directly upon the bottom plates of the cylindrical tank 11, but rests on a baffle plate 101 which consists of a cylindrical segment, concentric with the bottom wall of the tank and spaced therefrom at the ends by two removable separators 102. The upper longitudinal edges 101*a* of the baffle plate are crimped over so as to leave only a narrow space between the baffle rim and the tank wall for the circulation of the incoming gases.

In the former construction, the cylindrical tank was longitudinally mounted upon a rectangular box-like heating chamber (61) but was not in direct communication with the tank bottom wall separating them. On the bottom of said heating chamber was installed an electric resistance heater and directly over the same, the gas pipe through which the atomized mixture for treating the film emulsion was introduced and during its transit was vaporized, so that when it left the heating chamber through the lateral pipe bends, to be led into the cylindrical tank, it would reach the film tanks in thoroughly gaseous form (see former pipes 60, 70). This prior arrangement has been modified in the following manner.

The new heating chamber 103 is fixedly secured to the tank by being riveted or bolted to a strip, itself spot welded to the tank wall, and is of larger capacity and especially greater depth than the old one, as it not only contains a larger electrical resistance heater, (three units instead of two, Figure 5) but also a more elaborate distributing pipe system for volatilizing the gases.

Moreover, and what is of greater importance, a separate expansion chamber 104 which is almost as large as the former heating chamber is installed below and all along the baffle plate 101 and is not separated from the cylindrical tank, but forms the bottom part of it, shielded against the interior of the tank by the suspended baffle plate only.

The gas distributing pipe which comprises two parallel pipe runs 105 (Figure 4) and 106 connected in the middle by a T 107 into which the common supply pipe 115 for the two gases used for initial treatment of the films is connected, has four outlets 105*a*, 105*b* and 106*a*, 106*b* leading into the expansion chamber 104, and it is apparent that any gas entering the latter, either through these outlets or otherwise (through side inlet 108) must expand throughout chamber 104 and through the space between the baffle plate and the bottom plate of the tank 11, before it reaches the interior of said tank. Then it will be forced along the interior periphery of the tank, coming down in a midde stream, as the arrow in Figure 3 indicates, upon the top of the film racks and pervade them in a thoroughly equalized manner, not entering them unevenly in localized spots, as eventually would happen in the former arrangement.

The general outer arrangement of the apparatus is very similar to the one shown in the aforementioned co-pending application and will therefore be described in abbreviated form except where it deviates or presents additional features.

The cylinder cover 31 which during operation closes the entrance for the film racks is hermetically sealed to the flange 25 substantially as shown before, by a series of bolts 26, hinged on pivot pins 27, guided in slots 28 and tightened by nuts provided with wings or handles 29.

On top of a platform 48, erected over the cylindrical tank, is provided an exhaust pump 41 with flywheel 40, driven by means of the belt 45 from the electric motor 46. The centrifugal exhaust pump which is of somewhat different construction from the one formerly shown, is provided with an oil reservoir 122 for lubricating the pump and the exhausted air is conducted through said reservoir by means of a special exit conduit 123 while any oil, entrained by the air is caught by the baffle device and returned to the reservoir.

The air from the tank 11 is exhausted by this pump through the intake pipe 47, provided with the cut-off valve 116 and the pressure gauge 44; a check valve 124 being inserted between the intake elbow 125 and the nipple 43 which connects it to the gauge.

This evacuation of the air from the film stored chamber 11 dehydrates the film and thus reduces its thickness, and prevents scratching and tearing of the film when it passes the gate of the film projecting mechanism, which occurs due to its swollen condition, as well as prepares it for absorbing the gaseous media which occurs in its subsequent treatment.

The chemicals to be vaporized and employed for the preliminary treatment of the films are introduced one after the other through the carburetors 53 and 54, regulated by valves 51 and 52 respectively and passing through the separate valves 55 and 56 into the common feed pipe 57, provided with the shut-off valve 58 and extending into the heating chamber 103 (Figure 3) where it is connected by way of the central conduit 115 to the T-fitting 107 and to the distributing pipes 105 and 106. The feed pipe 57 has at its lower end also an outer outlet in the form of a drain pet-cock 117 which can also be used to break the vacuum as will be described hereinafter. A third mixture to be used in a vaporized gaseous form to give to the films a lubricating coating is introduced through the inlet 118 from where it passes through the carburetor 120 controlled by the valve 119, and enters the expansion chamber 104 through the pipe 121 and the side inlet 108.

The electric resistance heater comprises the three units 109, 110 and 111, made of strip heating material, mounted on the asbestos pad 126 and connected in series by the conduit 112 which comes from the switch box 113. The heat of the chamber 103 is controlled and kept at a constant predetermined value by two mercoid thermostats 114A and 114B, one at each end of the chamber, whose construction and electrical installation is well known to those skilled in the art, so that a detailed description may be dispensed with.

The operation of the complete device is as follows: The heating chamber is generally brought up to a predetermined temperature which then

can be maintained automatically by means of the mercoid thermostats. Then the racks on which the films wound on reels are mounted, are introduced into the chamber in a vertical or horizontal position, the cover **31** is hermetically sealed and the motor, which operates the exhaust pump, is started. When the vacuum, as the gauge **44** indicates, has reached 29½ inches and maintains itself, the film is in a dehydrated condition and the first vaporized mixture or gas is supplied through the inlet **49**, common feed pipe **57** and the middle pipe duct **115** from which it spreads through the four outlets **105***a*, **105***b*, and **106***a*, **106***b* into the expansion chamber **104** and finally enters the tank, containing the films, through the narrow spaces between the baffle plate and the tank wall.

Through the introduction of this vapor, the vacuum will drop from its maximum of 29½ inches to say 27 inches. This vapor or gas will in the present process act on the film base and tend to soften it. Without removing this vapor, the vacuum pump being meanwhile stopped, the valve **55** is shut, and by opening valve **56**, the second kind of vapor or gas, emanating from line **50** through carburetor **54**, controlled by hand valve **52**, is introduced the same way as was the first vapor.

This second vapor acts as a fixing agent upon the gelatinous emulsion, renders it insoluble, and hardens the surface. This treatment will of course lower the vacuum still further, for example to 25 inches. Then the supply of this second gas is shut off also and both gases are allowed to remain in contact with the films for a predetermined period, depending upon the nature of the gases and other working conditions.

When the treatment of the films is considered complete, the vacuum is broken or reduced to atmospheric pressure, either by opening a special outlet (not shown) on the expansion chamber or the tank, or by simply opening the drain pet-cock, **117**. After a certain time, determined by practice, during which the remnants of the first two gases will escape or condense and drain off, respectively, the outlet valve or petcock is closed again, the exhaust pump is started and the vacuum is increased again to 29½ inches.

Then the third gas or vapor which comes from supply pipe **118** and is an unheated gas, is allowed to enter the expansion chamber through inlet **108** and is left in contact with the films for a predetermined period.

This gas preferably acts as a lubricant on the emulsion to prevent excessive brittleness and to impart greater pliability to the same, and any vaporized medium or gas adapted to do this is claimed to come within the scope of this invention, although I do not limit the use of the third gas to this exclusive purpose, as I broadly claim the introduction of a plurality of gases, successively or simultaneously from separate sources for any purpose which may prove advantageous for a material betterment of the film and an increase of its durability. This concludes the treatment of the film emulsion after which the vacuum can again be broken, the cover **31** opened and the film reels removed, ready for shipment or immediate use.

Thus my new process and apparatus consists of a mechanism necessary to carry out the treatment of exposed and developed films by the following steps: first, the dehydration of the film to reduce its moisture content and reduce the thickness of the film; secondly, introducing a vapor therein to soften the base of the film; thirdly, admit a second gas for fixing the gelatine cover of the film for rendering it harder and less susceptible of picking up moisture; and fourthly, bathing the film in a carburized spray of some lubricating substance for rendering the film relatively free from friction when introduced in the projection apparatus.

An additional method of treating the film contemplates the packing of reels at right angles to its present position, thus placing the edges of the film directly in line of the movement of the gases in the tank, thus insuring a greater degree of infiltration of the heated gases and carburized lubricating spray.

The excess gases or vapors may be removed in the final step by repeating the final process a number of times, namely allowing the carburized lubricating spray to be continued on and off, carrying off the deposited excess until such excess clearly indicates that the excess comprises the pure lubricating vapor.

It is absolutely essential that in any reaction carried in the vapor phase where reactants are in the form of a spray, that particle size must be as small as possible, otherwise condensation of particles into larger aggregates takes place too rapidly and the whole effect of reaction in the vapor state is lost. The machine is so devised that by means of efficient carburetion plus heating elements, the size of the particles is made as small as possible.

It will be understood furthermore, that my invention is not necessarily limited to the exact mechanical embodiment herewith shown and described and that other modifications are possible to carry out the novel and improved process for successive treatments of motion picture films previously exposed and developed. The invention therefore should rather be judged by what is set forth in the following claims.

I claim:

1. A method of treating exposed and developed films comprising dehydrating said films by subjecting them to a high degree of vacuum; admitting while under a high degree of vacuum successive vapors for softening the base of the films and for hardening them; again subjecting said films to a vacuum, and thereafter introducing an atomized lubricant for covering said films while under the high vacuum.

2. A method of treating exposed and developed films comprising dehydrating said films by subjecting them to a high degree of vacuum, in an evacuating chamber; admitting to said chamber while under a high degree of vacuum, successive vapors for softening the base of the films and for hardening them, and allowing the successive vapors to intermingle in said chamber; again subjecting the films to a vacuum, and thereafter introducing an atomized lubricant for covering the films while under the high vacuum.

3. A method of treating exposed and developed films comprising dehydrating said films by subjecting them to a high degree of vacuum in an evacuated chamber; admitting to said chamber while under a high degree of vacuum, successive vapors, separately expanded in an expansion chamber, for softening the base of the films and for hardening them; again subjecting said films to a vacuum, and thereafter introducing an atomized lubricant for covering said films while under the high vacuum.

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