

[54] **FILM DRYER**

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95/100

[51] Int. Cl. **F26b 17/24**

[58] Field of Search **34/58, 122, 150,**
34/163; 95/90.5, 100

[56]

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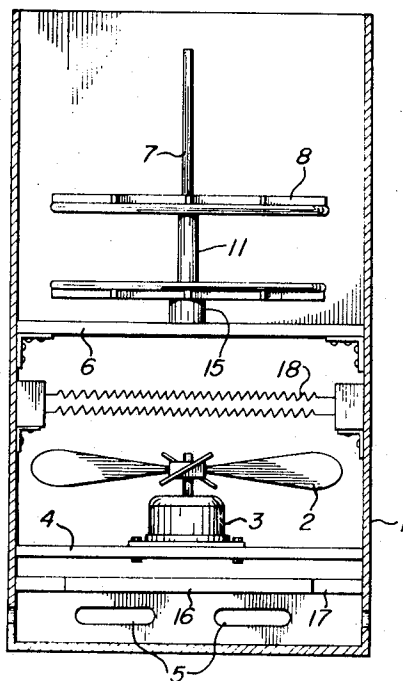
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[57]

ABSTRACT

A photographic film drying apparatus which incorporates both air flow and centrifugal force to rapidly remove water from processed film. The film is placed in a rotatably mounted holder and subjected to circular air flow. The circular air flow evaporates the water and rotates the holder. Thereby, a centrifugal force is provided to aid in the water removal process. Filtered air may be used to minimize the deposition of foreign particles on the film, and the air may be heated to further increase the water evaporation rate.

5 Claims, 5 Drawing Figures



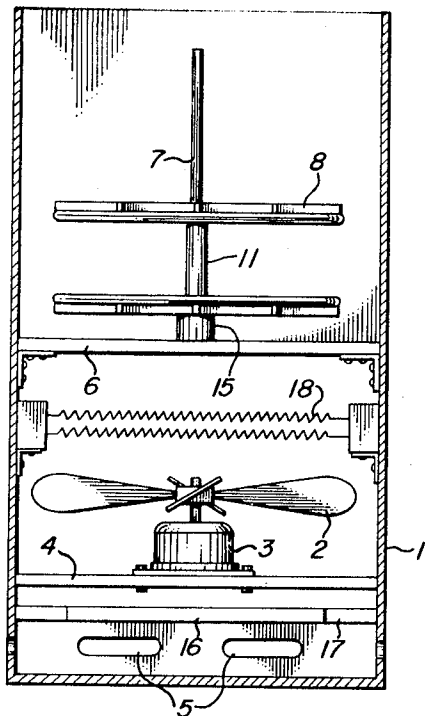


FIG. 1

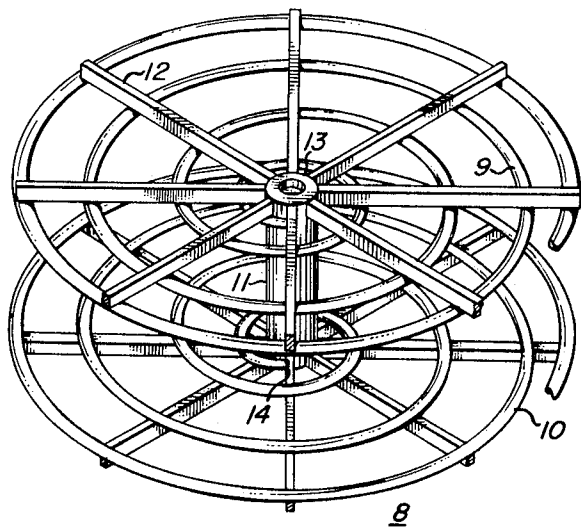


FIG. 2

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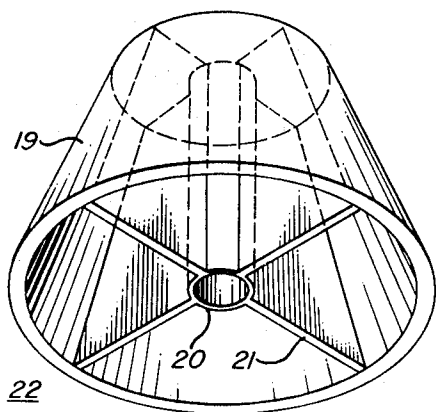


FIG. 3

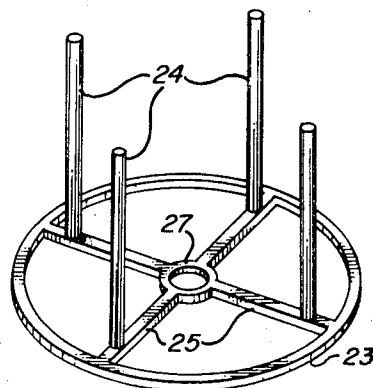


FIG. 4

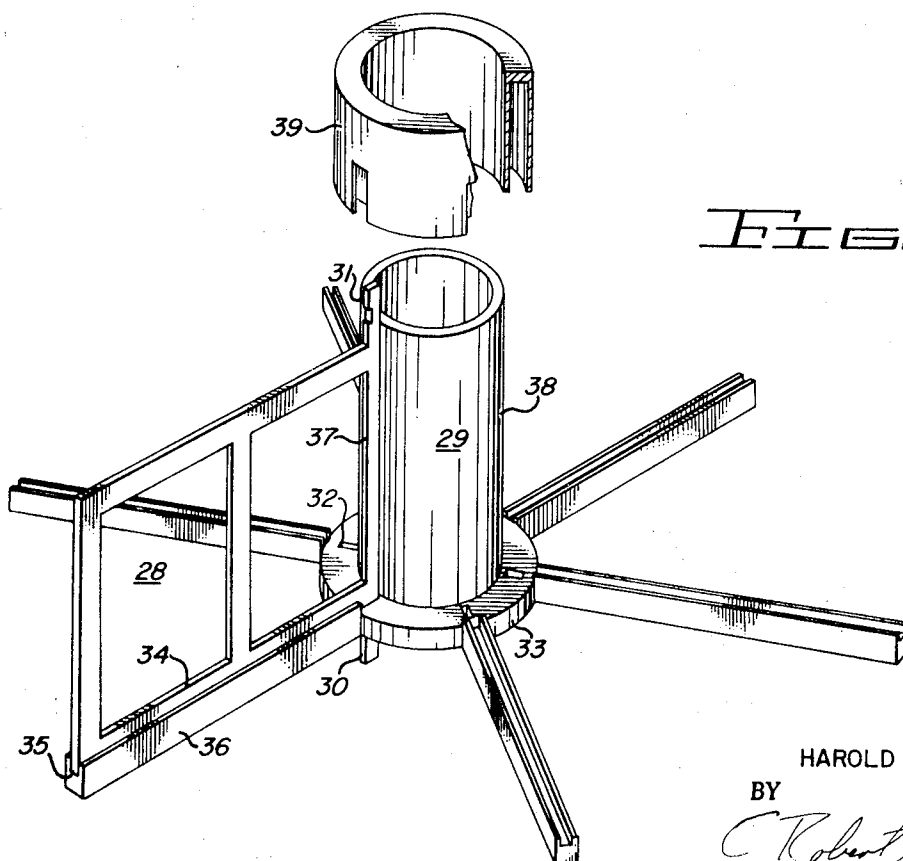


FIG. 5

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FILM DRYER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates in particular to apparatus useful during the drying phase of film processing.

2. Description of the Prior Art

In developing or processing photographic film, the film is bathed in various solvents, depending on the type of film. At the completion of the processing steps, the film must be washed to remove all traces of the chemicals to insure that the film will not continue to react chemically. The processing and washing steps leave the emulsion on the film base in a wet condition and it must be dried. Generally, the drying step consists of simply hanging the film and permitting the water to evaporate. This is a highly unsatisfactory method as the hanging film is subject to the deposition of dust, flying insects, or physical contact, any of which may mar or cause damage to the emulsion. Some attempts have been made to incorporate blown air to speed up the evaporative process, but these attempts have been generally unsatisfactory as the film is often in long strips and required very sophisticated film transport mechanisms to expose all of the film in a controlled manner to the air flow.

For individual negatives or short strips of film, a small drying cabinet may have been used to provide protection from dust. The cabinet was of simple construction consisting of a plain box with a lamp socket fitted close to the bottom of the box, above which was a baffle plate to distribute the heat. Vent holes were provided in the base immediately beneath the lamp, across each side of the baffle plate, and across the back near the top. The lamp induced convection currents which greatly reduced the time of evaporation. The bottom baffle plate ensured that the lower ends of the film were not subjected to violent heat, which might have resulted in uneven drying with the attendant risk of variations in emulsion density. The problem of dust and flying insects was still prevalent unless the cabinet was periodically cleaned. This air cabinet was satisfactory for low volume requirements, but required an excessive amount of film handling. This additional handling further increased the possibility of damage to the film.

SUMMARY OF THE INVENTION

Exposed rolls of film of various widths and lengths are usually loaded in a spiral fashion on commercially available reels and processed by bathing the loaded reels in various chemicals and finally washed in water. The present invention relates to and teaches a means for rapidly drying the processed film. The loaded reels are placed on an axle within an enclosure and subjected to an unheated or heated circular air flow to enhance the evaporation of the water. In addition, the circular air flow causes the reels to rotate whereby the resulting centrifugal force is utilized to aid in removing the water. The invention is also adaptable to rapidly drying individual negatives loaded in commercially available film holders by mounting the holders in a radial fashion about the axle.

A primary advantage of the invention is to provide a means for drying processed film by subjecting it to a circular air flow which removes the water by evaporation and centrifugal force.

Another advantage of the intervention is to obviate the need to handle the exposed film during the processing procedure.

Another advantage of the invention is to provide an inexpensive means for drying film which minimizes the deposition of dust or other foreign particles on the film.

Another advantage of the invention is to provide a means for drying processed film that is easily adaptable to various sized film.

Another advantage of the invention is to provide a means for drying processed film which permits the use of presently available and widely used film reels and film holders.

Another advantage of the invention is to provide a means for determining when the processed film is dry.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates the film drying apparatus.

FIG. 2 illustrates a reel for mounting the exposed film within the drying apparatus.

FIG. 3 illustrates a cone attachment for increasing the rotational speed of small reels.

FIG. 4 illustrates a mounting platform for a plurality of small reels.

FIG. 5 illustrates a mounting platform for a plurality of film holders.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Photographic film, after being exposed by a camera, must be chemically processed to obtain an image of the subject photographed. The individual steps and chemicals used in processing necessarily varies with the type of film used, but in general there is a strong similarity of function and purpose. In example, the steps for processing one of the popular color films comprise the following: The developer — the film is bathed in a developer to produce a metallic silver image in proportion to how much the silver halides of the film have been affected by light. In addition, the by-products of this action create a reaction to produce dyes in the film. When this step is complete there are both silver images and dye images. The stop bath — the film is bathed in an acidic bath to neutralize the alkali in the developer, stopping its action completely. The hardener — the film is bathed in a hardener to harden the film for further processing. Wash — the film is washed to remove the hardener. The bleach — the film is bathed in a bleach to change the metallic silver in the film to a soluble salt. Wash — the film is washed to remove the bleach. The fixer — bathing the film in the fixer dissolves both the salt converted by the bleach and the unused silver halides that were unaffected by the exposure in the camera. Wash — the film is washed to remove all traces of the fixer. Drying — the film is dried.

Of the above steps, the most critical in obtaining good quality negatives are the developing and the drying steps. The former can be performed without too much difficulty if the operator is careful in following instructions as to the strength of the solution and the timing of the immersion of the film in the developer. The latter is less easily controlled and extreme care must be taken by the operator each and every time a film is to be dried to prevent damage to the film. The latter is a process in which the experience of the operator is not of great benefit. Rather, the environment and

the means for controlling the environment of the drying film are far more critical.

The processing steps for roll film are generally accomplished by spirally winding the film on commercially available stainless steel reels. The design of the reel is such that both sides of the film are exposed to the chemicals without one part of the film being able to touch another part. The edges of the film, containing the film advance holes and the unexposed border, engage the reel. There are also commercially available tanks within which the loaded reel may be placed. The processing steps are then accomplished by pouring the solutions into and out of the tank and the film may be agitated within the tank by turning a knob on the outside of the tank which operatively engages the loaded reel.

After the processing steps, the presently existing method of drying the film is that of removing the film from the reel and hanging it up to dry. Necessarily, this requires extremely ginger handling of the film as the emulsion of the film is very soft and susceptible to scratching. During a portion of the drying process the emulsion becomes glue-like and will readily adhere to a foreign object resulting in either the emulsion being removed or the foreign object becoming attached to the film. The film should be hang in an area of good air circulation to speed up the evaporative process. This implies that the film will be subjected to dust particles in the air, as well as insects, etc. The degree of cleanliness of the processing room necessarily determines the amount of airborne contaminants. As most small commercial establishments and home workshops are not financially capable of providing near sterile conditions, the amount of contaminants present are of serious consideration. The invention is directed to this class of film processors and to provide them with a device requiring a minimum of attention to the drying process and yet permit non-contaminated dried film.

Referring to FIG. 1, enclosure 1, which may be cylindrical depending upon constructional considerations apart from the invention, houses the apparatus. A fan 2 and electric motor 3 provide the power for circulating the air. The motor 3 should be centrally mounted within the enclosure 1 by member 4 for best results. The fan 2 draws air through the open bottom of housing 1, or, if the bottom is not open, through apertures 5 located along the bottom portion of the housing 1, and expels the air through the open top. The top of the housing 1 may be covered so as to prevent the settling of dust and foreign objects within the housing 1 and have apertures (not shown) in the side of the housing for the air egress. A member 6, attached to the housing 1 and located above the fan 2, rigidly secures a pivotal member or axle 7 in relation to the housing 1.

FIG. 2 illustrates a commercially available film reel 8 used within the industry to process exposed film. The reel 8 may be briefly described as follows. The beginning and end of each of two identical spirals 9 and 10 are aligned so that the spirals 9 and 10 are coincident and mounted on an hollow axle 11 in a spaced relationship generally coincident with the width of the axle hubs 13 and 14. Radial members 12 extend from the axle hubs 13 and 14 and are attached to the spirals 9 and 10 at the points of intersection. The support members 12 are identically arranged on the exterior sides of each of the spirals. The number and crosssectional configuration of the support members 12 are usually deter-

mined by the size of the reel 8. Small reels, designed for 20 or 36 exposure 35mm films, generally have circular crosssectional support members 12, while reels designed for commercial rolls of film (up to 100 feet of 70mm film) generally have rectangular crosssectional support members 12. The axle 7 is designed to accommodate the hollow axle 11 of reel 8 so that the reel 8 is free to rotate about axle 7. A bearing 15 may be placed on axle 7 to support reel 8 and permit it to rotate freely.

In operation, fan 2 imparts an upwardly directed and circular air flow with the circulation being in the same direction as the rotation of the fan 2. This circular air flow strikes the support member 12 of the reel 8. As the sides of the support members 12 are struck by the circular air flow, a rotational force is applied to the reel 8. This rotational force is a function of both the circular air flow rate and the area of the sides of the support members 12. The rotational force exerted on the reel 8 will rotate reel 8 if the rotational force overcomes both the inertia of the reel 8 and the friction between the axle 7 and the reel 8. The air flow thus accomplishes two important and complementary functions simultaneously. The air flow passing through the reel 8 and necessarily adjacent the mounted film speeds the drying of the film by continuously supplying unsaturated air to evaporate the water. The air flow also causes the reel 8 to rotate. The rotation establishes a centrifugal force on the water on the film and tends to force the water to run to the periphery of the spiral. At the periphery of the spiral, the water is slung off the film. As the water travels along the spiral, a portion of it evaporates before it reaches the end of the spiral and could form "water spots" on the film. The invention also tends to inhibit the formation of these "water spots" because of the interrelationship of the spirally mounted film, the upwardly flowing air and the reel rotation. As the water travels due to the centrifugal force, it is also subjected to the upwardly flowing air. This air will tend to force the water to flow upwardly. At the upward extremity of the film, the film is in contact with the spiral member 9 and the relationship between it and the film is that of a channel, albeit an inverted channel, closed on the top and open on the bottom. Nevertheless, this channel will collect the flowing water, and as the water mass per wetted area is greater than that of a rivulet of water on the film, the water will be more responsive to the centrifugal force and more quickly dispersed to the extremity of the spiral. Thus, the time period of probable occurrence of "water spots" will occur during the time it takes for the water to be forced to the film sides from wherever it may be on the length of film, as opposed to the time it would take for the water to run the whole length of the film. This reduced time period is therefore of benefit.

In commercial film processing, time is always of concern and the minimizing of time requirements is both practical and profitable. When drying film, no advantage is obtained by continuing the drying process after the film is in fact dry. Thus, some determination of this condition would be beneficial. As the reel is placed on axle 7, it is wet and the water within the hollow axle 11 provides a lubricant to facilitate rotation. As an unexpected side benefit of the invention, it was found that this water lubricant will evaporate at approximately the same rate at which the film dries. Thusly, when the lubricant is gone, the rotating reel will squeak and it signifies that the film is dry.

Dust particles are always the arch enemy of film processing because they cause imperfections on the negative which will appear as black spots when enlarged, or as white spots on the prints. In order to combat this problem, especially in non-dust free environments, an air filter 16 may be disposed at the air ingress of the housing 1. The exact size and configuration of the filter 16 is not critical. It may be designed to accommodate any one of the readily available filters and should be mounted in a bracket 17 such that all air must flow through it. The size of the fan motor 3 will of course have to be selected to match the porosity of the filter 16 to provide an adequate air flow rate.

The evaporative process may be enhanced by providing heated air. A simple means for accomplishing this would be to dispose within the air flow an electrical heating element 18. Care must be exercised to prevent excessive heating which might curl or discolor the film.

FIG. 3 illustrates a modification to the invention in cases where the reel 8 is of small size such that the support members 12 thereof do not have sufficient side area to cooperate with the circular air flow and overcome the friction between the axle 7 and hollow axle 11. The truncated cone 22 in FIG. 3 is designed to be placed on axle 7 and rest on bearing 15, with the reel 8 placed on top thereof. The cone 22 may comprise an outer shell 19 attached to a hollow axle 20 by a plurality of vane-like members 21. In operation, the previously discussed circular air flow will impart a rotational force to members 21 and cause the cone 22 to rotate. The reel 8, resting on top of the cone 22 will also rotate. The diameter of the lower portion of the cone 22 is not critical but must be of sufficient size to provide for large enough vanes to overcome the inertia and friction previously discussed. The diameter of the upper portion of the cone 22 may be approximately the size of the reel 8 so that the air entering the cone 22 will be forced to pass through the reel 8.

FIG. 4 illustrates a further modification for drying a plurality of small reels. The assembly 26 is designed to fit on axle 7 and rest on bearing 15 similarly to reel 8. A base assembly 23 has attached thereto a plurality of vertical members 24 each suited for stacking one or more reels. In addition, reels may be stacked on axle 7 protruding through hub 27. The base assembly 23 may have a plurality of members 25 designed to interact with the circular air flow to cause the entire assembly to rotate, as discussed in respect to member 12 of reel 8. In addition to the assembly 26 rotating, the individual reels stacked on the members 24 will rotate about their own respective member 24 due to the fact that there is an air flow force gradient from the center of the housing to the housing side. As such, there will be an unequal air flow force on that half of the reel inward from its axle to that half outward from its axle. These force differentials, cooperating with the respective members 12 of each reel, will cause rotation of each reel 8 about its axle. The multiple reels may rest on bearings (not shown) similar to bearing 15 to facilitate rotation. If the rotational friction is relatively large and the air flow differential force is relatively small, the rotational force may be enhanced by resting each reel on a truncated cone, as described in respect to FIG. 3.

While the invention is particularly suited for drying roll film processed on reels, the nub of the invention may be applied to film processed on film holders 28 (See FIG. 5). These film holders are commercially

available for several different negative sizes and are used for individual negatives. Priorly, the negatives had to be removed from the holders to dry them, with the attendant dangers of dust and handling. With a support 29 such as shown in FIG. 5, the hangers 28 may be directly mounted thereon after the final washing by inserting one leg 30 of the support member 37 into slot 32 of the circular member 33. One side of frame 34 rests in the channel 35 of support member 36, where support member 36 is attached to circular member 33. The support member 37 is then generally parallel to the hollow central member 38 of the support 29. A cylindrical member 39 may be designed to fit over the member 38 and enclose the other leg 31 of support member 37 whereby the holder 28 is attached to the support 29. A plurality of holders 28 may be thusly attached to the support 29. In operation, the support 29 is mounted on axle 7 and the circular airflow coacting with the support member 36, in a fashion similar to that described for member 12, will cause the support 29 to rotate about axle 7. The lateral area of the negative surfaces, aligned in a vertical plane, will similarly coact with the airflow and ensure rotation of the support 29. The centrifugal force imparted to the rotating holders 28 will tend to cause the water to flow horizontally and upwardly to the outside edge of the negative, as discussed previously. The air flow will also promote evaporation of the water by more rapidly removing the saturated air adjacent the negatives.

While the invention has been described in its preferred embodiment, it is to be understood that the words which have been used are words of description rather than limitation, and that changes and variations may be made without departing from the proper scope or fair meaning of the subjoined claims.

I claim:

1. A film drying apparatus comprising:
 - a housing;
 - means for inducing a circular air flow within said housing;
 - a spiral film reel for mounting the film;
 - means for supporting said film reel including an axle disposed within said housing, and means for securing said axle in a spaced relation to the side of said housing; and
 - an open ended truncated cone, said cone including a hollow cylinder axially disposed within said cone for engaging said axle; a plurality of vanes within and attached to said cone for engaging the circular air flow, and means for mounting said film reel on said cone; whereby said circular air flow operably interacts with said film reel to effect rapid drying of the mounted film.
2. The apparatus as claimed in claim 1 wherein said supporting means further comprises
 - a base member rotatably cooperating with said axle,
 - a plurality of further axles, each said further axle being attached to said base member, whereby a plurality of said reels may be mounted on said further axles and responsive to said circular air flow.
3. The apparatus as claimed in claim 2 including plurality of open ended truncated cones, each comprising
 - a hollow cylinder axially disposed within said cone for engaging one of said plurality of axles,
 - a plurality of vanes within and attached to said cone for engaging the circular air flow, and
 - means for mounting a reel on said cone, whereby

each said cone aids in rotating its associated reel.

4. A film drying apparatus for drying developed negatives, said apparatus comprising:

an open ended cylindrical housing;

motive means for inducing a circular air flow through said housing; 5

means for mounting the developed film in alignment with the major axis of said housing, said mounting means including a hollow shaft having a hub at each end and two substantially identical coincidentally oriented spirals having the inner end of each said spiral attached to one of said hubs and capable of supporting said film therebetween; 10

means for rotatably supporting said mounting means within said circular air flow; whereby said film may be mounted intermediate said spirals with said circular air flow striking said aligned film at an angle and creating a force tending to rotate said mounting means. 15

5. A film drying apparatus for drying developed negatives, said apparatus comprising: 20

A. an open ended cylindrical housing;

B. motive means for inducing a circular air flow through said housing, means for mounting the developed film in alignment with the major axis of said housing, said mounting means including:

1. a cylindrical member engaging said supporting means;

2. a plurality of U-shaped members radially secured to said cylindrical member;

3. a plurality of film holders, each said holder being adapted to mount a section of film, said film holders being positioned within said U-shaped members;

4. a retaining ring circumscribing said cylindrical member and engaging a portion of each of said film holders; whereby the sections of film are radially disposed about said cylindrical member;

C. Means for rotatably supporting said mounting means within said circular air flow; whereby, said circular air flow, striking said aligned film at an angle, creates a force tending to rotate said mounting means.

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