MOTION PICTURE PHOTOGRAPHY FOR THE AMATEUR

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Chapter IX.

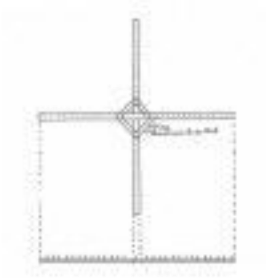
DEVELOPING AND PRINTING

First, if you wish my earnest advice—let some commercial laboratory do this for you. Did I not know the amateur so well, I should close this chapter here; but knowing him and knowing that he is never contented while some process remains un-investigated I clearly understand that I shall have to proceed. The actual steps necessary for the completion are almost identical with those in still photography, that is, the development of the film, fixing the negative, drying, printing, development and fixing of the print, drying and projecting. Of course, the usual washing and rinsing steps are included. The big difference lies in the fact that the usual motion picture film is a long and cantankerous piece of celluloid ribbon which winds its two hundred feet of snaky length about you at every opportunity.

Some kind of a rack is necessary to control this film in the course of development, and trays to enclose these racks are necessary. For convenience and the maintenance of a high moral code I should most earnestly advise that no lengths greater than fifty feet be attempted at one time. This length is ample for from one to five scenes, and if each scene be notched in the process of making the exposure, following each scene, the film can be divided into any convenient lengths. Trays to take a fifty foot rack are comparatively small, and in a pinch, these lengths can be dried by hanging from the backyard clothesline. These short lengths can be handled without any racks at all- in making preliminary trick picture tests I have often developed twenty-five to thirty feet of standard film without the use of a rack, but a rack is convenient and will make for cleanliness and will save much film which would be otherwise ruined.

Before proceeding with the description of the rack I shall mention the marking of the film. Professional cameras and many amateur instruments are equipped with punches which clip a portion of the edge of the film or punch a hole in it when pressed. However, these marks are so easily overlooked in the laboratory that most cinematographers at the termination of a scene crank twice to wind the end of the scene into the magazine, open the camera and clip out a triangle from the edge of the film, about a quarter of an inch deep, wind this past the gate, close the camera and crank the fogged film into the magazine. This provides an unmistakable mark for the guidance of the laboratory worker, and when dried, the fog makes the termination of scenes easily located. It is always well to be as saving as possible, but too great effort in this line will prove expensive in motion picture work, for only a few retakes will cost more than many feet of fogged and clipped film. The hand clipping has the additional advantage of keeping the interior of the camera box free of film shreds and clippings. True, catch boxes are sometimes provided, but they do not always work as they are intended to do.

We will now proceed with the description of the rack. This is made by carefully constructing a cross of wood with a mortised joint. The pieces should be of cypress, one by two inches, with the two inch sides uppermost. Starting about three inches from the center bore small holes every three-eighths of an inch along each arm.



Plan and side elevation of the developing rack for lengths of 100 feet and less. This shows bow the pins are set and the manner of winding the film. The tank is merely a box to hold the rack and is lined with acid-proof enamel.

Insert in each hole a brass pin which will extend upward a distance equal to fifty per cent more than the width of the film being used. Fifty millimeters will be ample for developing 38 millimeter film, and twenty-four millimeters will be sufficient for sixteen millimeter film. Now obtain a piece of cord five feet longer than the proposed capacity of the rack. Tie this to one of the center pins and wind it spirally about the pins, inserting pins as necessary, until enough have been inserted to take all of the cord. Now add another complete row and cut off the arms of the rack one inch beyond the last pins, and the rack is complete. The tray is simply a shallow wooden tray, one-half inch deeper than the distance from the bottom of the rack to the top of the pins. If the tray is of cypress it may be painted with tray enamel and used, but a better construction is to line it with galvanized iron or sheet lead and then paint it with tray enamel. Three such trays will be needed.

In the darkroom the, exposed film is removed from the magazines, the roll tightly held in the hand, and about a foot of the end pulled from the roll. The extreme end is then doubled about one of the inside pins and pinned with a common toilet pin. Then, unrolling just enough to place on the rack, wind it spirally about the pins until the length is on the rack or the rack is full. When using a full roll, feel the edges for clip marks, and at the last one felt, as the rack is nearly filled, tear the film, secure the free end as in the first place, by doubling about a rack pin and pinning. Now replace the remainder in the magazine before proceeding farther.

Winding the film requires attention to three points. First, any slack between the roll and the rack will inevitably result in finger marks, dust marks, dirty film and a legion of other troubles.

Second, the film must be wound tightly on the rack, as the film stretches in the baths and any slack would permit it to float out of the rack and become tangled. It is to prevent this that the pins extend upward above the film, so that ample developer can be used without entirely sub merging the pins: Third, be sure, absolutely sure, that the celluloid side of the film is next to the pins, otherwise your film will be ruined.

You will probably use Eastman film, and the best developer I have found for it is their No. 16 developer. I use this developer for both negative and positive— but never, never use the same bath for both negative and positive. Use the same formula, but not the same solution. The No. 16 formula, as furnished by the Eastman Kodak Company[1] is:

Water	One gallon
Metol	18 grains
Sodium Sulphite (des)	5 ounces, 130 grains
Hydroquinone	350 grains
Sodium Carbonate (des)	2½ ounces
Potassium Bromide	50 grains
Citric Acid	40 grains
Potassium Metabisulphite	87 grains

This formula is reduced from the original ten gallon formula and is based on avoirdupois weight.

The rack should be lowered into the solution slowly, then raised and lowered rapidly several times to clear the film of air bubbles. During development the film is examined from time to time and when the image shows up strong and clear on the back, rinse and immerse in the fixing bath which is the usual acid-hypo bath, made either with common alum and acetic acid, or with chrome alum and sulphuric acid.

When the film has been thoroughly fixed and washed it is ready to be dried. This can be done by hanging the film from a clothesline, pinning it up about every five feet, but such a method results in uneven drying and consequent uneven density in the finished film. It also is frequently the cause of dirt on the film, scratches and other faults and is most inconvenient.

A small drying rack is easily made, and will pay for itself in the improved quality of the first film dried upon it. Obtain two bicycle wheels and some light wooden strips, about one-quarter by one-half inch and as long as the rack is to be, three feet being ample for sixteen millimeter work, and for standard work it should be five feet long. This is calculated for thirty inch wheels. The strips are nailed to the circumferences of the wheels, about every six inches. The complete affair is a skeleton drum, a trifle more than thirty inches in diameter and as long as the strips. Sixteen millimeter film can be wound a layer in each inch, and two inches of linear space should be allowed for each turn of standard film. A drum three feet long and thirty inches in diameter will accommodate thirty- six turns of sixteen millimeter film, each approximately ninety inches long, therefore, 36 x 90=3,240 inches or 270 feet of film. This allows plenty of leeway. In like manner a five foot by thirty inch drum for standard film accommodates one turn for each two inches of length, so, each turn being ninety inches long, 90 x 30=2,700, or 225 feet. A drum of any capacity can be calculated using this method.

The drum is mounted on an axle, and some motive power is applied which will keep it turning, thus assuring even drying and consequently even density. A small sewing machine motor, or even one of the smaller 110 volt motors used to operate toys, will serve admirably. In case a large pulley is not at hand, the belt can be run over one end of the drum itself. A third bicycle wheel fastened to one end of the drum makes a fine pulley. The motor drive wheel should be small enough that the drum makes from one-half to two revolutions per second. The movement must be slow enough that there is no danger of the film being thrown off the drum, but it must be fast enough to ensure even drying of the film.

When the film is dry, it should be polished before removal from the drum. This is done by moistening a piece of chamois leather in alcohol and while turning the drum by hand, briskly rub the celluloid side of the film with this moist pad.

The drum should be placed in a room which is comparatively free of much dust, and care taken to keep the air as clean as possible. It is interesting to note in this connection that some of the large commercial laboratories have spent thousands of dollars for the installation of apparatus for washing and filtering the air before it is admitted to the building. The ideal amateur drying room would be one of cement which could be flushed with a hose a few hours before the film is to be dried. The film is placed on the drum and this is rotated until the film is dry to the touch as explained, it is then polished and removed, but even though spoken of as “dry” the film is not entirely dry and will not be for some days. During the process of development the film stretches and does not return to its original length for a week or more after removal from the rack. This stretching amounts to only a few thousandths of an inch in each frame and would seem to be inconsequential, but it is very important as will be seen when the printing process is described. After thorough hardening and setting it is ready for the printer.

I purposely omitted mentioning the sixteen millimeter film in the paragraphs on development. For the amateur to try to finish his own sub-standard would be pure experimentation, hardly justified, for the finishing is paid for in advance when the film is purchased. However, I shall give the process which was published in the British patent reports, and should some experimenter care to work with it I am sure the Eastman Company will not object, inasmuch as the said amateur has paid them for work which they will not be required to perform. In the first place, the new sixteen millimeter film is said to possess remarkable latitude as compared with the standard film, but nevertheless, the exposure should be carefully calculated. The developer is a hard developer as will be seen by this formula:

Sodium Bisulphite	192 grains
Hydrochinon[2]	192 grains
Potassium Bromide	192 grains
Water, q. s	16 ounces

The second solution is:

Sodium hydroxide	384 grains
Water, q. s	16 ounces

Take—

Of first solution	24 ounces
Of second solution	24 ounces
30% sol., hypo	192 minims
Formaldehyde	100 to 200 minims

Develop five minutes at eighteen degrees centigrade. (Approximately 65 degrees Fahrenheit.) The hypo tends to clear the highlights, and the formaldehyde is the old familiar hardener, both may be dispensed with, but it is better to retain them. After a thorough washing in running water for fifteen minutes, the film is placed in the reversing bath, not unlike the autochrome reversal bath. The formula is:

4% solution Potassium permanganate	5 ounces
20% solution Sulphuric acid	5 ounces
Water, q. s	100 ounces

If the film is not kept in constant motion in this bath a precipitate of manganese dioxide will be formed upon the gelatin emulsion. The action of the reversal solution is allowed to continue until all of the metallic silver is dissolved. As the undeveloped silver in the film is rendered insensitive by the reversal bath, this process may be completed in daylight. When the action is complete the film is removed and washed in a two per cent solution of sodium bisulphite to remove any manganese compounds which may have formed in the film. Five minutes is sufficient. This restores the sensitiveness of the undeveloped silver. Now comes the critical part. Some footage should have been made for test purposes. After the last mentioned bath the film is rinsed, and short strips exposed to diffused daylight and developed. At times there occurs here a second reversal, and if this occurs, bathe for three minutes in a one-tenth per cent. solution caustic potash at a temperature below eighteen degrees centigrade. However, this does not often occur. When the proper printing light has been determined, the film should be run from one reel to another past the source of light, until each portion of the film has received the proper amount of light. Then by proper safelight develop in any good developer. The recommended formula is:

Metol	17.66grains
Sodium sulphite	384grains
Hydrochinon[3]	70.66 grains
Sod. carbonate	38.5 grains

Pot. Bromide	7.7 grains
Water q. s	16 ounces

After development the film is rinsed and may be fixed in white light. It is then thoroughly washed and dried.

So, if you want to experiment, there you are! As for me, I think that I shall send my sixteen millimeter film to the factory for finishing. I have developed so much motion picture film that I am perfectly willing to avoid any such drudgery possible.

We shall now return to the finishing processes of the standard gauge film. We left it when we had obtained our dried negative film. Let us hope that it has hardened while we discussed the reversal of the sub-standard film

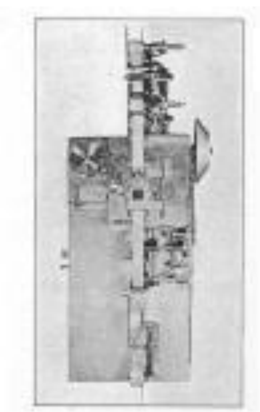
Two types of amateur continuous printers for short strip work

The negative is now ready for the printer. Motion picture printing machines are divided into two great classes. These are continuous printers and step printers. The continuous printer feeds the negative and the positive stock through a gate and past a source of light, both films moving at a constant, uniform speed. The control of this type of machine may lie in any combination of these factors. (a) The speed of the machine, (b) the width of the gate slit which admits the light to the film, (c) the distance of the light from the film and (d) the intensity of the light used. As one machine may combine all of these controls, an unnecessary delicacy of control is possible. This would seem to be an admirable type of machine, and when a perfect negative is used, it is entirely satisfactory, but with the exception of one or two high priced machines, the usual continuous printer is made for amateur and short strip use only. This is because of the creeping of the film. Suppose that the negative has stretched one one-thousandth of an inch in each frame. There are sixteen thousand frames in a reel, so the stretching in one reel would amount to sixteen inches! If an entire reel were to be printed this would mean theoretically that the frame would gradually sink and drop from the screen sixteen times in the reel. The frame line would be constantly dropping across the screen only to reappear at the top as soon as it disappeared at the bottom. Fortunately, in practice, it is not sobad as this. First the film is usually printed in two hundred foot lengths or less, arid second the cogs on the sprocket wheel tend to pull the two films into alignment, and when they can no longer do so, the teeth ride the film, tear it and the machine jams. I have seen frame lines jump a sprocket hole at a time, however. Despite this, Messrs. Bell & Howell for some years made a highly perfected continuous printer which was used widely in producing professional film, so it may be seen that the difficulties are not insurmountable.

However, the step printer must be acknowledged the superior. In this type of printer, the film is advanced by an intermittent movement just as in the camera and projector. Naturally, as synchronized shutter and intermittent movements are costly, this type of printer is comparatively costly.

The U. S. Cinematograph printer. This is a good step printer suitable for professional work although it lacks some refinements of the best machines.

The film being advanced by an intermittent, and moving freely during the time the shutter is dark, any stretching is compensated for on each frame, and green film may be made to give a very satisfactory print. The controls of this type of printer are the same as in the continuous type, with the exception of the variable slit. In the step printer, the aperture is fixed and determines the dimensions of the frame on the positive. The intermittent movements vary, but most of them are either of the Williamson type of claw or some variation thereof, or the Geneva star, the one movement which is used in cameras, printers and projectors alike



The Moy printer. This is another inexpensive type of step printer which will give professional service. This printer costs about $400.

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Most of the amateur printers offered at a low price, that is less than one hundred dollars, are of the hand driven continuous type, and for short strip work, i.e., fifty feet or less they will give beautiful results.

In printing it is well to make test strips a foot or so long, or at least such should be done until you become a proficient judge of film density. This test method will enable you to obtain the best results with a minimum loss of film. Film should be printed so that it is completely developed in four minutes at sixty-five degrees. Some laboratory technicians print a two-minute film and others range up to a ten-minute film. I have tried all of them and I have found that a four- minute film gives what I consider the best projection image. However, this will be a matter for individual choice, but until you are sufficiently proficient to experiment I should advise the four-minute film. I shall mention here the method employed in the large laboratories for printing scenes of various density. A man of wide experience in judging film density inspects the film, and marks the relative exposure on a card and clips the edge of the film with a special clip at the end of each scene. The machine is set by dial or pegs in a switchboard to correspond with the density marked and the film run through the machine. As each clip passes the gate, an automatic switch changes the resistance of the lighting circuit so that the light intensity is changed to the proper degree. Thus one expert can handle a battery of printers whose actual operation is supervised by girls who need have no technical knowledge. These machines cost from one thousand dollars upward.

The developer used for the print is the same number sixteen which is used for negative development, and my standard of four minutes development is calculated for this developer. Of course, there is always the chance to save a poor print by doping the developer, but frankly, I have little faith in such work. I have known photographers good men too, who habitually have a half dozen or so variations of their favorite developer stock always on hand, and wonderful indeed, are the results they claim for doping. They produce beautiful work, and there may be some basis for their claims, but in my hands doping has always been merely a process for saving a very poor film from utter destruction I have found that there is but one way to obtain good film and that is to make the correct exposure to start with, and this applies alike to both negative and positive. This must then be developed in the proper standardized developer and at the proper temperature.

Serious photographers have always recognized the importance of proper exposure, but the modern film for small cameras has been made so nearly fool proof, and will stand so much abuse that most amateur workers do not know to this day how to judge proper exposure. When a film may be exposed one second or twenty-five seconds on the same subject, and both give really good pictures it is small wonder that this should be the case. However, motion picture film incorporates so many conflicting qualities that latitude cannot be expected in the same degree as is found in still work. In every branch of motion picture work you will find the limitations more severe than in still work, although the lantern slide man will find himself comparatively at home. This is a good thing. After you have mastered cinematography and can produce good motion film under a variety of conditions, you will have but few failures in still work—if you apply the knowledge which you must have obtained in cinematography.

The positive film is developed, fixed and washed in the same manner as the negative. It is well to use a fairly strong acetic acid hypo bath and to wash in running water for thirty minutes.

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[1] A full list of professional formulae for developers, fixing bath, tinting, toning and so forth, as well as detailed theoretical discussion of the technique of cinematography can be found in the "CONDENSED COURSE IN MOTION PICTURE PHOTOGRAPHY," published by the Falk Publishing Co., N. Y.

[2] A synonym for Hydroquinone

[3] A Synonym for Hydroquinone