NEW MOTION PICTURE APPARATUS

During the Conventions of the Society, symposiums on new motion picture apparatus are held, in which various manufacturers of equipment describe and demonstrate their new products and developments. Some of this equipment is described in the following pages; the remainder will be published in subsequent issues of the Journal.

A NEW TREATMENT FOR THE PREVENTION OF FILM ABRASION AND OIL MOTTLE*

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General film appearance and picture quality have long been major problems with the motion picture industry. Of the numerous factors influencing screen quality, this paper will deal with two, namely, film abrasion and oil mottle.

The former of these, film abrasion, has been the object of much research leading to a large number of patented processes, some of which are in use in the trade. These processes, in general, leave something to be desired, either in effectiveness or in price, frequently in both. They depend for their effectiveness on the principle that the treated surfaces will be more resistant to abrasion than those not similarly treated. Whereas this may be true in some cases, the fact remains that no practical film surface has been found which will resist abrasion indefinitely. Therefore, when these treated surfaces become abraded, they present the same problem as do any other scratched films.

Protection of Film from Abrasion.—Experiments have been conducted in this laboratory and in the field with a new type of film treatment based on a new principle. The aim has been to devise a lacquer which can be applied easily and removed easily. This lacquer, when applied to both sides of the film, becomes scratched just as the film surfaces would have been scratched by any sharp points coming in contact with it. If the thickness is correct, however, normal scratches do not go through the lacquer layer into the film. Therefore, on removal and renewal of the lacquer, the film is found to be in as good condition as when new.

As for the lacquer itself, it was necessary that it fulfill certain definite requirements. These requirements were:

(*1*) Its manner of application must be simple, requiring practically no special equipment.

(*2*) Its rate of application must be comparable to average processing speeds.

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(*3*) It must be easily removable without the aid of solvents or special equipment.

(*4*) It should be applicable to both sides of nitrate and safety films without any deleterious effect upon physical properties, such as curl, flexibility, moisture absorption, *etc.*

(*5*) It must dry rapidly to give a smooth coating of glossy appearance. The reason why a glossy surface is essential will be discussed later.

(*6*) It should make the films fingerprint-proof.

Let us now see how the Eastman Protective Film Lacquer fulfills these requirements.

Application of Lacquer by Wick Method.—Fig. 1 shows the simplest manner by which this lacquer may be applied to either 16 or 35-mm films. In this method

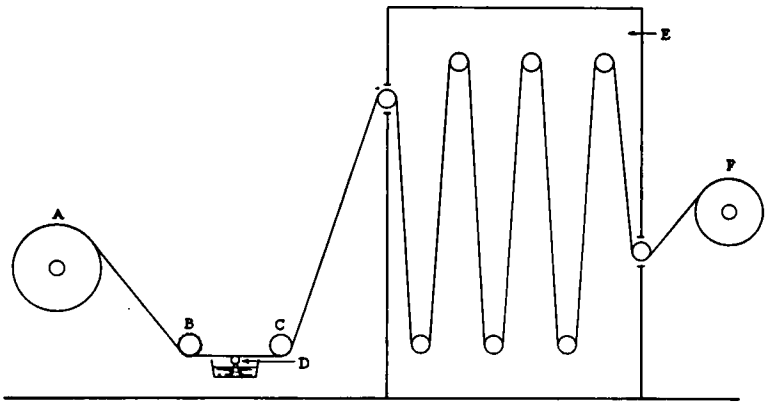

FIG. 1. Apparatus for applying Eastman Protective Film Lacquer to the entire surface of 16 or 35-mm film by means of a wick: (*A*) stock roll; (*B*) drive sprocket; (*C*) idle roll; (*D*) plush wick and holder; (*E*) drying cabinet; (*F*) take-up roll.

the entire width of film, perforated area included, is coated with the lacquer. This is accomplished by drawing the film from the stock roll over a strip of plush wet with the lacquer and thence into the drying cabinet and onto the take-up roll. In the case of this plush wick method, the thickness of the coating will depend somewhat upon the speed of application. At high speeds the coating may become quite thin due to the inability of the wick to absorb liquid rapidly enough. If the coating becomes too thin the covering power of the lacquer will be impaired and proper protection against abrasion will not be provided. It is suggested that this method be used only for speeds of application of 50 feet per minute or less.

Fig. 2 shows a close-up of the wick and lacquer pan. A suitable wick may easily be constructed by clipping a strip of plush around a glass rod by means of a wire stapler.

Fig. 3 shows a plush or felt-covered roll which may be used in place of the stationary wick. The roll is driven slowly in a direction opposite to that of the film travel. In this case the thickness of the coating is independent of the film speed,

as the speed of the roller wick may be increased in the same order as the film speed is raised. The speed of application, therefore, will be limited only by air cabinet capacity, *etc.* Applications should be satisfactorily made at speeds as high as 150 feet per minute.

Application of Lacquer by Bead Method.—Fig. 4 shows the apparatus for applying the lacquer to the picture and sound-track area only of 35-mm film. In this method the film is wrapped tightly about the idle roll *D* and the lacquer is applied by means of an auxiliary roll *E* which revolves slowly in a pan of lacquer. This applicator roll *E* does not quite come in contact with the film in operation but at the beginning of the coating it is brought momentarily into contact with the film on the idle roll *D*, and then the two are separated slightly. The bead of liquid which forms between the film and the applicator roll is thereafter maintained and the coating is accomplished by this liquid bead and not by contact with the applicator roll. By this means a smooth layer of lacquer is applied onto the film from perforation to perforation. These edge lines are quite sharp and may be maintained to within about 0.002 inch from a straight line. This method, although

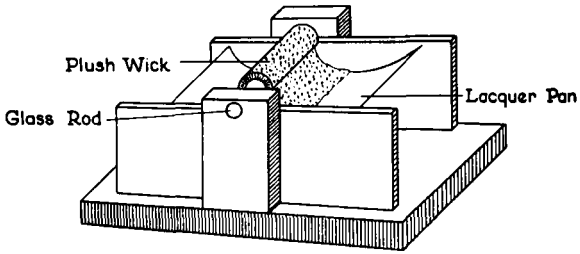

FIG. 2. Close-up of plush wick and lacquer pan.

more complicated than the wick method, gives coatings of greater thickness and better appearance. It is especially adaptable to negatives, duplicating negatives, master positives, and the like, since no lacquer reaches the perforated area and therefore can not cause trouble from the standpoint of dirt, positioning, *etc.* In the case of this bead method, the thickness of the coating is dependent not only on the relative speeds of the film and applicator roll but upon the distance between the applicator roll and the film. By this method lacquer has been continuously applied to 35-mm films at a speed of 150 feet per minute.

Removal of Lacquer.—The protective coating can be removed easily by immersion for one or two minutes in 1-per cent sodium carbonate at 65°F, followed by a clear water rinse. In practice, therefore, the coating can be removed easily and completely by passing the film through a machine similar to a processing machine in which the film is given a two-minute immersion in 1-per cent sodium carbonate followed by a clear water rinse (Fig. 5). In order to avoid the possibility of emulsion-stripping in this removal process, it is recommended that the sodium carbonate solution contain 1 per cent by volume of commercial formalin solution. This will prevent swelling of the emulsion and likewise minimize the possibility of emulsion-stripping on films which have not been hardened sufficiently in the original processing operation.

Fig. 6 illustrates the removal of the lacquer in a regular processing machine merely by the substitution of a neutral rinse for the customary acid stop bath following the developer.

Effectiveness of Treatment.—Thus the requirements in regard to simplicity of operation and speed of operation have been satisfied. Furthermore, comparison of coated and uncoated films both immediately after coating and after service in the field has shown that there has been no noticeable change in physical properties. In addition, fingerprints may be removed completely from the coated film by gentle wiping.

Films treated with this lacquer will be protected against all ordinary cinch marks and against the normal scratches found on most films which have been in service in the trade. It would be ridiculous, of course, to pretend that any lacquer of a thickness of 0.0001 inch could not be scratched through, if conditions are severe enough. Our experience, however, indicates that such scratches seldom occur in practice.

There is one other point in regard to this scratch-protective layer that should be mentioned. It has been pointed out that our aim was to apply a lacquer

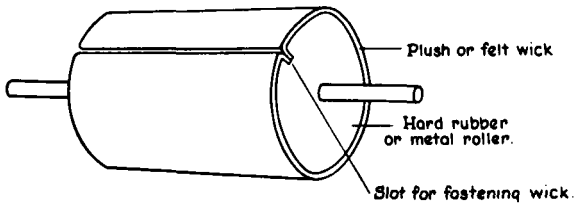

FIG. 3. Plush or felt-covered roll for continuous high-speed wick application of lacquer.

which would bear the scratches which would normally be found on the film. The question naturally arises, "To what extent does the coating itself become scratched? Does it scratch more or less readily than normal film surfaces?" This question can be answered at the present time only in the following way. Laboratory comparisons have indicated that the coated films have approximately the same scratch resistance as untreated films. However, without a single exception, the experience with these coated films in the field has indicated that they are definitely more resistant to abrasion than the uncoated checks. The ultimate answer to this question must be deferred until more practical information has been accumulated.

Protection of Film from Oil Mottle.—To this point we have been concerned with film abrasion. We will now consider the closely allied subject of oil mottle or, in other words, the continual flicker on the screen due to oil spots on the film. In the course of our study, it soon became apparent that flicker due to oil on the film was more detrimental to screen quality than was the occasional scratch. Scratches which are extremely prominent to the technical people of the industry nearly always go completely unnoticed by the average theater patron, due, no doubt, to absorbing interest in the story. On the other hand, flicker on the screen must be avoided by all means. Noticed or unnoticed, this mottle most surely has its

effect upon the eye and upon the fatigue of the spectator. Although no scientific proofs of this are available, I believe that the comments of the spectators who are allowed to see both clean film and oily film, one after the other, are sufficient indication of the increased pleasure in viewing the mottle-free film.

This question of oil on the film has not had the attention given to it which it deserves. Heretofore, it has not been thought of as an actual damage to the film as is the more conspicuous scratch. Furthermore, one has thought that if oil does get on the film it can be removed by cleaning. It is true that oil may be removed easily from a small area of film with a clean pad and fresh carbon tetrachloride, but it is quite another matter to clean an entire roll effectively without streaks, bloom, abrasion marks, *etc.* Thus it is that oil, which often gets on the film on its initial run, regardless of the quality of the house, usually stays there throughout the life of the film. Large sums of money are spent by film manufacturers, processing laboratories, and studios in order that the photographic quality of the

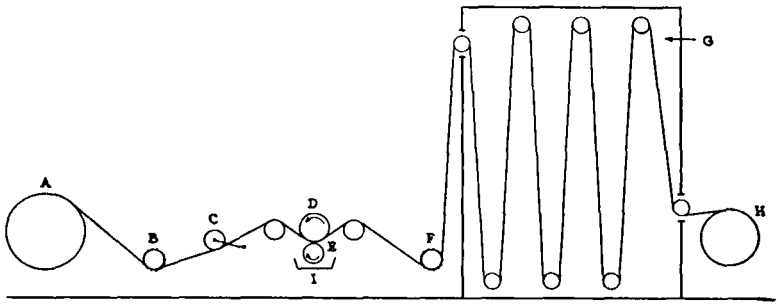

FIG. 4. Apparatus for applying protective film lacquer to the picture and sound-track area only of 35-mm film by means of a liquid bead: (*A*) stock roll; (*B*) drive sprocket; (*C*) float roll (oil-damped); (*D*) idle roll; (*E*) driven applicator roll; (*F*) drive sprocket; (*G*) drying cabinet; (*H*) take-up roll; (*I*) lacquer pan.

pictures may be maintained at the highest possible level, yet this oil mottle often nullifies completely the careful work which has been done on the picture to this point.

The reason why oil spots on film produce mottle is well understood. Each oil spot produces a glossy surface which permits more of the light from this area to be focused on the screen than from the neighboring unoiled surfaces.

The remedy, of course, is to make the whole surface glossy so that there will be no more light coming from the oily spots than from the rest of the surfaces. This lacquer accomplishes this to a remarkable degree. Although the trained eye can readily distinguish the oil, even on the lacquered film, the improvement is great enough so that most spectators would feel that the mottle is entirely eliminated.

Results of Field Tests.—For the evaluation of the effectiveness of this lacquer treatment under actual trade conditions, a feature picture was placed at our disposal by the Metro-Goldwyn-Mayer Company. A portion of this print was given the lacquer treatment at the time of release. The entire feature was then

put into service through the Buffalo Exchange of M-G-M. At intervals the print was brought to the laboratory for examination. This allowed a comparison to be made between the untreated sample and the lacquer-treated sample in respect

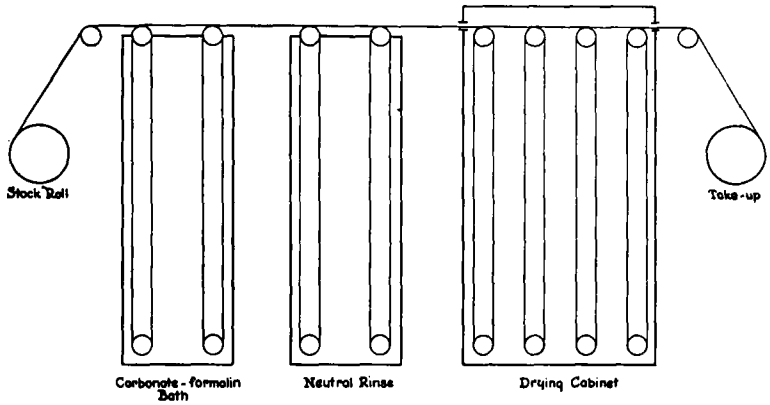

FIG. 5. Apparatus for removal of protective film lacquer by means of carbonate-formalin solution.

to abrasion and oil mottle. Screen tests of the two samples clearly indicated that the abrasion of the lacquered sample was considerably less than that of the untreated sample. Likewise even though there was the same amount of surface oil on both films, the mottle on the screen due to this oil on the treated film could

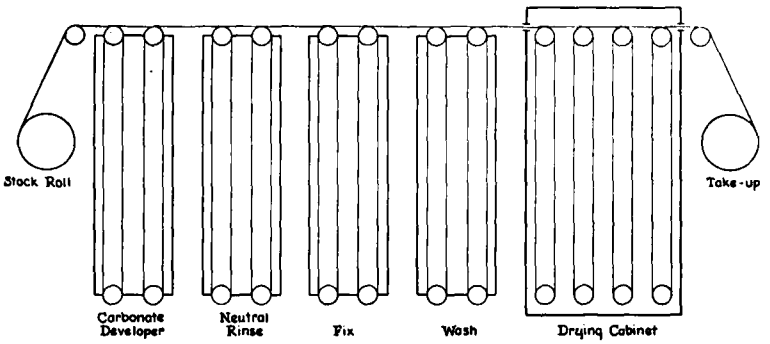

FIG. 6. Regular processing machine used to remove the protective film lacquer.

be detected only with difficulty, whereas that of the untreated sample was very pronounced.

When sufficient reduction of screen quality resulting from abrasion was noted on the treated samples, portions of them were retreated, *i. e.*, the original lacquer removed in carbonate solution and a fresh coating applied. Consequently that

portion of the print which was thus retreated from time to time retained "new print quality" throughout the 35 bookings or approximately 164 runs.

Remarks.—It should be mentioned that the solvents employed are similar in inflammability to ethyl alcohol, and therefore all electrical equipment such as light fittings, motors, switches, *etc.*, should be solvent-vapor-proof. Recirculation of the air in the cabinet is inadvisable. The exhaust vapors should be conducted outside the building. The solvents are similar to those used in quick-drying lacquers and finishes, and the same care should be exercised as when handling any inflammable volatile organic solvents.

Acknowledgment.—Acknowledgment is made to Mr. W. D. Kelly of Metro-Goldwyn-Mayer for the use of their prints for the preliminary field tests. Acknowledgment is likewise made to Mr. J. H. Spray of the Ace Film Laboratories, Brooklyn, for the practical information gained in his plant on the use of the lacquer during the past year on color-films as well as on black-and-white negatives and prints.

DISCUSSION

QUESTION: What is the cost of applying the lacquer?

* MR. TALBOT: The cost of materials is about $0.40 for each side for each 1000-ft roll. The labor cost will vary from almost nothing, if the lacquer is applied on the processing machine and no extra help is required to take care of it, up to $0.50 or $1.00 a roll if a special job is made of it and only a few rolls are treated.

QUESTION: Can the lacquer be applied to various types of color-film?

*MR. TALBOT: The difficulty with the application to color-film is that most color processes utilize dyes which are soluble either in water or dilute sodium carbonate which makes the removal of the lacquer difficult. It has been used commercially for some time by the Ace Laboratories for coating their duplitized color-prints largely for the purpose of the elimination of oil mottle, although the scratch resistance of the lacquer itself is also a factor. The new universal lacquer can be removed by an alcohol treatment, although care must be used to avoid warping the film. Experiments are under way with this new type of lacquer and the use of isopropyl alcohol for its removal from Technicolor film.

The application and removal of the lacquer by carbonate solution is entirely satisfactory in the case of Kodachrome.

QUESTION: What is the cost of equipment for applying the lacquer?

*MR. TALBOT: That depends entirely upon the set-up. It is to be assumed that any processing laboratory will have equipment available, such as the stock roll, drying cabinet, and rewind mechanisms; therefore, the only special equipment is the coating unit. The cost of this coating unit will depend on the method employed. If the simple wick method is employed for speeds of 50 feet per minute or less, the cost of the equipment will be but a few cents, *i. e.*, a strip of clean plush, a glass rod, and a lacquer pan. If the wick method is to be employed for speeds greater than 50 feet per minute, a plush-covered driven roll is necessary. The cost of this equipment will be the cost of a small motor plus the cost of a slotted roll for holding the plush. The cost of this roll should not exceed $5.00.

For bead application the coating unit is somewhat more complicated and should be made with great precision, if the unit is to operate satisfactorily at high rates of

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* Communicated.

speed. Detailed plans of such a unit are available from the Eastman Kodak Company upon request.

QUESTION: How many release prints could be made from a negative coated with this lacquer?

*MR. TALBOT: The Ace Laboratories made 375 prints from a negative which had been coated on the emulsion surface with the protective film lacquer. It was not necessary to remove the lacquer from any reel during this printing. After the 375 prints were made the coating was removed and the negative appeared to be in just as good condition as before release printing began. Presumably the negative could be recoated and another 375 prints made. Possibly this cycle can be repeated many times.

QUESTION: Is it necessary to use sodium carbonate solution for the removal of the lacquer or will any alkaline developer suffice?

*MR. TALBOT: Laboratory tests indicate that any alkaline developer will remove the lacquer in about two minutes and that the neutral rinse following the developer is not absolutely necessary. The use of a carbonate-formalin bath followed by a neutral rinse gives an additional factor of safety, but it is believed that the coating can be completely removed by passing the treated film through a commercial processing machine.

QUESTION: Will the removal of the lacquer by developer harm the developer in any way?

*MR. TALBOT: No, we believe not. The tests that we have run indicate that there is no change whatever in the action of the developer after its use to remove the lacquer. It would be necessary, however, to run this test on a much more extensive scale and with a wider variety of developers than we have used to be absolutely sure that no effect whatever occurs.

QUESTION: Is the lacquer available in large quantities?

*MR. TALBOT: The lacquer which the Ace Laboratories have been using for the emulsion side only is available in large quantities. The universal lacquer which is applicable to both sides of nitrate and safety films is available at the moment in sample lots only (one gallon), but unless something entirely unforeseen happens, it will be available in large quantities in a few weeks.

RECENT DEVELOPMENTS IN 8-MM COPPER-COATED HIGH-INTENSITY POSITIVE CARBONS*

W. W. LOZIER, G. E. CRANCH, AND D. B. JOY**

Since the introduction of the "Suprex" carbons about seven or eight years ago[1] there has been a remarkable expansion in the use of these small-diameter, copper-coated carbons. The rapid growth of this type of arc is evidenced by its use in the majority of all the medium-size theaters in the country. The wide acceptance of

* Presented at the 1940 Fall Meeting at Hollywood, Calif.; received October 25, 1940.

** National Carbon Company, Fostoria, Ohio.