8mm Color Positive Release Prints With Magnetic Sound: A Progress Report

By ROBERT A. COLBURN

Silent 8mm color reduction prints were produced almost 25 years ago. Constant improvements in methods and materials led to many commercial uses. Although a paper on 8mm magnetic sound was first presented to the Society in 1947, little progress was apparent until late 1959. The Geo. W. Colburn Laboratory adapted existing equipment and designed and built new equipment to meet the demand for quality 8mm color sound prints in volume at a cost substantially lower than that of 16mm prints, despite the many additional operations involved.

THIS PRESENTATION is not intended to be a technical treatise, but rather a progress report on the present state of 8mm color sound print production techniques as developed within our own organization.

The production of 8mm color reduction prints was first offered to the amateur trade almost 25 years ago when color film first became available for 8mm cameras. Prints were then made on the early Type A emulsions, one 25-ft roll at a time, on a primitive printer now out of existence, as far as we know. Exposure corrections were made visually during the printing operation by means of changing the lens opening manually. After color duplicating stock was introduced we were able to improve quality, and a new printer was built which made it possible to include automatic scene-to-scene exposure corrections.

By 1946 there was some activity in making quantity release prints in 8mm. Scenic subjects such as Eruptions of Mauna Loa, The Wonders of Luray Caverns, found a ready market for travelers who wished to supplement their own moving pictures. The old problem of quantity printing from a single original film and also the desire to introduce fades, lap dissolves and overlay titles led to the making of low-contrast 16mm reversal masters from which almost any quantity of 8mm prints could be made. While quality suffered somewhat, because of second generation printing, the introduction of Eastman Reversal Print Film, Type 5269 duplicating stock in 1956 made this method commercially acceptable. At one time, attempts were made to lower printing costs by use of a double 8mm color reversal master, but they were abandoned by our laboratory because of poor quality. In the meantime, some activity became apparent in the commercial and industrial field which used the 8mm color film as a demonstration reel for a particular product.

With the development of a continuous magazine for 8mm film in August of 1959, commercial use of continuous loop demonstration films was launched. Two such devices were then available. One, a complete package setup, was developed by Technical Services, Inc., in Farmington, Mich. It uses a Kodak 300 Projector reflecting the image off a mirror onto a rear-projection screen. The entire unit is enclosed in a fiberboard display. Operation can be continuous or actuated for one complete run by a pull ring on the front of the display. This device features a center-drive continuous magazine, connected by a rubber tube to the take-up spindle.

Cousino Electronics Corp. in Toledo had adapted its continuous $\frac{1}{4}$-in. tape Audio Vendor magazine to 8mm film use, calling it a Visual Vendor, and by specially designed brackets could mount it on almost any make of projector. A subsequent refinement of this magazine is at present being used in special projection equipment now on the market.

Before the end of 1959, Eastman Kodak Co., in preparing to market its new Kodak Sound 8 Projector, asked the Geo. W. Colburn Laboratory to supply a demonstration reel with sound, to be packaged with each projector. This was not an easy assignment, especially since thousands of prints were required to keep up with the Eastman delivery schedule. Equipment had to be designed or adapted to handle the numerous steps involved, and methods devised to assure a steady, large flow of the finished prints.

Camras Work on Magnetic Sound for 8mm Projection

Before discussing this relatively new method of producing 8mm color sound release prints in quantity, let me say that "magnetic sound for 8mm projection" is not new. In April of 1947, Marvin Camras of the Armour Research Foundation presented a paper* at a Chicago SMPE Convention titled just that: "Magnetic Sound for 8mm Projection." In it, he describes how several silent projectors were converted to include a magnetic soundhead and demonstrations were made, apparently requiring apologies for lack of "high fidelity" and presence of "wow." His conclusions have a familiar ring:

"It is apparent that magnetic sound has a number of special advantages for the amateur: (1) recordings can be made in the home, without special equipment; (2) they can be played back immediately without processing; (3) records may be erased and re-recorded; (4) old films can be adapted for sound by adding a track; and (5) present silent equipment can be converted for sound."

To me the discussion following the paper is most interesting. *Question:* "What progress is being made toward commercializing the coating process?" *Answer:* "You have to have both things simultaneously. You have to have projectors that will use the film and you have to have the film. The laboratories that coat the film will want the market for it, and those who make the projectors will want the film available. We hope that within a few months there will be some of this film available commercially and possibly some experimental equipment to use it."

The "few months" stretched out into numerous years until The Calvin Co. in Kansas City introduced in 1952 its 8mm magnetic sound projector. Perhaps Mr. Camras' prediction "You have to have both" was the reason this projector was eventually discontinued.

Renewed Activity on 8mm Magnetic Sound Projector

Suddenly, the whole project got into motion. The May, 1960, issue of *PMI* (*Photo Methods for Industry*) pictured no less than six then-available 8mm magnetic sound projectors, four of them completely new, and two merely silent projectors with soundheads attached. Since then many advances have been made and additional projection equipment has been offered.

With the introduction of Eastman, Color Internegative Film, Type 7270, an entirely new method of production became possible. We found that by making direct reduction prints from this material to Eastman Color Print Film Type 7383 (8mm color positive) we could attain a far better quality than by any other intermediate method.

Our first problems at the time, of course, were to perfect the making of

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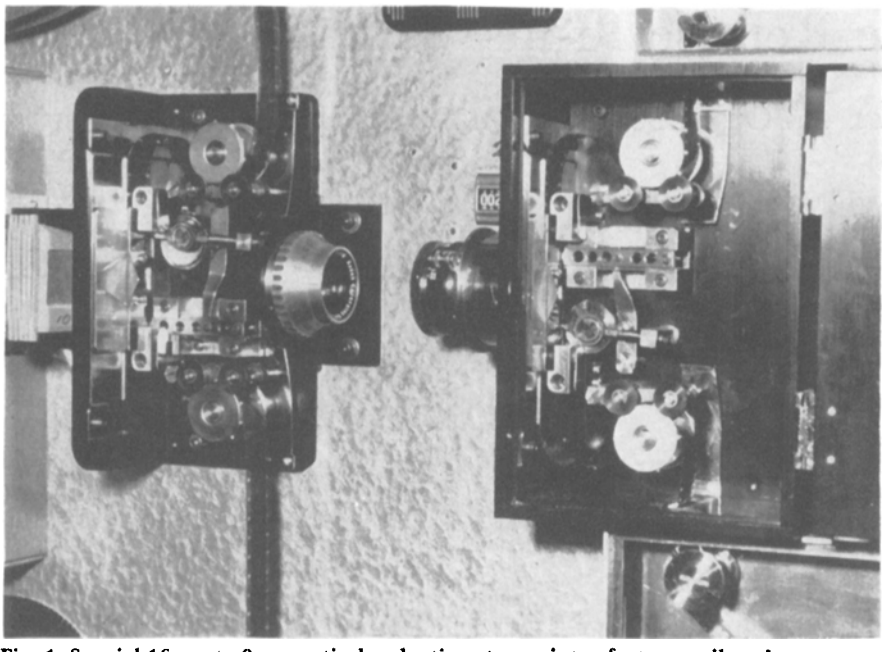


Fig. 1. Special 16mm to 8mm optical reduction step-printer features pilot-pin construction on both heads for maximum steadiness.

16mm color positive sound prints as described in "A Symposium on 16mm Internegative/Positive Release Printing" presented on October 20, 1958, at the Society's Convention in Detroit and published in the September, 1959, *Journal*.

Producing 16mm color positive optical sound release prints is now to us a relatively simple process. After an exposure and color-corrected color internegative picture and a negative optical track have been prepared, prints are made with one pass through a high-speed continuous printer running at 300 ft/min. The color picture is processed, and the optical track is redeveloped to a silver image in a single pass through the processing machine and comes off ready for projection.

For 8mm color sound printing we begin at about the same place, with a suitable 16mm color internegative (the same one used for 16mm release printing, if desired) and preferably a 16mm magnetic mix of the soundtrack, although a 16mm optical positive track can be used satisfactorily. Here all similarity ends.

We found that an entirely new reduction printer had to be designed and built because of the physical and photographic characteristics of the two film stocks involved. Ordinary optical step-printer mechanism design was not adequate, and it was necessary to devise pilot-pin construction for both 16mm and 8mm heads as shown in Fig. 1 to assure maximum steadiness. Printer speed is limited, therefore, to 45 16mm ft/min. A more powerful light source was required than on previous reduction printers to compensate for the slow speed of color positive. No scene-to-scene exposure or color correction facilities are needed, however, since these corrections are made in the internegative. There is provision for overall color correction to accommodate differences in emulsion sensitivity.

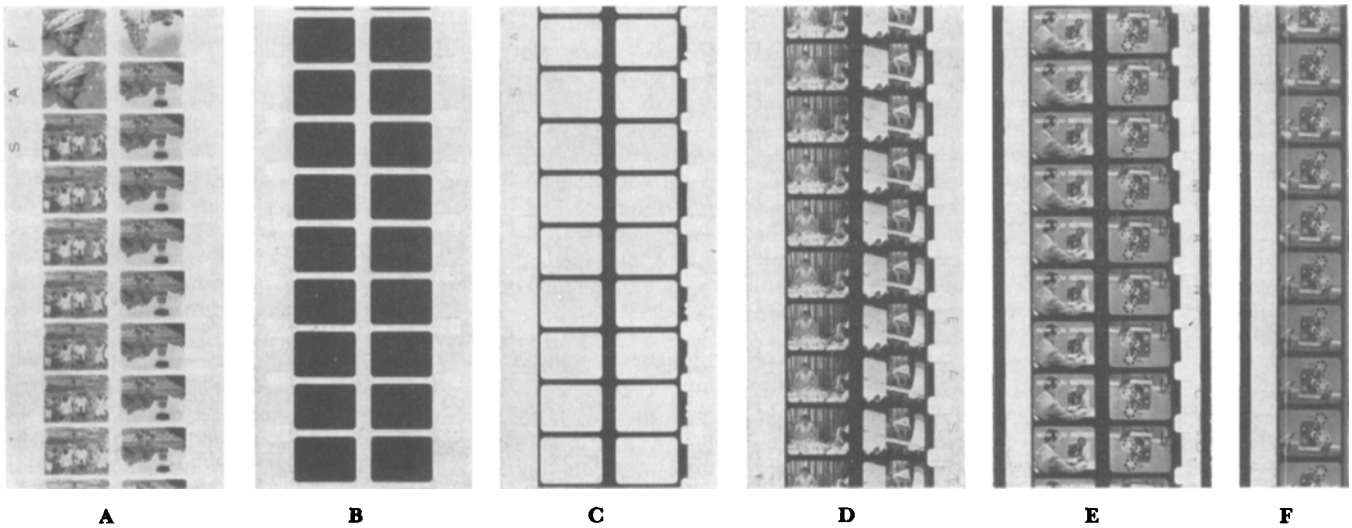
Frame Line Consideration

The next problem was a matter of frame line. The full 16mm frame must be printed to standard 8mm camera aperture size, so that no appreciable portion of the picture area will be cut off by the 8mm projector aperture. As can be seen in Fig. 2A, a wide, clear area is left at the frame line as well as along each side. A slight misalignment of the projector aperture would show this area on the screen.

Thus a double 8mm frame line mask, as shown in Fig. 2B, was prepared on special equipment used to make steadiness test films, to a size about midway between camera and projector aperture sizes, to assure overlap all around. This, printed by itself, looks like Fig. 2C. Each roll of double 8mm print stock then must go through this second frame line printing operation on a high-speed continuous printer before processing, to produce a composite print, as shown in Fig. 2D.

Fortunately, the processing procedure is normal except that the usual optical sound redevelopment applicator is bypassed.

The next step is an emulsion hardening treatment, either Vacuumate or Permafilm, to improve projector steadiness. At this point a preliminary inspection is made to eliminate further work on defective prints. Then the film is Magnastriped in the area between the perforations and the edge of the



A B C D E F

Fig. 2. (A) double 8mm optical reduction print of picture only shows wide, clear frame line; (B) frame line mask is made on special test film camera; (C) frame line mask is printed on continuous 16mm printer; (D) composite print of picture and frame line mask completes printing operation; (E) magnetic sound stripes are added to processed print; and (F) film is slit to single 8mm form for transfer of sound signal.

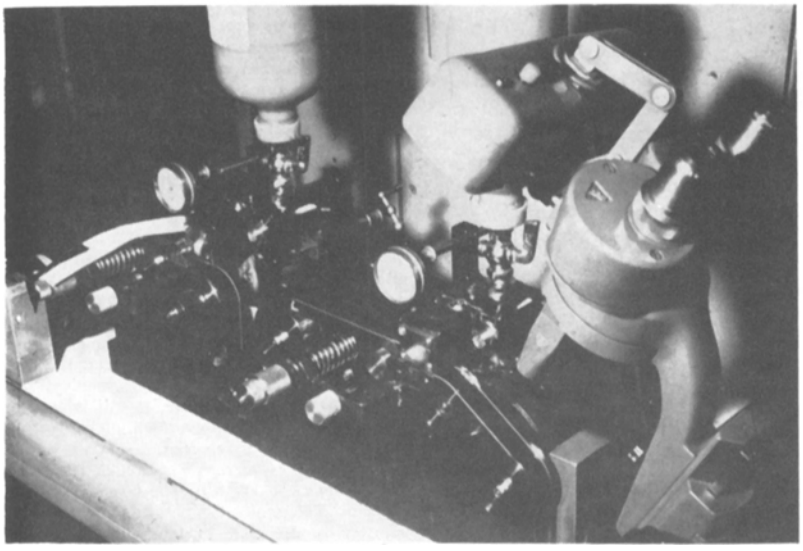


Fig. 3. Two 30-mil magnetic oxide sound stripes are applied to the processed film between the perforations and edge of film on the base side.

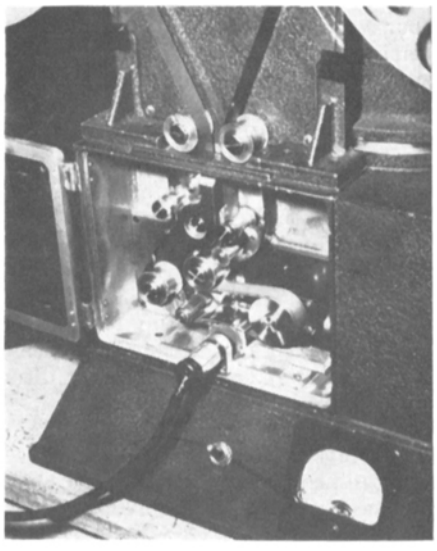


Fig. 4. A Maurer 16mm Film Phonograph reproduces sound from 16mm magnetic or optical soundtracks.

film. The stripe is approximately 30 mils wide. Heretofore, since most recording stripes on 16mm were 50 mils or 100 mils in width, and the 30-mil stripe was used primarily as a balance stripe, the application of the narrow stripe was not critical. However, with the narrow stripe we found that very small variations in the consistency of the striping material could vary the thickness beyond normal tolerances for good sound recording. Minute lumps could also cause momentary dropouts. Thus, a special rolling mill was needed in order to condition the material for consistent application. On the striping machine, shown in Fig. 3, two heads in tandem apply the stripe first to one edge and then the other. Figure 2E shows the final result.

Original plans were to then transfer the sound to both edges in the double 8mm form with one pass, recording forward on one side and backward on the other. But expediency and lack of time for research made the use of a Kodak Sound 8 Projector itself the most practical re-recording medium. Thus, the next step became slitting into two separate 8mm films, on a specially built slitter. Figure 2F shows a single 8mm print ready for recording.

The re-recording playback unit is a Maurer Film Phonograph, shown in Fig. 4, modified to accommodate an adjustable magnetic head, in addition to the optical playback. This was set up first with a single Kodak Sound 8 Projector, the speed being governed by a synchronous motor. It was discovered that the construction of the projector made it possible to line up any number of projectors in tandem, as shown in Fig. 5, and by removing the gate and pull-down mechanism, extending the drive shafts and connecting them together, to drive them all with a single motor. All nylon rollers in the transport mechanism have been replaced by carefully machined brass rollers to minimize "wow" from this source. The original amplifiers have now been replaced by improved units which permit recording at a lower level, reducing distortion. A $\frac{1}{25}$-hp synchronous motor is used to drive the whole assembly and is equipped with a heavy flywheel to help stabilize the sound. With the present setup, four recording units are operated at one time. Incidentally, in the Kodak Sound 8 projector, the original film was only 100 ft in length, making it possible to splice eight internegatives together in a single roll for repeat printing. The 16mm magnetic master recording is set up in an endless loop, so that one single continuous operation will record 32 individual prints.

Then comes final inspection by actual sound projection. At this stage, any picture defects that escaped the previous inspection, or any sound dropouts, are detected. The prints then go to final mounting and packaging, ready for delivery.

Steps Toward Further Improvements

As can be seen in comparing the amount of labor involved in handling the numerous phases of 8mm color sound production by the direct reduction method with 16mm printing, higher labor costs more than eat away the savings in film stock and processing in low-quantity runs, and only in larger quantity can there be any substantial saving in the per print cost of a given subject.

Tests have been continuing for some time for release printing from a double 8mm color internegative. Many improvements have been made since testing began. First of all an improved light source in the optical reduction printer made it possible to use an $f/5.6$ lens opening in making the double 8 internegative. Improved film movement mechanism reduces unsteadiness in the internegative stage. But it was found that attempting to print both sides of the internegative at once on a continuous printer caused misalignment of the perforations opposite the sprocket. Thus, while the print on the sprocket side showed excellent results, the other print was quite inferior. Substitution of an 8mm drive sprocket for the 16mm sprocket, placement of pressure rollers directly over the 8mm frame and replacement of the aperture drum masking off the opposite frame are modifications made on our high-speed continuous printer (300 ft/min) making it possible to produce 8mm color contact prints of uniform quality by two passes through the printer. From the quality standpoint, the definition now seems adequate for some uses, such as travel films for resale. On the other hand, while this double-8mm internegative method would reduce

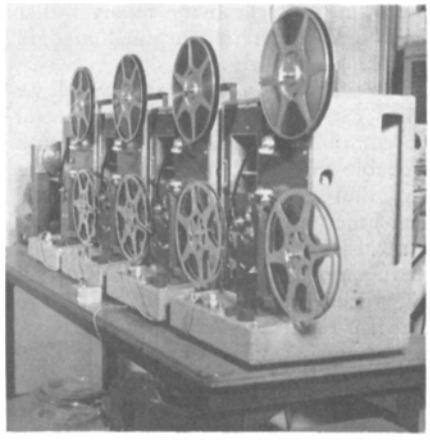


Fig. 5. Four interlocked Kodak Sound 8 projectors re-record sound on four 8mm magnetic-striped prints at one time.

labor costs considerably, most commercial productions would require the best possible quality that can be produced only by the direct reduction step-printer method previously described.

The first industrial company, as far as we know, to go into an extensive 8mm color sound sales program is the DoAll Co. of DesPlaines, Ill. They have engineered their own special carrying case that will accommodate a Kodak Sound 8 Projector and up to 22 individual subjects 10 to 20 min long, each describing and demonstrating a different piece of heavy industrial equipment. They have more than 150 projector units in the field. In the case of the Eastman demonstration reel, the film was produced specifically for 8mm, but in the case of many of the DoAll productions, the films were originally produced for 16mm release. The 8mm versions are being used as an additional medium for a much wider distribution to specific sales prospects.

We feel that this is an important new and supplementary use of the motion-picture medium, destined for wide usage. A great deal of interest is being shown in the educational field as well as the present industrial use, and while I do not care to make any predictions, I will say that a second 16 to 8 reduction printer specifically for color positive is already proving inadequate to supply the demand. We have therefore started work on a new printer design using the same direct step-type frame-for-frame reduction method, which will increase production of a single machine manyfold, with less wear on the internegative. This certainly will enable us to supply prints at a substantially lower cost than at present without sacrificing quality. A new, more rugged sound transfer machine is also being built to replace the Kodak Sound 8 projectors. There is no doubt that a great deal of other progress in 8mm color sound release printing is being made.

Discussion

George Lewin (Army Pictorial Center, Long Island City, N.Y.): What is the lineal speed of the film when you're doing the recording?

Mr. Colburn: The film is recorded at 24 frames/sec. We have attempted to record at higher speeds but there was too much distortion in the sound so we reverted to the 24 frames standard speed.

Mr. Lewin: In the whole matter of 8mm film, now that it's evidently becoming more commercialized and is about where 16mm film was eight or nine years ago, we may be asked by the Army, as we were then, whether magnetic tracks are feasible for our type of production. Then the considered opinion of everybody was that magnetic sound was not advisable for film such as the Army's training films or orientation films, because of the ease with which it would be possible to erase, or damage or change the message on the film. It seems to me that this is a pertinent question with 8mm and I wondered if anyone has any comments on it.

Mr. Colburn: From the start for commercial applications we have thought it would be advisable to have only playback projectors rather than ones in which the soundtrack could be erased or changed; however you might want the erase and record heads if you were going to send the film overseas or to put a different language on.

Mr. Lewin: Well, of course, it still is easy to erase a whole reel of film even without unreeling it if anybody is inclined to do it.

Thomas Hope (Eastman Kodak Co., Rochester, N.Y.): I have checked with the Organization of European Economic Cooperation over there, and they report that in four years of using magnetic film they've had only one experience of wiped-off track in many thousands of prints.

Louis Forsdale (Teachers College, Columbia University, New York): Many teachers, particularly in elementary schools and perhaps in secondary schools, would be delighted to have their students get involved in the process of making their own tracks to put on film. This would be particularly attractive if it were possible also to put back the original track if the students' track did not work out too well. The idea is to get the children involved in this particular medium.

The Manufacture of 8mm Prints at Technicolor

By W. E. POHL

Methods used at Technicolor for preparation of 8mm magnetic-sound release prints made from 35mm Eastman Color Negative or 16mm Ektachrome source material are discussed.

Because the manufacture and sale of 8mm release prints is in its very early stages at Technicolor, this should be considered as a preliminary report rather than as a report on our final method of making such prints.

The preparation of 8mm sound release prints can be carried on from several sources of original material. It seems probable that in the first stages of this work that subjects that have been made for 35mm or 16mm release or industrial use will also be made in 8mm. Since the great appeal of 8mm to industrial and educational users is one of cost, we believe that it is essential to set up methods for manufacturing 8mm prints that will deliver the best possible quality compatible with low cost. If only a few prints are made, print-downs to 8mm from the negative used in producing either the 16mm or 35mm release are probably feasible and equipment to accomplish this can be made available. For large volume orders, contact printing from a multiple-rank dupe in the final stage of print preparation appears necessary to keep the speed up and the costs down.

We have explored more than a dozen ways of making an 8mm sound release print from 35mm Eastman Color Negative source material with such obvious changes as working from silver separation masters and interpositives, as well as printing down to the 8mm from 35mm in either the final stage or in two stages, printing first to 16mm and then to 8mm. We have also explored the making of 8mm prints from 16mm source material, both by direct print-down and direct duping methods.

Most of the source material for 8mm prints is either Eastman Color Negative, 16mm Ektachrome or successive exposure negative used for cartoon photography. Since the contrast or gamma specifications to which each of these several source materials are developed differ from each other, it is necessary to make a correction for the source material in preparing intermediate or separation masters for printing down to the 8mm printing dupe if the duping method is used. Additional problems are posed when several source materials are intercut in the final result.

We have explored various methods for making what we call a quadruple-rank dupe, which is made on specially perforated 35mm stock. Visualize if you will four 8mm prints side by side, all heads out and all emulsion up, then add to the unperforated edge, 3 mm of stock and a set of perforation holes in this 3 mm. Stock perforated in this way can be used to produce commercial prints on a 1:1 contact printer, printing from a quadruple-rank dupe onto Eastman Color Positive. The quadruple-rank dupe will carry four identical 8mm images side by side and can be prepared from

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