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

Presented on May 9, 1961, at the Society's Convention in Toronto by L. B. Happe for the author, W. E. Pohl, Technicolor Corp., 6311 Romaine St., Hollywood 38.
(This paper was received on May 3, 1961.)

suitable masters or interpositives using a beamsplitting prism printer to minimize the amount of printing required to obtain the four images.

Possible advantages of the quadruple-rank system could be the use of existing equipment so that the release prints can be printed and developed on the same printer and developer as are used for printing double-rank 16mm prints. No additional printing or developing equipment would be required in the release channel, and inspection could be carried out on all four prints at a time on the 16mm double-rank projector. In printing and developing, we use only the two outside set of holes. The remaining three sets of holes come into use only when the film is slit and are then used for projection purposes.

There are also substantial economies in the application of the magnetic soundtrack, since all four prints can be striped in the 35mm-width form with a single pass through the striping machine. Similarly, all four prints can be electrically printed with the magnetic sound with a single pass through the magnetic printing machine.

We have experienced unexpected trouble with grain when working with some of the combinations which can be outlined from various source materials and have spent a considerable amount of time in studying means of avoiding these difficulties.

We are also studying the application of the Technicolor imbibition process to the problem of making 8mm release prints from both 35mm and 16mm source material with very gratifying results. This application appears most interesting on the basis of the tests so far completed, and we believe the benefits of printing down directly from a relatively larger area negative to be particularly beneficial in producing 8mm prints of good grain and definition characteristics.

Developments in Magnetic Striping 8mm Sound Film

By EDWARD SCHMIDT

Although the idea of coating a stripe of magnetic material on the edge of motion-picture film was the subject of American patents as early as 1919, it was not commercially feasible for 8mm film until recently. Successful 8mm sound projectors became possible after the development of high-precision, long-wearing magnetic heads and low-cost compact electronic components. Two machines for coating magnetic stripes on film have been produced by Soundcraft, the first for coating 16mm raw stock, and the second for coating 8mm processed film.

THE YEAR 1960 saw the commercial introduction of magnetic sound 8mm projectors. This promoted the design and construction of two new striping units: one for single 8mm film and the other a high-speed laboratory production machine for prestriping raw stock prior to exposure and development. These units represent a continuation of the development of the wet striping process which was first demonstrated by Reeves Soundcraft at the October, 1950, Lake Placid SMPTE Convention. Why did it take ten years for magnetic sound on 8mm film to become a commercial reality? For that matter, perhaps an even more interesting question is, why did it take fourteen years from the time of the original Marvin Camras demonstration of November 14, 1946, at a meeting of the Acoustical Society of America in Chicago? A brief history of the development of 8mm sound on film is extremely interesting and will serve as a proper background and understanding for the 1960 and 1961 work which we will describe.

Many years ago the practicability of obtaining sound for motion-picture film through the medium of a magnetic stripe and magnetic heads had been explored. When Soundcraft applied for Magna-Stripe patents in 1950, the patent office cited a number of references to American and foreign patents. The earliest of these was 1884, but this had no significant bearing on the process or method. However, in 1919 there were two patents issued which separately thoroughly covered the basic article of a stripe of magnetizable material on perforated film for the production of moving pictures with sound. One of these patents was especially significant. Here the inventor had placed, alongside the perforations, a pod of collodion containing magnetizable particles of iron. His patent drawings illustrated the use of a ring-type head, but he drew the film down through the gap between the pole pieces.

Continued attention was paid to the perfection of striping systems from the days of those early patents and culminated in Marvin Camras' aforementioned demonstration. He repeated this demonstration on April 5, 1947, at an SMPE Convention in Chicago.*

For an illustration of additional activity in the field, Lloyd Thompson presented, at the same convention in Chicago, a paper entitled "Movie Sound 8mm Projector." He summarized his paper, "The first commercial 8mm sound projector has been introduced with the sound on a disc running at $33\frac{1}{3}$ revolutions per minute. Automatic synchronization is used and the turn table and projector are not connected. 8mm sound films for use with the projector are available."†

Camras' demonstration and subsequent application work by many experimenters clearly indicated the technical advantages of magnetic recording for the motion-picture industry and demonstrated that a striping system should have considerable application in the market place. Characteristics such as frequency response, signal-to-noise ratio and freedom from deterioration with use, plus the inherent simplicity of the magnetic recording and reproducing process itself, ensured that the process should someday find acceptance. Striped film represents the only practical method of obtaining sound on 8mm film.

Amplitude Modulation Problems

However, there was a serious stumbling block — that of amplitude modulation. The magnetic recording process depends upon intimate contact between the head and the surface of the magnetic oxide. This problem is not too severe in the case of 35mm film, with its high lineal speeds and relatively wide track areas, but when we reduce the speed to the neighborhood of 3.6 in./sec and have only 25 mils of track width available for the stripe, we find that it is necessary to employ high unit pressures between the surface of the stripe and the head

Presented on May 9, 1961, at the Society's Convention in Toronto by George Bassett for the author, Edward Schmidt, Reeves Soundcraft Corp., Danbury, Conn.
(This paper was received on July 12, 1961.)

* See Robert A. Colburn, "8mm color positive release prints with magnetic sound: a progress report," in this issue of the *Journal*.

† See William D. Hedden and Kenneth B. Curtis, "Early 8mm sound developments," in this issue of the *Journal*.