

an era in which the motion picture is launched on a growth period of stupendous proportions. Film and the moving-image are well on the way to overtaking the printed word as Man's most popular form of recorded information.

As all of us know, Man's road to the stars is won only through hard work, increased engineering achievements, and at the cost of many failures along the way. In the same manner, there are many obstacles to be hurdled before 8mm sound film becomes an unqualified success.

The need is here!

Teachers clamor for a system which will allow youngsters to check out film prints from the school library and run them at home in preparation for the next day's classes. Great refinements in projector threading, reliability and screen brilliance are demanded daily. Church groups seek some satisfactory answer to

motion pictures sufficiently economical to be used in graded Sunday Schools. Doctors and scientists are becoming excited, as witness the recent formation of the American Science Film Association, about the motion picture as an everyday tool to use alongside the slide rule and the computer in their research activities.

Business leaders faced with rising labor costs are desperately using audiovisual means to improve worker productivity and to expand overall company sales and profits. Government leaders all over the globe are calling for bold new uses of the motion-picture medium to interpret and to disseminate programs and messages of official importance.

Where is that complete college curriculum on 8mm sound film and teaching machines which can be airlifted to the jungles of Africa and Latin America, or to the Near East?

Table I. Predicted Total Number of 8mm Sound Projectors in Use by 1976.

Location	Units
U.S. Home Cine . . .	7,500,000
U.S. Nontheatrical . .	3,000,000
U.S. Total:	10,500,000
Overseas Free World . .	5,000,000
Total	15,500,000

With such a potential market in the offing, present engineering problems no longer seem quite so difficult or expensive to solve.

Already, educators are pointing out that today's educated citizen must be filmicly literate too. Our children will discover that the mark of an Educated Man is not only that he can handle his native language in written and spoken forms with finesse, but that he can also express himself in the international language of the film and of the moving image.

Early 8mm Sound Developments

By WILLIAM D. HEDDEN
and KENNETH B. CURTIS

Although increased interest and activity have been shown recently in the use of 8mm sound films, following the introduction of several 8mm sound projectors, much research and development had been done in the past by those interested in 8mm films. This paper presents a historical résumé of the work of the late Lloyd Thompson and some of his early developments. Particular attention is given to the sound projection equipment that he introduced and to some of the film procedures that he utilized to make release prints.

IT IS WELL KNOWN that one of the leading pioneers in the development of the 8mm field was the late Lloyd Thompson, former Vice-President of The Calvin Company. Even when 16mm was hardly established, Lloyd was experimenting with 8mm sound. Since his tragic death in December, 1960, it has been believed that some record of these early developments in 8mm might be both important and interesting to record.

Before discussing the 8mm work specifically, brief mention is necessary of Lloyd's technical background in 16mm. In 1932 Lloyd Thompson joined forces with Forrest and Betty Calvin who were then operating an advertising company. Thus began the production organization and laboratory known as The Calvin Company. This company was one of the first to utilize 16mm film as

a commercial communications medium. Lloyd supplied the technical and engineering force to this organization. For the most part, 16mm laboratory equipment was practically nonexistent. Processing machinery, printers, sound recording equipment and laboratory production techniques were all designed, constructed and put in operation under his direction. An understanding of this background is essential to appreciate Lloyd's early 8mm efforts.

In the middle 1940's, The Calvin Co. was developing a considerable amount of amateur home motion-picture film. By then 16mm was an accepted industrial tool; however, Lloyd was greatly impressed at the very high ratio of 8mm to 16mm amateur film received. He wondered why there could not be sound for 8mm also.

In 1946 Lloyd formed the Continental Products Corp. to market an 8mm sound system that he had developed. This system was patterned after the Vitaphone System where a turntable played sound as a projector showed the picture. He synchronized the two by placing a 1000-cycle note on the disc running at 33 $\frac{1}{3}$

rpm. This tone started the projector which was threaded at a sync mark on the film. Synchronization was accomplished in this manner. A description of this projector* was published in 1947. The projector was designed so as to use a Kodascope 8-33 projector mechanism. This simplified Continental's manufacturing operation. (See Figs. 1-3.)

One other interesting point about this first Movie-Sound-8 should be mentioned. The projector was designed to operate at 16 frames/sec, as most 8mm work was done at that speed. Arrangements were made through Castle Films to release numerous film subjects for home consumption.

Records were made to accompany the pictures. Since most of these films existed as 16mm 24 frames/sec sound subjects, some method was necessary to convert the pictures to 16-frames/sec prints. Lloyd accomplished this by building a skip frame printer that skipped every third frame. Thus a 16-frames/sec print could be obtained with the normal sound on the disc. A few critical observers could detect this difference when the picture and sound disc were projected in synchronization; however, the arrangement generally was quite successful and very good synchronization was obtained.

The turntable operated at 78 and 33 $\frac{1}{3}$ rpm. The 33 $\frac{1}{3}$ speed was used for the Castle subjects and other subjects com-

* Lloyd Thompson, "The Movie-Sound-8 Projector," *Jour. SMPTE*, 49:463-467, Nov. 1947.

Presented on May 9, 1961, at the Society's Convention in Toronto by William D. Hedden (who read the paper) and Kenneth B. Curtis, Calvin Productions Inc., 1105 Truman Rd., Kansas City 6, Mo.

(This paper was first received on April 3, 1961, and in final form on June 19, 1961.)

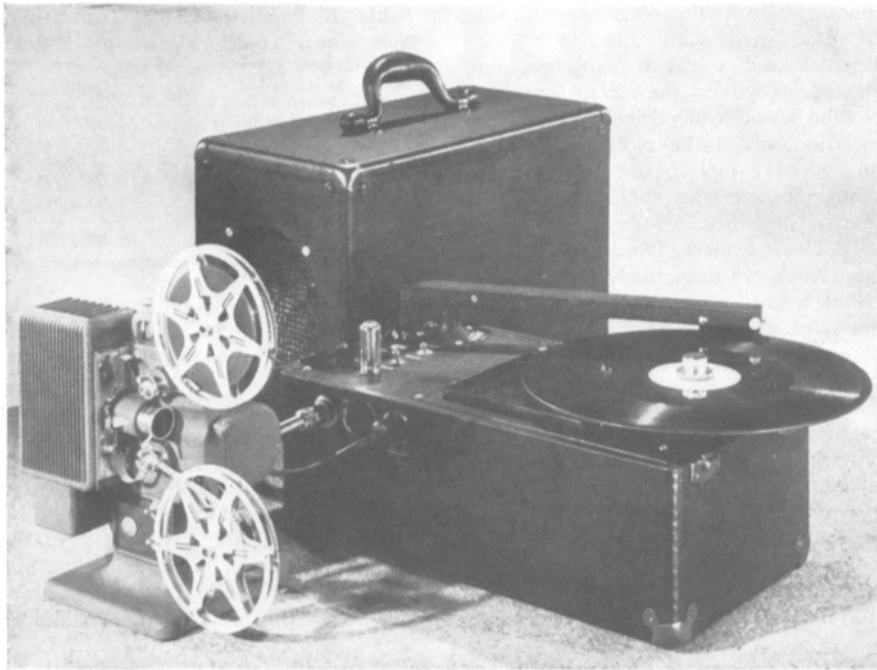


Fig. 1. Continental Products Disc Projector with turntable and case (speaker).

mercially produced, and the 78 speed for home records. It is interesting to remember that this was three years before the general introduction of 33 $\frac{1}{3}$ records for home use.

About a thousand of these units ultimately were sold. Some mechanical defects, such as an underpowered motor, were present; however, the first rumors of magnetic striping in 1947 and 1948 indicated that an even better method of 8mm sound might soon be feasible. Magnetic sound would eliminate the disc and allow the amateur much more freedom for recording. Thus came the idea for the second Movie-Sound-8, the first 8mm magnetic sound-on-film projector to be introduced for sale (Figs. 4-6).

The Movie-Sound-8 was quite different from conventional 8mm projectors. In the design it was found impossible to use much of the conventional 8mm silent projector design as it simply did not work for 8mm magnetic. A good illustration was the drive motor. Universal-type motors with brush commutators were convenient but created too much noise. High-speed fans also were too noisy. For this reason a low-speed, constant-speed Bodine motor with fan was placed on the back of the machine as far away as was possible. This produced a very quiet-running machine.

The 1600-ft take-up reels provided are considered by the authors to be an important feature where industrial use is contemplated. This feature is not found on many current 8mm projectors. (The machine actually was capable of using 2000-ft 8mm reels if desired.)

Much work went into the magnetic sound system. Existing 16mm magnetic sound design was not satisfactory for

8mm, owing largely to greater sprocket flutter in the 8mm. Consequently, the Roto-Magnetic Stabilizer was invented and patented. This device was essentially a loose-loop and tight-loop system. A tight loop was used on the take-up side of the record-playback head, and a loose loop on the intermittent side. A unique flywheel and stabilizing design allowed the film to move quite uniformly over the magnetic head, producing good sound quality at either 24 or 16 frames/sec.

A two-channel amplifier was provided for recording purposes. Two signal sources could be mixed together, such as background music or sound effects and voice. Separate accessories also were available (Fig. 7).

Many of these features are relatively common today, but the significant and interesting thing is that this was basic research and development in the 8mm projector field, and that it was undertaken successfully a number of years before other similar projectors were introduced. Many of the reasons behind the engineering design are discussed in a rather basic 8mm treatise.†

Basically, the Movie-Sound-8 introduced in 1952 was quite similar to the 8mm sound projectors announced in 1960. The earlier disc projector was found to be a good proving ground for a number of features — such as 16- and 24-frame/sec operation which was included on the magnetic projector.

Stating simply that the 1952 projector was merely “introduced” is a gross simplification. Magnetic sound in

† Published in the PSA Technical Quarterly, February, 1954, and reprinted on the pages immediately following by permission of the Photographic Society of America.

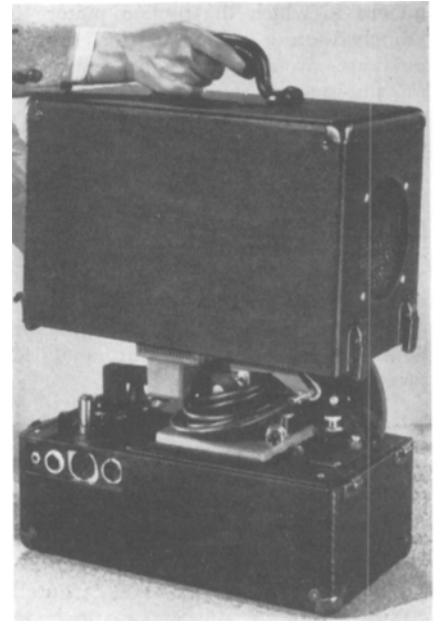


Fig. 2. Assembling speaker over projector showing portability of projector.

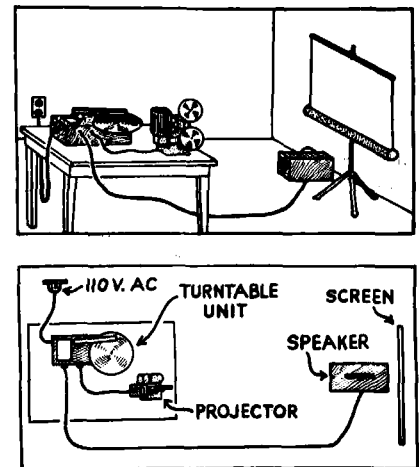


Fig. 3. Diagrams for use of Continental Products Disc 8mm Projector: (top) setup of projector, turntable and amplifier, speaker and screen; (bottom) schematic of setup.

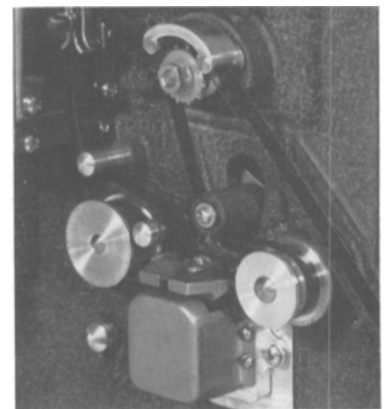


Fig. 5. Movie-Sound-8, magnetic soundhead.

1950-52 was in its infancy. Recording onto 8mm film having a stripe 0.025 in. wide with the magnetic materials and recording heads available in 1951 represented quite a contrast in effort to the same problem today. At that time, no commercial means for striping the 8mm film existed. Through numerous conferences with the Minnesota Mining & Mfg. Co., a magnetic laminate material suitable for 8mm as well as 16mm was made available.

Then came the means of applying this stripe to 8mm film. Much work was done with 3M in conjunction with this problem before 8mm striping was successfully accomplished. This illustrates but one of the problems that required a solution before film could even be used on the 8mm magnetic projector.

With magnetic striping possible and an 8mm projector available, a new consideration was raised. The first view of 8mm was largely for the amateur, but why could it not be used industrially? In the early 1950's much work was done at The Calvin Co. in learning the best method to produce 8mm magnetic sound prints from existing 16mm and

35mm subjects. It was believed that industry might use a small, lightweight, 8mm sound projector. Working with the Caterpillar Co., Peoria, Ill., The Calvin Co. converted a number of existing 16mm industrial subjects into 8mm sound prints for a trial by the Caterpillar Co.

The first attempt at making black-and-white prints was the obvious method of making a double 8mm negative, optically reduced from 16mm, then printing by contact and slitting the prints. Much printer design work on this method was undertaken and abandoned. All work pointed again to the slow, step-reduction method as the way of obtaining the best 8mm quality.

Much investigation went into laboratory developments to make 8mm sound prints from existing 16mm or 35mm productions. Various 16-8 and 35-8 step-reduction printers were constructed for this work. This investigation ultimately led to the development of a high-speed continuous 16mm to 8mm reduction printer also described at this time.†

† See later pages of this issue.

Some interesting film problems arose from these 8mm laboratory investigations. For color, only the 5265 Kodachrome Duplicating stock was available at the time. In order to get color duplicates, step reduction from 16mm masters was about the only practical method to follow. This was slow and the resulting color quality was not very good. Had color positive materials been available then, the story would have been different. However, owing to the poor quality and slow production of color prints, most work was done in black-and-white.

One interesting discovery did lead to an important improvement in 16mm materials, however. It was soon found that the existing black-and-white dupe negative material, type 5203, did not have satisfactory resolution for 8mm work. Negatives were made with better success on master positive stock, type 5365. The best results were obtained, however, using Panchromatic Separation film perforated for 8mm. This film, when used as a negative, required a very short development time. The Eastman Kodak Co. has since introduced a material with a more normal development time, but with these same improved photographic characteristics. This is the current Eastman Fine Grain Panchromatic Duplicating Negative Film, Type 7234.

The Movie-Sound-8 magnetic projector was placed on the market in 1953 and production runs were made. In all, approximately 1200 units were sold. A very few mechanical deficiencies were noticed in mass production; however, these deficiencies could have been corrected quite easily had there been a continuing market for the machine. Several factors can be mentioned for the failure of this projector to realize a large market. Its price at that time was considerably higher than those of silent 8mm projectors, although it was well under the prices of 16mm sound models. However, the price was an obstacle. Also, it was found that the problems of advertising and marketing such a unit on a national scale were larger than could be undertaken at that time. These

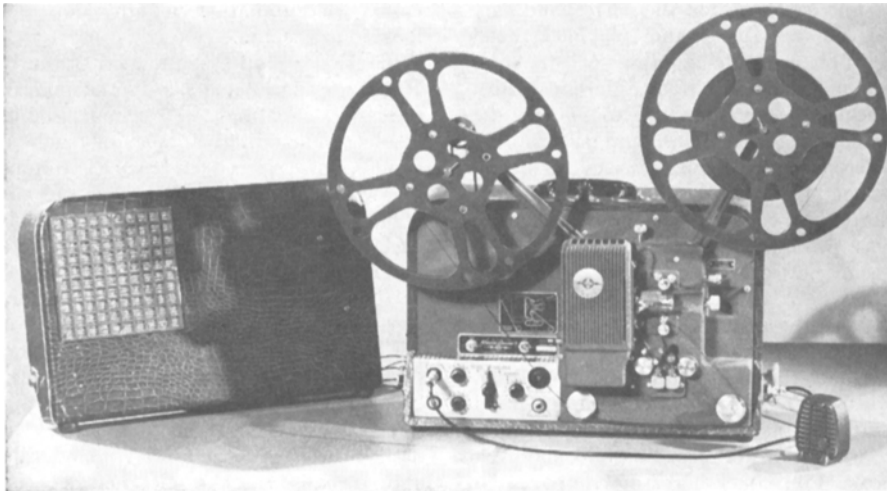


Fig. 4. Movie-Sound-8 — first magnetic 8mm sound projector.

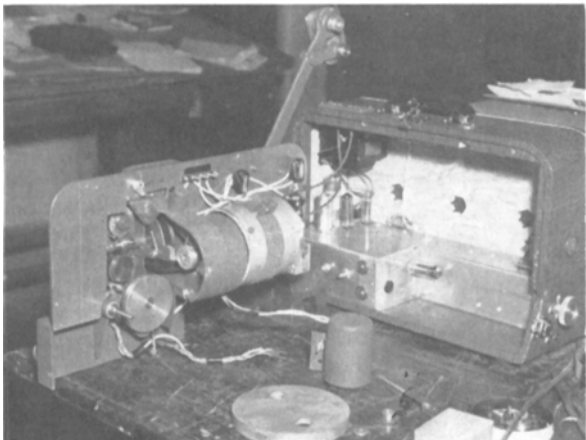


Fig. 6. Inside of Movie-Sound-8 showing motor, one sound-stabilizer flywheel assembled, second sound flywheel on bench.



Fig. 7. Accessories for Movie-Sound-8.

economic problems, rather than technical factors, limited the sale and use of the magnetic Movie-Sound-8. Several of these Movie-Sound-8 projectors are now used at Calvin along with current models for inspection of 8mm prints.

Shortly, it is hoped that much of the engineering data and other material

concerned with Lloyd Thompson's early work on 8mm sound projectors will be collected under a suitable arrangement so that they may be preserved for use by the industry. It would be in keeping with his outgoing nature that this material be shared with anyone needing help in this field.

In closing, the authors of this paper wish to acknowledge the honor and privilege they enjoyed working with Lloyd Thompson. His work in this 8mm field ably illustrates his professional ability, pioneering spirit and personal integrity.

A REPRINT

Problems in the Design of an 8mm Magnetic Sound-on-Film Projector

By LLOYD THOMPSON

USERS of 8mm motion-picture equipment have long wanted an 8mm sound-on-film projector. Optical type 8mm sound reproducers have proved impractical. The magnetic type of machine seemed to be more promising, for several reasons. With a magnetic sound-on-film projector the user can record his own sound as well as play it back, and this seemed to be a highly desirable feature for amateur film users. Also old silent films can be given a sound accompaniment after a magnetic track has been applied to the film. Magnetic tracks on 8mm films, however, impose their own problems in sound projector design. The 8mm film runs at a slower linear speed than does 16mm or 35mm film. Even when projected at 24 frames/sec its speed is only 18 ft/min. It was considered necessary to design a projector which would satisfactorily record and play back both at the slower silent film speed and at the current sound film speed. Such equipment would interest owners of old film who, by having a magnetic soundtrack striped on them, could add sound to the old films. The two-speed requirement complicated the design problem.

Another source of trouble was in guiding the film. Since the magnetic soundtrack is placed outside the sprocket holes on the margin of the film it can be no wider than approximately 0.025 of an inch. The film must be guided accurately so that the magnetic track will always line up over the record and playback head in the same position. The sound head could not be made wide,

extending on both sides of the striping, because some of the magnetic coating might run over into the sprocket holes during application. This would introduce a great deal of sprocket "flutter" if a wide recording and playback head was used. Therefore, the recording and playback head was restricted 0.025 in.

The narrow track and correspondingly narrow recording and playback head require accurate guiding of the film and accommodation for different widths. Because 8mm film is exposed in the camera as 16mm film and slit in half after processing, the accuracy of slitting is not always maintained as it is in the film factory where the unexposed film was produced. Because of slitting inaccuracies and because of shrinkage, 8mm film is not always 8mm wide. A guide system to work satisfactorily has to take this fact into consideration.

Good results in magnetic recording, whether it be on film or tape, demand that the magnetic coating be in good contact with the recording and playback head. Film is rather stiff compared to cellophane tape, which is used for magnetic recording on most $\frac{1}{4}$ -in. magnetic tape recorders. For that reason, it is a little more difficult to keep film in good contact with the head. Also different rolls of film will have different amounts of curl in them, so that a contact device must maintain contact even though there is a varying amount of curl in the film itself. Of course, if the film is damaged or there is too much curl in it, it may be impossible to get contact, but such films are in the minority.

The problem of flutter is very bad in 8mm film because the magnetic striping is placed along the outside edge of the sprocket holes. When the sprocket holes are punched in the film, there is naturally a deformation of the film at that point. If the usual method of putting the film around the sound drum is used on

an 8mm magnetic film projector, sprocket hole flutter will be introduced in the recording and playback mechanism. A sound system has been developed to overcome the difficulties just mentioned. This system, described in a pending U.S. Patent, is called the Roto-Magnetic Stabilizer. It utilizes a principle which is called a combination of tight loop and loose loop system.

The loose loop system, used on early 16mm sound projectors and some modern ones, is capable of excellent sound results. One disadvantage of such a system, however, is a tendency to produce "wows" in the mechanism or in and out of focus with the light beam if the film has excessive curl. This difficulty was largely overcome by changing to what is known as the tight loop system that is widely used on sound projectors today. For 35mm and 16mm films the tight loop system seems to work quite satisfactorily, but when it is tried with 8mm film it gives difficulty. It has a tendency to damage the sprocket holes rather easily and, because of the closeness of the sprocket holes, it makes such a machine rather difficult to design so that it can be threaded properly.

The dual flywheel system of recording and playback is a tight loop system that gives very good results with 35mm and 16mm films but when used with 8mm film it seems to have certain disadvantages.

For those reasons, the Roto-Magnetic Stabilizer was designed to use the tight loop system only on the take-up side of the record and playback head. Between the intermittent and the record playback head the loose loop system is used. Such a system makes the projector easy to thread, it is easy on the film being handled, and it is comparatively simple to build. As shown in Figure 1 [see Fig. 5 in the preceding paper in this *Journal*], two drums are used as in the double flywheel arrangement. How-

Reprinted by permission of Robert L. McIntyre, Editor, *PSA Journal*, from *Photographic Science and Technique*, *PSA Technical Quarterly*, February, 1954. The late Lloyd Thompson was Executive Vice-President, a co-owner and co-founder of The Calvin Company, Kansas City, Mo. This paper was adapted from a talk presented before the Motion Picture Division at the PSA National Convention in New York, August 12 to 16, 1952.