Compact Rear-Screen Projector for 8mm Films With Magnetic Sound Stripe

By R. G. HENNESSEY

There are properties of 8mm magnetic film which permit exceptional life as well as initial economy in adaptation. Equipment advantages in comparison to previously existing machines are presented. Results of life test runs are presented as well as results of other tests. Various applications of 8mm equipment are described in detail.

NEVER in history has the demand for improvement in transmission of ideas and techniques been so urgent. Whether the field be education, foreign affairs or merchandising, continual challenge is found in the search for stream-lined methods for communication of increasingly complex information. To date, no medium can approach the universal impact of the sound motion picture in gaining attention and ensuring acceptance. Regardless of age, sex or background, the understanding and retention of presented information far exceeds results obtained by any other pre-programmed method.

A new and perhaps revolutionary motion-picture tool is now coming of age in the development of 8mm magnetic sound film. Its flexibility and economy seem to offer a timely answer to the current need for modernized audio-visual systems. Introduced on the American scene slightly more than a year ago, it immediately resulted in activity which gave indication of its promise.

Film recorded with Cinephonic 8mm sound cameras (Fig. 1) has been accepted as evidence in Federal Court and cited in a formal decision as a predominant influence in making an award. An intriguing point is that 8mm size and simplicity permitted candid camera techniques in picture taking as well as ease in later courtroom use of the sound projector (Fig. 2).

Highway officials and public utility groups have used the same combination of equipment for on-the-spot coverage of accidents. In subsequent safety campaigns, spontaneous commentary by observers and participants were dramatic high spots in presentations of recorded mishaps.

High schools and charm schools, precision industries and amusement industries have found equally advantageous the permanent recording of activities on 8mm magnetic sound film. In some cases the aim is self-evaluation, in others, the transmission of the "first-hand" type of information to separated groups. In each situation, flexibility and economy have been primary factors in the decision to utilize this tool.

While this type of usage was significant and expanding, it was evident that the potential for almost universal application of 8mm magnetic films could not be fully realized until a viewing unit was designed specifically for audio-visual use.

Development has now been successfully concluded. Production engineered equipment can be presented. The program through which it evolved can now be reviewed.

Equipment Design Considerations

The design criteria set for this equipment aimed at significant reductions in size, weight, complexity and cost in comparison to any existing equipment. In mind was a tool to assist communication in teaching, training and selling. Specifically, the tool was to be a lightweight, rear-screen, 8mm sound projector. The basic criteria for it were:

(1) operational simplicity,
(2) minimize size, weight and cost, and
(3) maximum durability — life and handling.

In satisfying item 1, all associated components, such as speaker, screen and line cord, were to be self-contained. To permit repeated showings without rewind or rethreading, a continuous magazine was considered essential.

In regard to item 2, size on the order of a small portable typewriter and a target weight of 15 lb were felt to be satisfactory. Cost, even in single-unit quantity, it was felt, should be well under $400.

Item 3 made mandatory the development of a completely transistorized amplifier with an output of about 3 w and the design of a mechanism and film-

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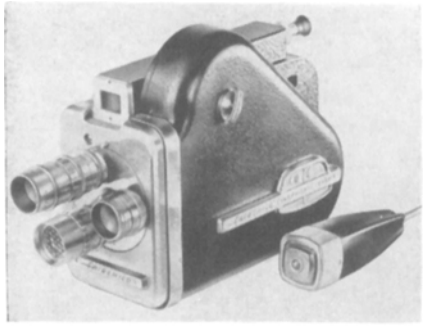

Fig. 1. Fairchild Cinephonic 8mm sound camera.

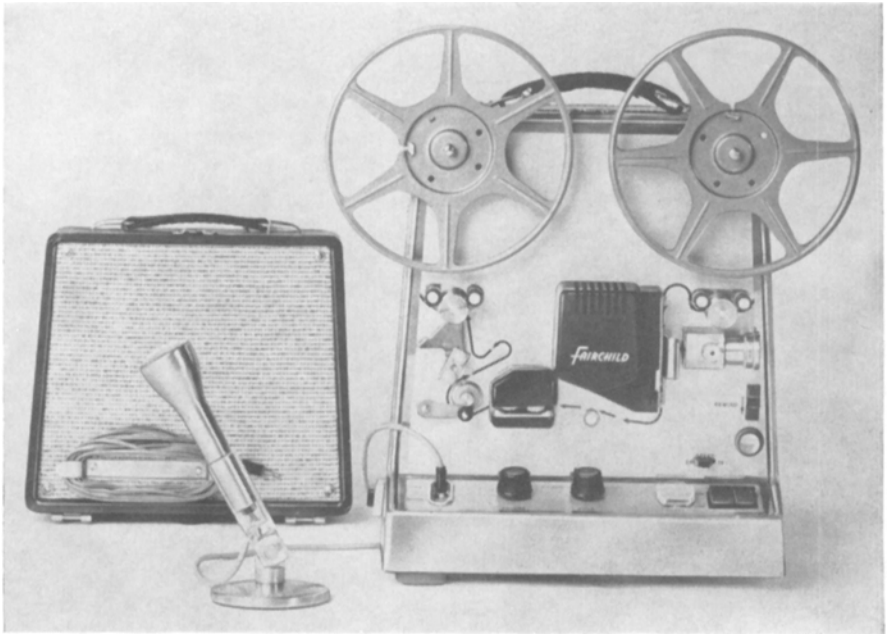

Fig. 2. Fairchild Cinephonic 8mm sound projector.

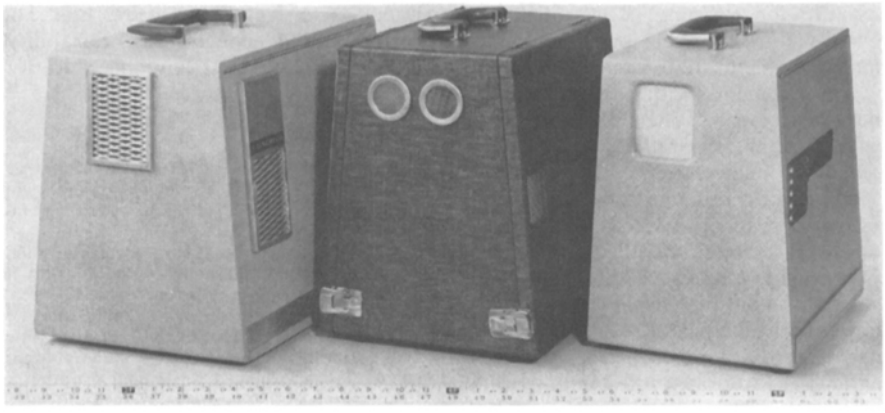

Fig. 3. Successive audio-visual projector prototypes.

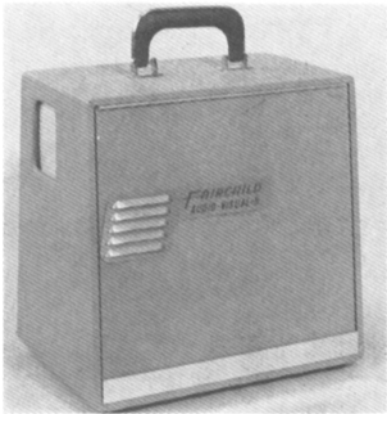

Fig. 4. Final Fairchild Audio-Visual Projector.

path components to provide heavy-duty advantages without weight penalties.

In addition to advantages intended for the user, it was realized that audience consideration demanded a very low level of machine noise and good screen brightness.

Film Capabilities

Because we recognized that our "ultimate weapon" would be influenced in its successful application by the characteristics of its ammunition, our early investigation was searching and thorough in this direction. We were soon satisfied that the cost of 8mm reduction prints, magnetic striped and sound printed, would show a saving of 25 to 35% over 16mm. We also felt that an improvement in life would be likely.

A program of testing was begun using different types of 8mm films and magnetic stripes. Results indicated durability far in excess of anticipation. The linear speed of 8mm film is only half that of 16mm when projected at the same frame rate, and because of shorter pull-down and narrower width the acceleration stresses are greatly reduced. When the film is stored in a continuous loop coil, the area of surface contact is low and tension loads decrease correspondingly. Additionally, the narrower film has superior ability to resist perforation damage because of mishandling.

The conclusion, based on exhaustive tests under full operating conditions, was that 8mm sound-striped film is capable of repeated and continuous projection for well over 1000 showings. This of course assumes a path and claw design which eliminates small radii and unnecessarily high accelerations. Heat is also a factor to be kept within reasonable limits to avoid premature film aging and embrittlement.

The magnetic stripe, either dispersion or laminate, imposed no limitation on life, the fact being that it exceeded the emulsion in endurance. Indeed, it may be said to protect the emulsion, especially in the endless coil where it tends to prevent intimate surface contact. The raised stripe affords a bearing surface which reduces film pullout tension while supporting pressures normal to the film surfaces.

Projection Equipment

The line of equipment which resulted from our development program is unique and meets the criteria originally stated. Lightweight and self-contained, it is capable of continuous showing of magazine-loaded 8mm magnetic sound film in lengths up to 400 ft. This exceeds 20 min in single running time.

Figure 3 shows, left to right, successive prototypes of the equipment. The relative size can be judged by comparison and by reference to the scale included in the illustration. Weights ranged from 20 lb for the unit on the left to 15 lb for the final unit on the right. The maximum dimensions of the last unit are 12 in. high, 12 in. wide and $8\frac{3}{4}$ in. deep to contain the projector, amplifier, magazine, screen, speaker and controls.

Another view of this final model (Fig. 4) shows the side which provides the access door for loading and service.

In operating mode (Fig. 5), the side opposite the service door hinges to a horizontal position. A projection screen, equipped with side wings, folds down from the front edge of this horizontally locked door. Visible in the illustration is

Fig. 5. The projector in operating position.

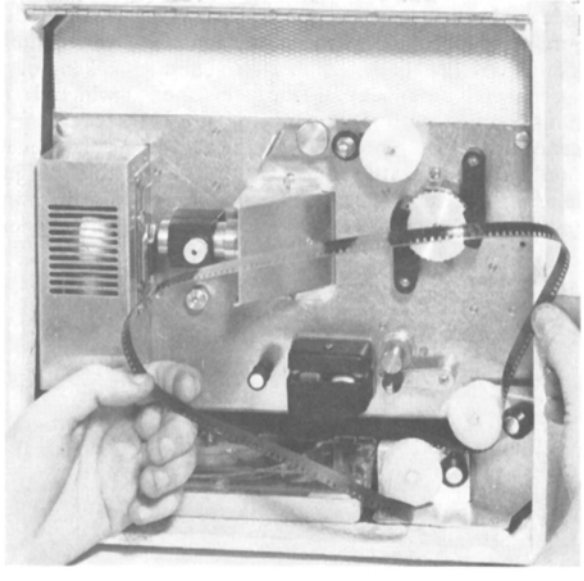

Fig. 6. Audio-visual mechanism and lamp side.

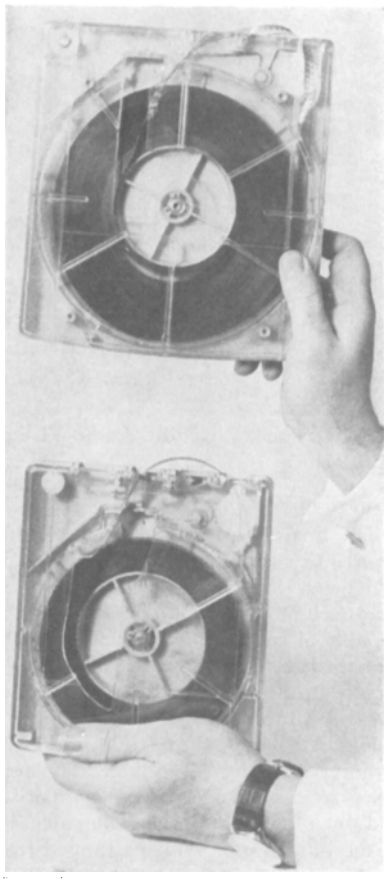

Fig. 7. The projector magazines, 200- and 400-ft capacity.

a control section, recessed at the body grille. Here a single knob provides on-off and volume control for the system. Additionally, a jack is provided for optional use of a headset or an external speaker. Symmetrically opposite on the grille and not shown in this illustration is an additional recess and a reel-up line cord for a-c supply.

Figure 6 shows the mechanism and lamp side of this same model with magazine in place and film loop withdrawn for threading. Several design points are evident in this view. The simple path assures minimum film wear and ease in loading. Large diameters in rollers and sprocket eliminate small radii in the film-handling path, thus reducing stress concentrations, especially at perforation corners in brittle films. The mirror housing (to right of lens) is a snap-out unit and permits easy access to lens and aperture for cleaning. This quick removal feature also provides for adaptation to straight front-screen projection by replacement with a two-mirror, snap-on accessory. When this is used, the picture throw is parallel with the lens axis, as with conventional projectors.

To permit continuous showing, or successive operations without having to rewind or rethread, modified tape magazines provide film exit from a center coil and take-up on the outside coil. Figure 7 shows both 200- and 400-ft capacity magazines. In storage, the loose threading loop is withdrawn into the magazine cavity for protection by spinning the magazine turntable with the loop free. When threading, this loop is again pulled out to the necessary length. No drive for these magazines is employed. Properly modified, the film tension on the feed side is quite low, and yet serves to rotate the turntable and stored coil so as to accomplish take-up.

Conclusion

The simplicity of the final design is its most apparent feature. This simple design took considerable effort and a much longer time than other more complicated designs, now discarded. The effort to avoid straying from the single-purpose machine was constant. Expanding functions invariably introduced complexity.

In the case of the amplifier, advantage was taken of special-purpose silicon transistors developed by Fairchild's Semi Conductor Div. for end uses far more demanding than in the audio-visual projector.

Weight and space problems were initially posed by transformers. In this final unit there is not a single transformer as such. Windings added to the motor iron provide all the a-c stepdown voltages needed and even the amplifier, though push-pull, requires no output transformer.

In reducing claw noise below the conventional minimum, advantage was taken of the unidirectional advance which is the only requirement in this particular machine.

In general, then, we have idealized this design by keeping its specific end use in mind in preference to modifying already existing equipment originally intended for general purpose use. The corresponding benefits in durability, weight, size and cost have been gratifying.

Discussion

Harry Sombor (General Electric Co., Syracuse, N.Y.): What sort of frequency response did you get in the combined system of recording and reproduction?

Mr. Hennessey: There is no difficulty in going out to 7000 cps, and there is no difficulty in obtaining a signal-to-noise ratio of 45 db. I should qualify that by saying "at 24." Sixteen, of course, is a mythical number these days; 18 is the figure. It will be somewhat less than 7000 cps, not too much I think. I ran a demonstration at 18 for the SMPTE group in New York and I think, by ear, it was quite good. The investigation that we do is a serious effort — it takes a lot of time. We speak in terms of 2000-hr life, which in 24-hr days requires some time to run tests. On the sound side all work has been at 24 because this is definitely the standard and the numbers I gave you were at 24 frames/sec.

Mr. Sombor: What sort of film stocks have been successfully prestriped?

Mr. Hennessey: We have simply gone to any number of labs and received a beautiful job on picture and sound as well, it being reduction from 16mm to 8mm, of course.

Gary Kaess (Keystone Camera Co., Boston, Mass.): What lamp were you using in your projector?

Mr. Hennessey: We are using, throughout the projector, wherever possible, low voltages. Now, this ties to the awareness that in the educational field, low voltages are a nice point. It is a low-voltage lamp, the amplifier is a low-voltage amplifier; there are no voltages that are exposed that are higher than in an electric train set.

Mr. Kaess: You're not using the same Sylvania you are using in your regular machine, are you?

Mr. Hennessey: Oh no.

Mr. Kaess: What's the life on the head? You say 500 hr on the total machine. What do you expect out of the heads themselves?

Mr. Hennessey: We'll certainly have to approach that with the head as well, and tests indicate that this is accomplishable.

George Lewin (Army Pictorial Center, Long Island City, N.Y.): With the large sprocket you mentioned, do you anticipate any problems with film after it has shrunk?

Mr. Hennessey: No. The number of teeth engaged on that sprocket is pretty conventional. We have a large sprocket mainly to avoid taking the film through radii or around radii that are small. We are trying to keep the path so that it's relatively gentle, so that the curvatures are large. It's not a matter of getting more teeth on the sprocket.

Mr. Lewin: Would you care to give us any estimate of the flutter that you achieve in this machine?

Mr. Hennessey: 1% peak to peak.

Fred Aufhauser (Vicom, Inc., Rochester, N.Y.): What size screen are you using?

Mr. Hennessey: It's nominally an $8\frac{1}{2} \times 11$, probably closer to $8\frac{1}{4} \times 10\frac{3}{4}$. Actually that screen size is pretty much what sets the package size.