Film-Tech

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The Sound Reproducer discussed in this reprint from the Journal of the Society of Motion Picture Engineers is the same as the Century Master Sound Reproducer.

These Sound Reproducers were designed in cooperation with engineers of the Century Projector Corporation. Note on page 283 --- Century has contributed many ideas to its design and manufacture.

A perfection of sound film stabilization has been accomplished which may never be improved upon. Thus, this sound head, as well as the Century Standard Sound Reproducer, represents top performance in post-war theatre equipment.

These reproducers are distributed exclusively in the United States by recognized Independent Theatre Equipment Dealers and in the foreign market by Westrex, Inc.

CENTURY PROJECTOR CORPORATION

WESTREX MASTER SOUND FILM REPRODUCER*

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Summary.—*The following article describes a new design of film reproducer which has brought the flutter content to a minimum, and which will maintain its low flutter rate regardless of ordinary wear and tear. Other unique features embodied in the design are a new optical system, rugged construction and ease of maintenance.*

Over 7 years have elapsed since the Western Electric Company developed its last theater sound film reproducer. The interval of time has been sufficiently long to permit a well-considered evaluation of how much has been accomplished as well as to point the direction that future development should take.

When the former machines were in good adjustment and the film was in good condition, the performance obtained appeared to meet the needs of the theater industry rather satisfactorily. The machines, however, were subject to two vagaries which sometimes affected their performance to a point that was discernible to a critical listener. These may be summed up as scanner-bearing trouble and the physical condition of the film. Either resulted in an increase in the low rates of flutter.

It seemed, therefore, that future endeavor should point first toward the attainment of assured stability of operation and then toward such further improvement in performance as may seem to be justified.

In the new reproducer a film path and filter system have been developed wherein the film compliance is utilized to obtain attenuation of high-frequency disturbances while at the same time means are provided to minimize the possibility of the vagaries of the film from setting up low rates of flutter sometimes referred to as "wows." The theoretical basis for the filter system is discussed in detail elsewhere.[1]

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A front view of the machine is given in Fig. 1, with the doors open and with the photocell amplifier cover plate removed. Film has been threaded to show the film path.

Film Path.—The film is received from the projector head as a free loop and is held in contact with the scanning drum by a pressure roller. It leaves the drum under controlled tension, passes over the damped spring compliance roller, and is then engaged by the sound sprocket. There is a free film loop between the sound sprocket and

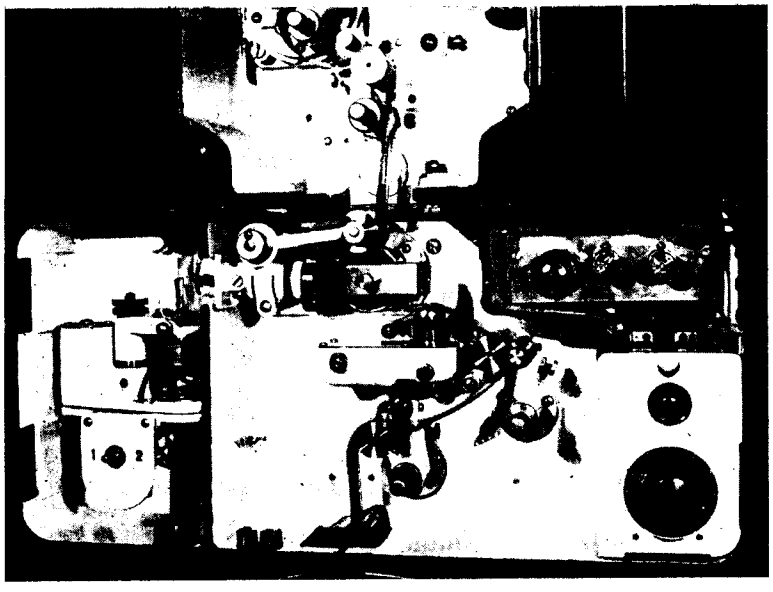

FIG. 1. Front view of Westrex master sound film reproducer.

the holdback sprocket. Thus it is seen that the film path between the scanner and the sound sprocket is isolated from disturbances originating in either the picture head or take-up magazine by free loops. The pressure roller is provided with means for lateral movement to align the sound track with the optical axis. This adjustment is provided with an indexed head so the correction for a misplaced sound track can be preset and the alignment can be returned to normal without requiring special attention.

With the machine running it is desired that the film between the scanner drum and the sound sprocket be under a tension of approxi-

mately 300 grams. Since there is a free loop above the scanner drum, this requires that a constant load be applied to the latter. This is accomplished by associating an eddy current drag with the scanner flywheel. The eddy current drag is obtained by a copper ring rotating in a magnetic field produced by permanent magnets. The amount of drag is controlled by altering the position of the magnets and it, in turn, determines the amount of tension in the film between the scanner drum and the sound sprocket.

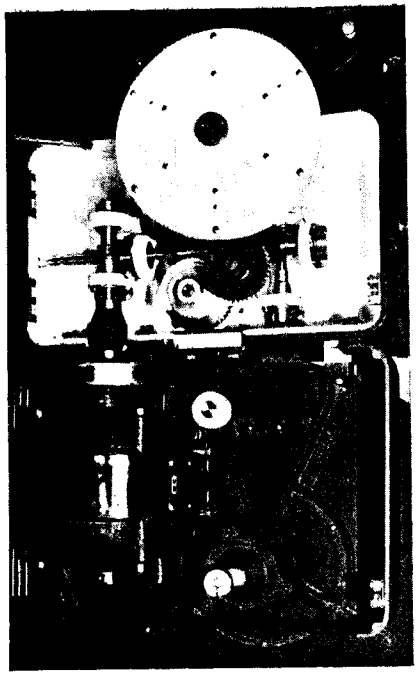

FIG. 2. Drive gear assembly.

Scanner Assembly.—The scanner assembly consists of a scanner drum, a solid flywheel, and an eddy current ring and permanent magnets mounted in a closed casting. It mounts as a complete assembly in the main frame wall by means of 3 cap screws. Its radial position is determined by a dowel pin, thus facilitating its removal and replacement without adjustment change. In the previous scanner designs irregular bearing friction has been a major source of trouble, particularly since the film was under relatively light tension. In the present design, the scanner shaft is supported in 2 small $^3/_8$-in. outboard ball bearings and as a result, disturbances from the scanner bearings have been practically eliminated.

Compliance Damper Assembly.—The compliance damper assembly consists of a casting in which is mounted a pivoted arm. The arm is spring tensioned and has a viscous damper attached to it. The arm supports a ball-bearing mounted roller over which the film rides. The arm pivots have been designed to have a minimum of friction and lateral play and consist of cone points operating in ball races. The spring tension is adjustable by means of a locknut and

screw. The cup containing the damping fluid is readily removed for inspection by loosening a thumbscrew. The damping fluid has been chosen to have a minimum of viscosity change with temperature.

Optical System.—The optical system consists of the prefocused base, 9-v, 4-amp exciter lamp, the Bausch and Lomb *41-87-35* objective, a pair of collective lenses, and a photocell. The lamp assembly is flexibly mounted and contains the usual lamp and an auxiliary lamp with means for adjustment of the filament in the vertical plane. In case of an emergency burn-out, the auxiliary lamp can readily be

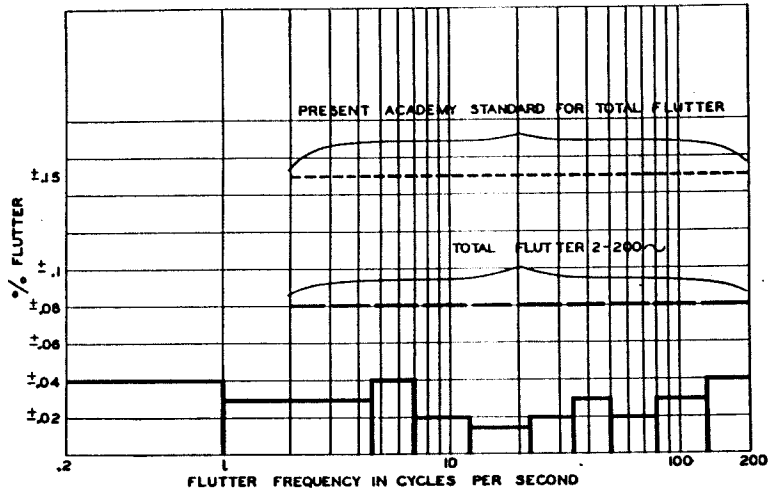

FIG. 3. Flutter performance chart.

moved into its correct position on the optical axis, and power transferred to it by operating the auxiliary lamp switch. The Bausch and Lomb lens tube has been widely used in the theater field and needs no description.

Between the film plane and the photocell is a doublet lens followed by a single lens. The doublet images the film plane in the aperture of the single lens, thus providing a plane in which separator lenses may be placed for scanning 100-mil push-pull or double track should this requirement arise. The single lens images the aperture of the doublet onto the cathode of the photocell. Under this condition the photocell cathode sees a spot of light of uniform area and variable in intensity, irrespective of the nature of the modulation on the film.

The collective lens system assembly is removable by means of a thumbscrew for cleaning.

Drive Mechanism.—Fig. 2 shows a rear view of the machine with the rear cover and motor cover removed. It shows the drive gear assembly.

The drive mechanism has a vertically mounted motor that is flexibly coupled to a vertical shaft. This shaft drives a horizontal shaft through a pair of right-angle helical gears. The horizontal shaft contains 2 helical drive gears which drive 2 cross shafts. One cross shaft supports the sound sprocket. The second supports the holdback sprocket and the chain sprocket for driving projector heads other than the Century head. A third cross shaft provides the drive for the take-up and is gear coupled to the holdback sprocket shaft.

When the sound head is set up with a Century projector a new type of coupling has been provided. This consists of a second vertical shaft in line with and coupled to the vertical shaft in the projector head by a flexible shaft. This eliminates the relatively expensive chain or pinion drive in current use with other types of projector heads.

A flywheel is provided on the motor shaft to insure a sufficiently slow starting time and a hand brake is available for a quick stop in case of a film break.

Transmission System.—The photocell and a 2-stage photocell amplifier are assembled on a small flexibly mounted chassis which is removable for inspection. Two Western Electric *6AK5* tubes are used. The first stage is a gain stage, while the second is an impedance transforming stage of the cathode follower type. A separate gain attenuator is mounted on each machine. The attenuator is located beyond the photocell amplifier at a point of relatively high level.

Performance.—Fig. 3 shows a chart of the performance from the flutter standpoint as measured on a preproduction model of the reproducer. It will be noted that at no flutter rate does the amount of flutter exceed ±0.04 per cent, while the total integrated flutter from 2 to 200 cycles does not exceed ±0.08 per cent. This performance is considerably better than the flutter requirements of the present standard of the Research Council of the Academy of Motion Picture Arts and Sciences. The time of recovery after the passage of a film splice is less than one second. There is little tendency for the film to weave in this tensioned system. Sufficient studies have been made to indicate that this performance will be realized in commercial

production and will be maintained in the field with a minimum of service.

The transmission system has been sufficiently isolated so that no machine noise can be heard above photocell hiss with the machine running, the lamp on, and no film in the optical path.

The authors wish to take this opportunity to acknowledge the numerous contributions of machine design that have been made by the engineering department of the Century Projector Corporation.

REFERENCE

[1] DAVIS, C. C.: "An Improved Film-Drive Filter Mechanism," to be published in a forthcoming issue of *J. Soc. Mot. Pict. Eng.*