

## NEW MOTION PICTURE APPARATUS

*During the Conventions of the Society, symposiums on new motion picture apparatus are held, in which various manufacturers of equipment describe and demonstrate their new products and developments. Some of this equipment is described in the following pages; the remainder will be published in subsequent issues of the Journal.*

### A SOUND KODASCOPE\*

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The reproduction of sound on 16-mm. film employs the same general principles as those used in sound reproduction on 35-mm. film, but owing to the nature of the problems involved and the difference in the operating conditions encountered, it is much more difficult to reproduce sound of satisfactory quality on 16-mm. film: (1) The 16-mm. projectors are generally operated without enclosure, in the same room as the audience. The noise of the projector, which has continually been a problem in silent projection, becomes of paramount importance, since a much lower level of noise than that found in old projectors is annoying with sound accompaniment and materially interferes with the enjoyment and intelligibility of the sound. (2) Sixteen-mm. projectors are generally operated by inexperienced persons, and for this reason must be designed to provide the easiest and most positive operation with all the controls easily accessible and to provide the greatest insurance against film damage. In this connection, major considerations are the operations that involve handling the film, such as threading and re-winding. (3) The projector and its associated equipment are not permanently installed, and it is necessary that both the size and the weight of the units be such that they can be moved about. It is also necessary that they be protected by adequate cases.

One of the most difficult problems, so far as the sound is concerned, is to assure sufficiently uniform speed of the film through the scanning beam. The main element in practically every device for this purpose is a flywheel of adequate rotational inertia, which means considerable size and mass. The size and weight considerations mentioned above present a difficult problem in the design of a mechanical filter that will work with a smaller flywheel. An added complication in a 16-mm. sound projector is the provision for the projection of silent films, which are taken at 16 instead of 24 frames per second. This provision requires a pull-

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down movement to operate within a sufficiently limited angle to provide the necessary three interruptions of light per frame to overcome flicker at the silent

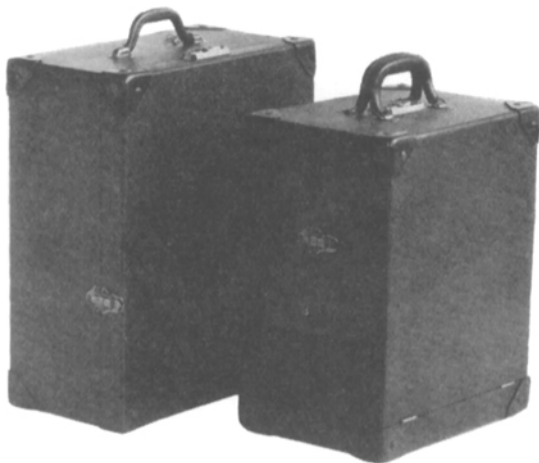


FIG. 1. Carrying cases for loud speaker and projector.

speed, and, at the same time, to be sufficiently quiet when operated at 24 frames per second.

Such are the problems involved, and the Sound Kodascope has been designed as the best possible compromise between these various limitations and with the cost of the machine only a secondary consideration.

Two carrying cases are provided for the projector and the associated equipment (Fig. 1). One of these accommodates the projector, the power cord, and a 400-ft. reel. The second, which serves as the loud speaker cabinet, is also provided with storage space for the cable connecting the pre-amplifier on the projector, with the power amplifier in the speaker cabinet, a 1600-ft. reel, extra lenses, and some minor parts.

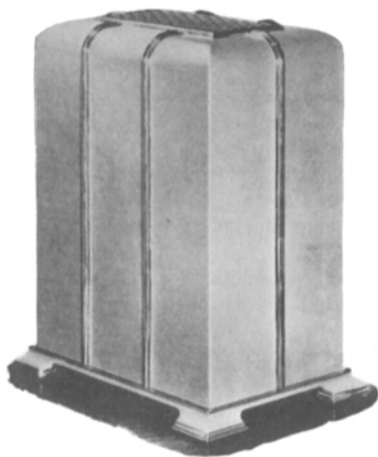


FIG. 2. Projector as it appears unpacked from the carrying case.

The projector unpacked from the case is shown in Fig. 2. When not in use, it is completely enclosed by a satin-finished aluminum case which forms an integral part of the machine.

The front portion of the projector case opens in two parts on two hinges, thus completely disclosing the threading mechanism as shown in Fig. 3. The reel

arms unfold from the body of the projector into positions allowing ample clearance for 1600-ft. reels as shown in Fig. 4. The take-up reel operates at right angles to the supply reel. This construction makes for compactness in the operating area because the plane in which the take-up reel operates is parallel and close to the front and face of the machine. By virtue of this arrangement, the film is given a half twist and enters the take-up reel at a slight angle, minimizing any possible scraping against the outer flanges of the reel.

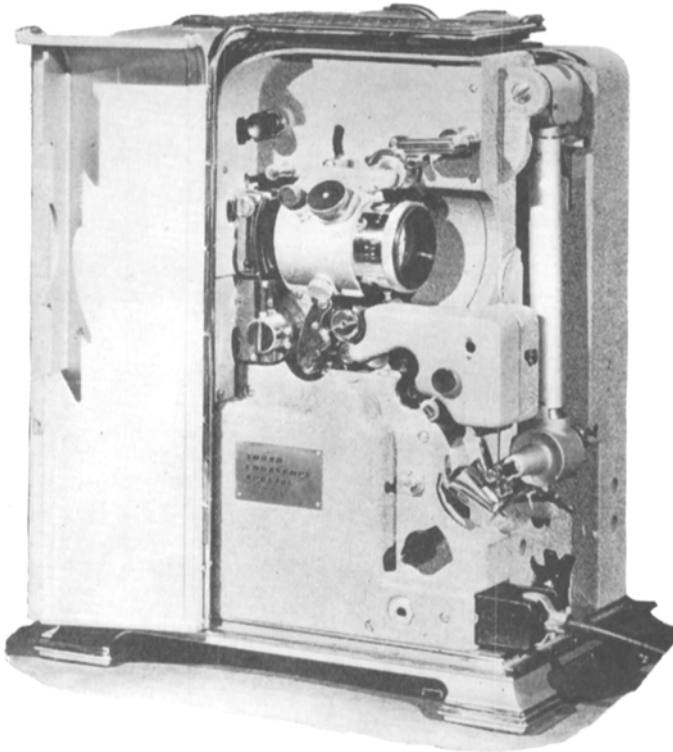


FIG. 3. Front covers of projector swung aside, disclosing the threading mechanism.

Threading the projector is very easy. Starting from the supply reel, the film is led over the feed sprocket, down through the curved gate which has been thrown forward by the starting and stopping lever. From the gate the film is passed over a lower loop-forming roller, over the sound drum, thence it is pushed through a slot onto the sound sprocket and through a channel to a pair of snubbing rollers, from which it passes over a tapered guide roller and takes a right-angled turn to the take-up reel. The loops are formed automatically by two rollers, one

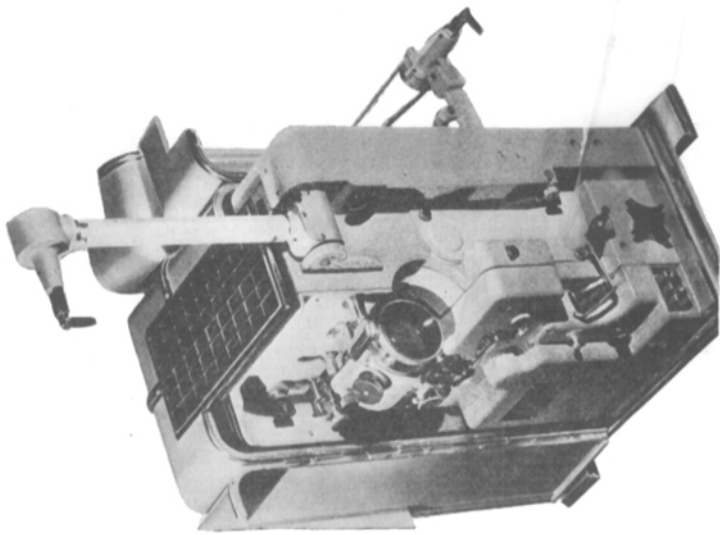


FIG. 4. Reel arms unfolded from the projector, ready to receive the reels for projection.

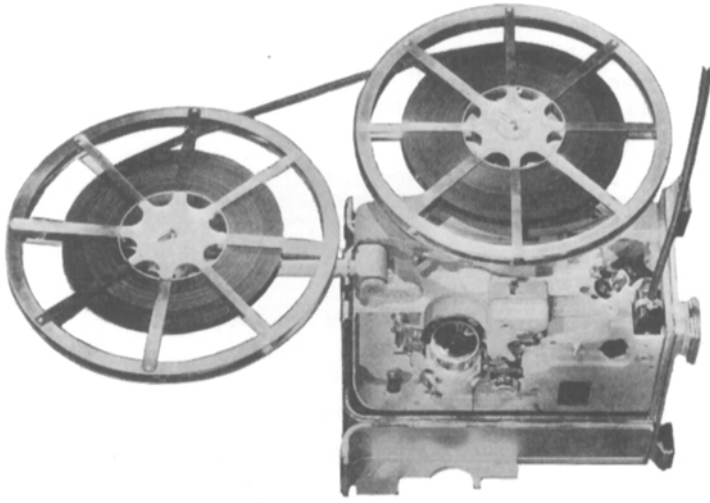


FIG. 5. Supply reel swung into rewind position.

above and one below the picture gate, which move out while the starting lever travels forward in a clockwise direction. When the loops have been formed to exact size, the gate moves into place, the loop-forming rollers return to their initial position, and, as the starting lever approaches its extreme clockwise position, it closes the motor switch. If one desires to check the threading, a push-button has been provided which momentarily closes the motor circuit. This can be done either before or after the gate has been closed and provides a convenient and positive check on the threading before the main switch is closed.

Aside from ease of operation, this method of threading has the additional advantage that, since the loops are always formed to exactly the same size, synchronism is assured. When the threading has been completed, a section of the case may be closed, thus enclosing the loops and materially reducing the noise. The section of the cover in its closed position does not interfere with the various controls required for operation.

The projector is supplied with an  $f/1.6$  lens of 2-inch focus; but the lens mount is designed for the interchange of lenses by means of a convenient cam latching device and will accommodate an  $f/1.6$  lens of 4-inch focus. The entire front of the gate assembly may be removed for cleaning and inspection. The front part of the gate also includes a framing device. A 750-watt projection lamp is standard equipment, but other lamps may be used. By moving the knob on the front of the machine between two positions, the projector may be run at the constant speed of 18 frames per second for silent film or 24 frames per second for sound-film.

The rewind mechanism, which is operated by a second motor, is located in the top of the projector. This mechanism engages with the supply reel by turning the latter through an angle of 90 degrees, as shown in Fig. 5.

The pull-down mechanism is the result of an extended investigation which included a great many types of pull-downs. Its mechanism is on the lamp side of the film, leaving the body of the projector on the other side of the film free from other elements, such as the sound mechanism. The pull-down is essentially a symmetrical Lumière cam movement. The claw (Fig. 6) is integral with the cam shoes and is cut from a solid piece of steel so that the mass may be a minimum. The two cams operating the claw are carried on the same shaft which is accelerated by an off-center drive instead of the customary hit-and-miss action, so that the pull-down movement is covered by a shutter equivalent to 60 degrees of the pull-down cycle.

To reduce the noise arising from acceleration of the cam shaft, the mass is minimized by cutting it from a solid bar of steel except for the in-and-out cam. The dimensions of the in-and-out cam provide just the necessary withdrawal of the claw from the film on the return stroke, and the surface on which it bears is shaped to cause the claw to follow a prescribed path during the pull-down stroke. The whole movement operates in a dust-tight enclosure and is constantly flooded with oil. In the design of the pull-down, serious consideration has been given to the elimination of unsteadiness in projection. To this end, bending stresses have practically been eliminated from the claw and the acceleration at the end of the pull-down stroke is very low, requiring a low tension or friction in the gate.

It will be noted that only a single claw engages the film. Some projectors use two claws in tandem on the same side of the film. A tandem claw does permit the pull-down movement to pass a section of film in which there is a single dam-

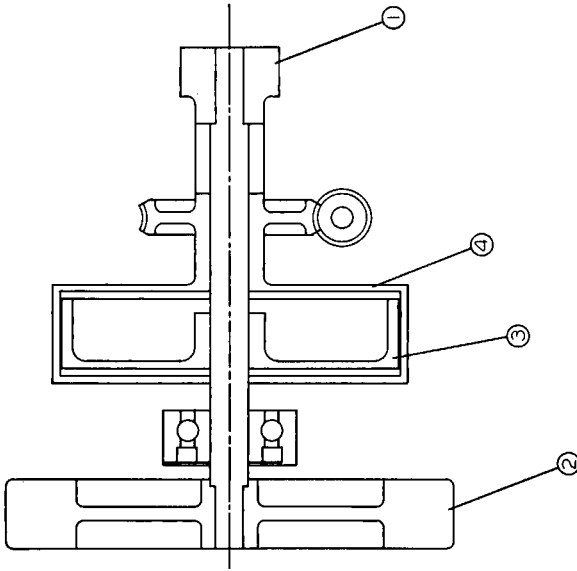


FIG. 7. Diagram of mechanical filter comprising the viscous drive, the flywheel, and the film drum.

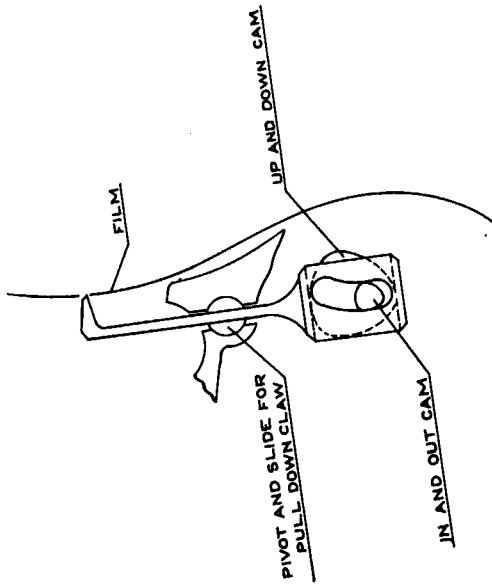


FIG. 6. Diagram of pull-down mechanism.

aged perforation without loss of loop. However, if two successive perforations are damaged, the loop will be lost. It has been claimed that a tandem claw distributes pressure on the film, reduces the wear, and increases the life of the film. Experience has shown that the life of film is determined not by the number of times it passes through the projector, but by accidental damage in handling it.

The seriousness of losing a loop is the resulting damage to the film and the difficulty of rethreading. The Sound Kodascope film-handling mechanism is so designed that it is practically impossible to damage film by loss of loop. Furthermore, the loop may be reestablished most easily by turning the operating knob off and returning it to the operating position.

As stated earlier, the film motion through the scanning beam is generally governed by some type of mechanical filter whose main element is a flywheel. The function of this filter is to isolate the film from various disturbances that would otherwise act upon it. After studying several such devices, the one shown in

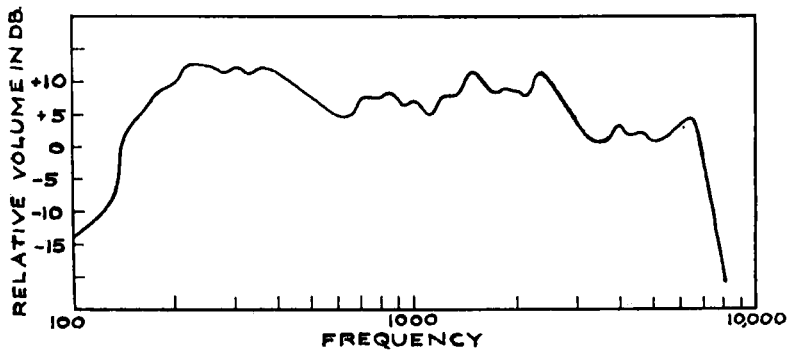


FIG. 8. Overall frequency characteristic from film to acoustic pressure, film loss not included.

Fig. 7 was chosen as being the most practicable at the present time. The soundtrack is scanned on film drum 1, whose motion governs that of the film at this point. This film drum is mounted rigidly on a shaft which also carries a flywheel 2 and a second drum 3. This system is driven by a viscous coupling between the drum 3 and a hollow shell 4, which, in turn, is driven by the projector mechanism. The mechanical filter as a whole is designed so that the viscous medium is provided from the same oil bath as that used for lubricating and silencing the projector mechanism.

Under ideal or specified conditions of operation, the performance of this drive approaches perfection. While the change of viscosity of the oil with temperature, and the change of perforation pitch with film shrinkage, in extreme cases, would interfere with the performance of the filter, these extreme cases are not normally encountered in practice.

As stated previously, the power amplifier is mounted in the loud speaker cabinet; while the pre-amplifier is mounted at the bottom of the front side of the projector and can readily be detached for servicing. The photoelectric cell is re-

moved with the pre-amplifier. On the front face of the pre-amplifier housing is the volume control knob; this knob also actuates the off-and-on switch. Below this knob is a microphone jack, by which a microphone can be connected to the amplifier. Immediately above the knob is a tone-control switch, whose purpose is partially to compensate for variation in the frequency characteristics and other qualities of 16-mm. prints.

Owing to the variations in print quality, the choice of the overall frequency

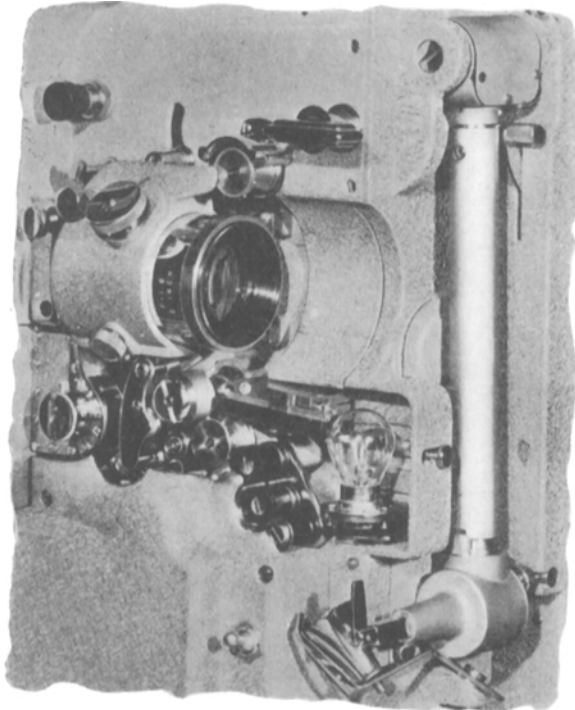


FIG. 9. Protective cover removed from the sound optical system showing the exciter lamp and the lens tube with its mount.

characteristic of the sound reproducing system is difficult and depends largely upon guesswork.

In designing the reproducing system, the aim was to obtain a frequency characteristic essentially uniform between 150 and 6500 cps., exclusive of the film loss. This choice was made upon the basis that a sufficient number of good prints are available to justify this frequency range. The actual acoustic output obtained from a print previously corrected for film loss, on a projector picked at random, is shown in Fig. 8. The slight rise in the curve in the region between 170 and 600 cps. is due to cavity resonance in the loud speaker cabinet.

There are a large number of prints which, from poor definition, excessive ground-noise, and other causes, will sound better and be more intelligible when the frequency range of the amplifier is reduced, and hence a tone control has been provided which reduces the amplification of both the high and the low frequencies. Prints can be made on existing commercial equipment and material that would justify considerable extension of the frequency range.

The sound optical system and the exciter lamp are shown in Fig. 9, with the protective cover removed. The exciter lamp, which is rated at 0.75 ampere, 4 volts, is equipped with an automobile headlight type prefocus base. Since the type of optical system used is not critical to lamp filament position, this method of locating it is quite satisfactory. The optical system is carefully adjusted at the factory and should require no further attention. A knob at the front end of the projector is provided for shifting the focus of the sound optical system from one side of the film to the other. This adjustment is necessitated by the fact that original black-and-white reversal prints, and, generally, reduction prints from 35-mm. film, must run through the picture gate with the emulsion side of the film toward the projection lens; duplicate contact prints from original black-and-white reversal positives and some types of original reversal color positives must be run with the emulsion side away from the projection lens. Thus, if the focus of the optical system can not be shifted from one side of the film to the other according to the emulsion position, a serious loss results in the high frequencies, amounting to as much as 15 db. at 4000 cps. for a large-aperture optical system.