By HUBERT W. WATKINS

SERVICING MOVIE SOUND

Maintenance and Repair of Sound-on-Film Systems

"THE show must go on." This is an honored tradition in the entertainment world. Vaudeville and stage actors often work while ill or bereaved to preserve this tradition. Today it is the watchword in thousands of moving picture houses in all parts of the country, from the smallest neighborhood movie to the most palatial urban theater.

The local radio technician can help uphold this tradition, at a profit for himself. He is readily available when sound trouble occurs and has the equipment, spare parts and knowledge to make either a permanent or temporary repair usually in a matter of minutes. The break may thus be limited to an absolute minimum, thereby saving the theater prestige and money that would otherwise be lost in refunded admissions.

Any radio technician who intends servicing theater sound equipment—either routine or emergency — should first notify the business agent of any union under which the projection booth may be operated and obtain his permission to enter the booth for that purpose. He should also ascertain that his servicing the equipment would not violate the terms of any contract the theater may have with a service organization.

SOUND-ON-FILM SYSTEMS

When sound was first brought to the screen it was in the form of 16-inch wax recordings. For each reel of film a corresponding wax record was necessary for the sound. This system had many disadvantages. The principal one was that of synchronization between picture and sound. Proper synchronization was dependent on placing the reproducer needle accurately at the start mark on the record and the film start mark in the picture aperture. This insured that picture and sound started in synchronization. However, if any film had been damaged and removed, synchronization did not exist from that point to the end of the reel. It became common practice to replace any damaged film with an equal length of black film in an effort to maintain synchronization.

This system has been replaced with sound-on-film recording. In addition to other advantages, it insures perfect synchronization between picture and sound at all times because the picture and sound are both printed on the film.

The sound is recorded approximately nineteen frames ahead of the picture; in projection this places at the scanning beam that point on the sound track which corresponds to the picture in the aperture at any given instant. The frequency and volume range that may be recorded on film is far greater than that possible with disc recording.

All sound-on-film may be broadly classified as variable-area, which is essentially an oscillographic trace of the signal currents (Fig. 1-a), or variable-density, which is a half tone photograph of the recorded sound (Fig. 1-b). Both operate on the principle of modulating a beam of light, which is made to pass through the sound track and on to the cathode of the photoelectric cell. The photo-cell converts the light variations into electrical impulses whose wave form corresponds to the recorded sound. These impulses are very feeble and must be amplified many times before they are strong enough to operate the speakers.

THE SOUND HEAD

It is extremely important that the film move past the scanning point at a uniform speed of *ninety feet per minute*. All traces of flutter or variations in speed must be absorbed so that it will not affect the movement of the film past the scanning point. This is accomplished by free-running loops on both sides of the scanning point. These loops absorb any flutter or sudden variations in speed. The film is pulled through by a constant speed sprocket (Fig. 2).

The rotary stabilizer or oil-damping wheel is used in later sound systems to

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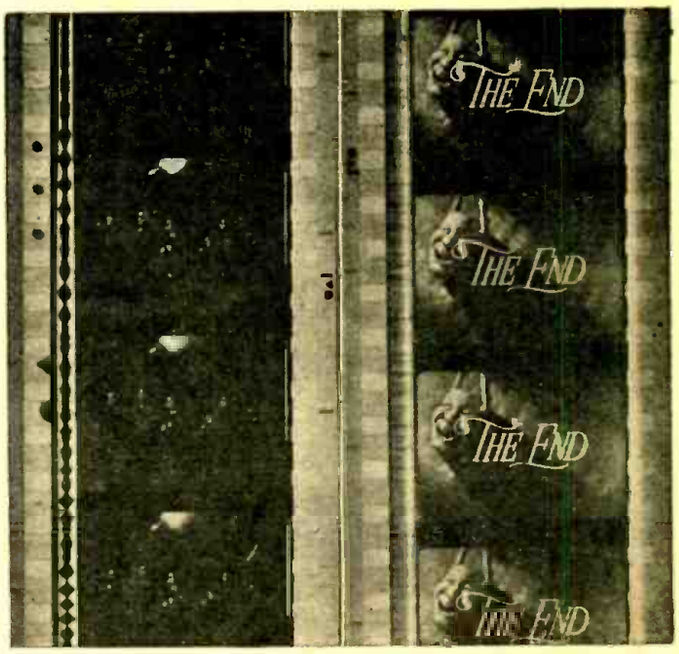


Fig. 1-a, left—Variable area; 1-b, right—variable-density strip

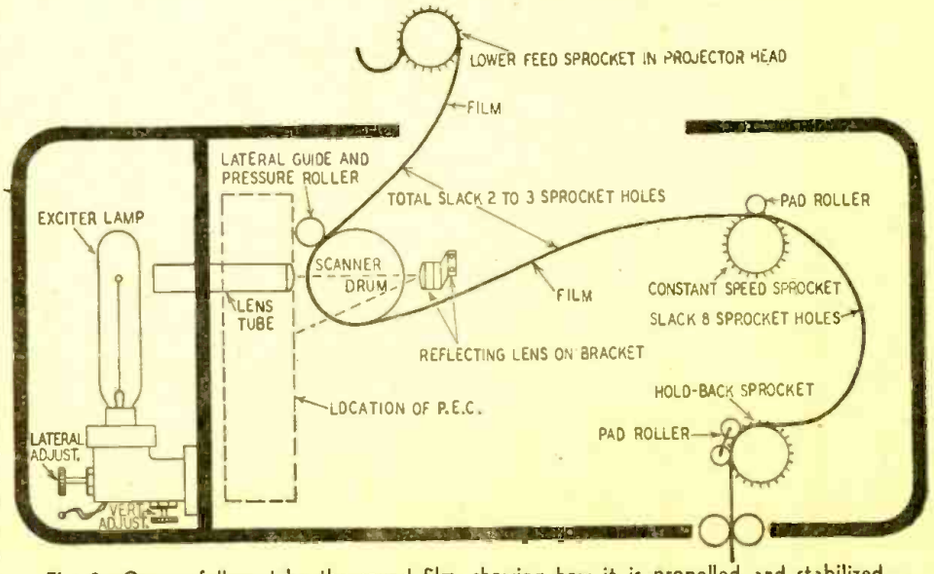


Fig. 2—Course followed by the sound film, showing how it is propelled and stabilized.

insure uniform film speed at the scanning point. This is simply an oil-damped flywheel which is not geared to the mechanism in any way, but is driven by traction between the film and the scanner drum, which is mounted on the same shaft with the damping wheel. Since this wheel is not geared to the mechanism, it is free of all variations in speed inherent to the mechanism.

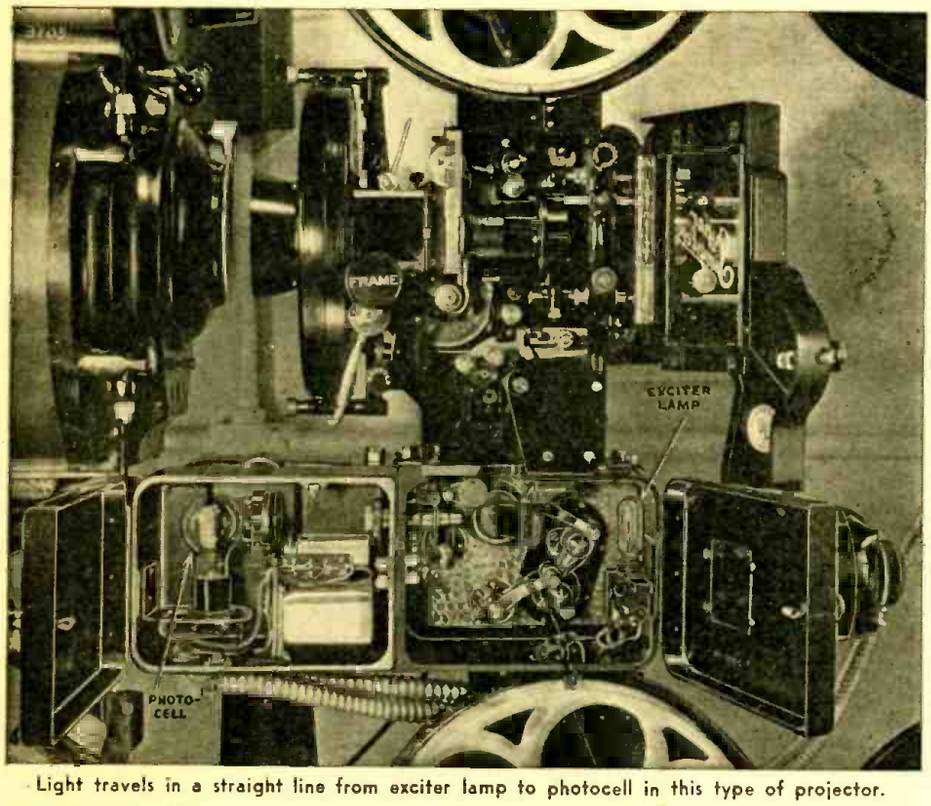
The damping wheel should pick up—from a dead stop to full speed—in two to three seconds. A peculiar gurgling distortion which lasts from one to ten seconds after changing from one machine to the other is usually caused by this wheel not having reached full speed when change-over is made. This is caused by a worn or improper adjusted guide and pressure roller (Fig. 2). The obvious remedy is replacement or adjustment of this roller to insure proper traction between film and scanner drum.

The drum may be spun by hand to determine if it runs freely. The run-out should be smooth with no jerky or sudden stops. The deceleration time (from normal speed) is between thirty and sixty seconds. If it is much less than this or if the stop is jerky or sudden the bearings should be cleaned and inspected. The scanner drum should also be inspected for end play. If end-play exists the film will weave in its motion past the scanner, resulting in the light beam being modulated by the framing lines or sprocket holes. To remedy, remove the damping wheel and reverse one of the spring washers provided to absorb end play, or add another washer.

In the older sound systems the film is pulled through a sound gate by the constant speed sprocket. This sound gate exerts a slight pressure on the film which results in an even pull at the scanner. Mounted on the same shaft with the constant speed sprocket is a heavy flywheel, the inertia of which protects this shaft and its sprocket from flutter and variations in speed. Free-running loops are provided to isolate the scanner.

THE LIGHT SYSTEM

The exciter lamp and optical system should be adjusted so that it projects on the sound track a uniformly illuminated image approximately .084 by .0012 inch. Lateral and vertical adjustments are provided on the exciter lamp bracket, and it should be carefully adjusted so that it is in perfect alignment with the optical system. The volume and frequency response will be seriously affected if the inside of the glass envelope is blackened from use, or if the filament sags. In either case the lamp should be replaced and proper adjustments made.



Light travels in a straight line from exciter lamp to photocell in this type of projector.

The sound head must be *clean*. Tests show that a film of oil or dirt on any part of the optical system will seriously affect the high frequency response. The lens, mirrors, etc., should be thoroughly cleaned with lens tissue; all other parts of the sound head may be cleaned with a soft cloth.

Unless it is definitely known that the optical system is out of focus, no adjustment should be made. If adjustment is necessary, one of two methods, both using Academy 8000-cycle test film, may be used:

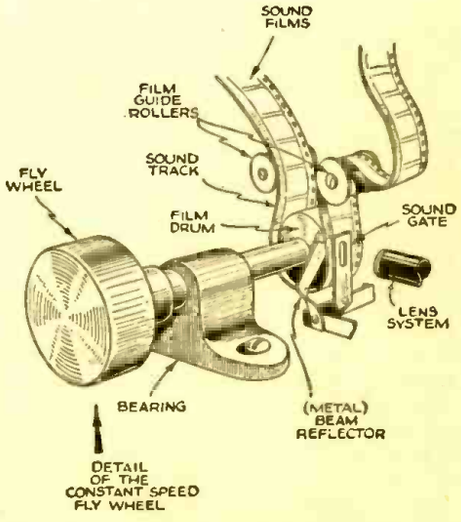
Thread the test film in the machine and—with the machine running—adjust the lens tube until maximum response is obtained from the amplifiers. This may be observed aurally or with an output meter.

The second method of adjustment is known as the flicker test. A white card is placed between the film and reflecting lens. When the film is moved slowly, by hand, the frequency lines cause a definite flicker of light on the card. The lens is in focus when the lines appear to be stationary. If they appear to move up or down on the card, the lens tube should be adjusted.

In modern sound heads the lens tube is accurately adjusted for azimuth at the factory and it is not necessary to disturb this adjustment in order to focus the lens. This is not true in the older types because the lens tube is simply held in a clamp. If the locking screws are loosened the lens tube may be rotated as well as moved forward or backward. In fact it would be practically impossible to adjust the focus without rotating the tube slightly, and if any adjustments are made special care should be taken so that when the adjustment is finished the lens will be in focus and the image will be parallel with the frequency lines on the sound track.

If test film is not available, fairly accurate adjustments may be made by running any film with good sound recording and making adjustments for maximum high frequency response.

The lateral guide roller (Fig. 2), should be adjusted so that the scanning beam does not strike the frame lines or sprocket holes. The adjustment may be checked by running Academy Buzz Track film (which has a silent sound track with a low-pitched buzz recorded on each of the sound track border lines). Turn the adjusting screw clockwise until the buzz track can just be heard, then turn in the opposite direction, counting turns and fractions of turns, until the opposite side of the buzz track, which is a different frequency, can be heard. Turn the screw clockwise again half as many turns and fractions of turns as was required to bring the beam from one side of the track to the other. This centers the beam on the sound track.



How lens, sound gate and mirror are placed.

If Buzz Track film is not available

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this adjustment may be made by running any film with sound recording and adjusting so that frame line flutter will be heard at one extreme and sprocket hole hum at the other. The roller should be centered between the two in the manner described above.

All pad rollers (Fig. 2) should be adjusted so there will be a clearance equal to two thicknesses of film between them and the sprockets on which they run.

The sprocket teeth should be inspected and the sprocket replaced if they show signs of wear. Since the sprocket teeth wear on only one side it is often possible to reverse the sprocket end for end, which places the opposite side of the teeth against the film while pulling, thus increasing the useful life of the sprocket.

(A second article will appear in an early issue)

FM radio is in a quandary in which many stations are transmitting their full allotted time to audiences which approach the vanishing point, said T. R. Kennedy of *The New York Times* last month. Cause of the paradox is the "moving upstairs" of the transmitters, pursuant to FCC order, while most of the present receivers receive only low-frequency FM transmissions.