There has been considerable theoretical interest in polarized light, and some of the most outstanding classics of physical literature have been written about the theory and use of it; yet, though polarization is one of the commonest manifestations of light—as common as color—the majority of engineers know little about it; and quite properly, because up to now it has not been commercially available. Now that large areas of polarizer are obtainable, this old property of light can be put to valuable new uses.

The polarizing material consists of a suspension of billions of crystals too small to be seen under the microscope, their polarizing axes all turned in the same direction and each crystal possessing some polarizing power so that the total effect of the thousands of layers of crystals in the sheeting is that of vigorous polarization.

MR. MCGUIRE: What is the material of the polarizer?

MR. LAND: Broadly, the principle requires the use of any minute polarizing crystals turned the same way, so small as to render the sheet homogeneous and non-scattering. In particular, one substance that we have used is iodo-quinine sulfate, well known since 1850, but not useful hitherto. One suitable suspending medium is cellulose acetate. We use other crystals and other suspending mediums, but those I have mentioned are good examples of a combination satisfactory for many purposes, and are quite adequate for illustrating the principle.

MR. ROGER: Are the crystals oriented by mechanical means?

MR. LAND: We have used electrical, gravitational, mechanical—all sorts of methods. The particular method chosen is a matter of expediency, refinement, and commercial availability.

THE DEBRIE 16-MM. PROFESSIONAL PROJECTOR*

H. R. KOSSMAN**

For many years the policy of the Debrie Company has been to manufacture motion picture equipment conforming only to the highest professional standards of quality and precision. No deviation from these standards has been allowed in the new 16-mm. sound-film projector. Prior to the introduction of this piece of apparatus, the Company had not been engaged in the manufacture of any type of 16-mm. projector; hence there was no tendency to base the design of a new sound projector upon a production necessity involved in the possible use of existing tools and dies.

The design of the machine has been such as to accomplish the following aims, which have seemed most desirable in a projector using 16-mm. films: simplicity and sturdiness, omission of unnecessary parts, ease of threading and operation, most efficient use of the light-source, and quietness of operation (Fig. 1).

In spite of the apparent simplicity of the film path in the Debrie projector, the reproduction of a constant-frequency record exhibits minimal fluctuation or

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** Andre Debrie, Inc., New York, N. Y.

waver. This is accomplished by applying the same precise manufacturing methods employed in producing our high-grade professional cameras and laboratory apparatus.

Only two sprockets are used in the machine (Fig. 2), the feed sprocket and the sound sprocket, which latter also feeds the film to the take-up reel. The sprockets are large in diameter, having 16 teeth each. Pressure rollers for holding the film in place upon the sprocket teeth are not used. When threading, the film is simply slipped under fixed rollers, set at the proper distances from the sprocket axis to assure perfect engagement at all times. It is felt that such an arrangement presents less danger of damaging the film.

The intermittent motion of the film is effected by a double claw, which engages two consecutive perforations of the film simultaneously. This distribution of strain upon the film over two perforations is especially important in a 16-mm. sound projector, where the work of moving the film has to be performed entirely from one side. Not only does such an arrangement distribute the wear more evenly, but it also renders the operation of the intermittent more dependable. Even if one perforation of the film should happen to be damaged, the two-claw intermittent would still pass the film dependably through the gate.

The claw movement is so arranged that films made according to either the SMPE standard or the so-called DIN-ICE standard can be projected without the necessity of using a reversing prism, which always entails a loss of light and definition. This permits the use also of standard-printed films for rear projection, as frequently used for advertising work.

After leaving the gate, the film forms a small loop and then passes to the sound drum, where it is held in proper relation to the sound optical systems by a tension device made of special hardened steel (Fig. 3). The sound optical system is rigidly in accurate focus. However, an interesting and unique feature is incorporated here, as the optical system may be quickly adjusted by means of a small lever to focus the slit image upon *either* side of the film. Such an adjustment, it will be seen, permits the use of film with the emulsion either facing the light-source or facing the objective, permitting the sound-track always to be sharply focused with relation to the sound optical system.

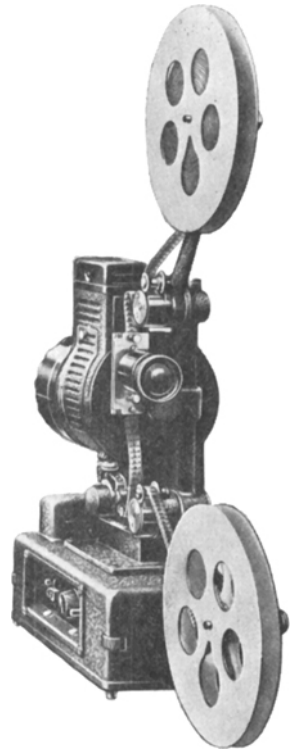

FIG. 1. Showing complete projector with 800-ft. reels, 50-mm. $f/1.7$ projector lens.

After leaving the sound gate, the film passes over a mechanical filter which is so positioned as to afford optimal results with respect to uniformity of motion of the

film. The take-up sprocket is located in direct line with the feed sprocket, and both feed and take-up arms are placed in advance of the main mechanism. These arms are long enough to permit the use of 2000-ft. reels. Rewinding the film upon the take-up reel is accomplished by an efficient gear drive and friction clutch of the type that has been in long and successful use in Debrie cameras. Such construction entirely avoids the use of spring belts, with the result that there is no necessity of using reels having unusually large hubs, as is the case when 1600-ft. reels are used with spring belt take-up (Fig. 1). The Debrie take-up construction allows the use of a 1600-ft. reel with a hub small enough to allow it to carry as much as 2000 feet of film.

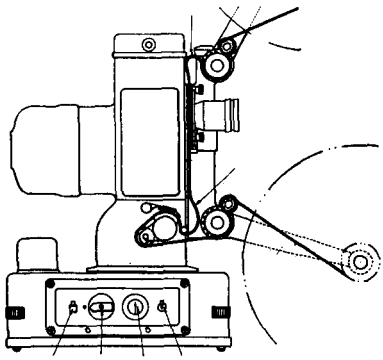

FIG. 2. Showing simplicity of threading: only two sprockets (16-tooth), and no pressure rollers.

The path of the film through the machine is fully channelled and protected, and is so arranged that the film is kept as far as possible from the lamp house and motor, as such parts have a tendency to radiate heat which might dry out the film in constant use.

The entire film-moving mechanism is integral and built as a single unit (Fig. 4). It includes the shutter, the condenser, and the lens assembly. However, the lens mounting swings clear of the aperture, so that cleaning can be efficiently done. All parts of the machine are substantially built. Die-cast parts are incorporated

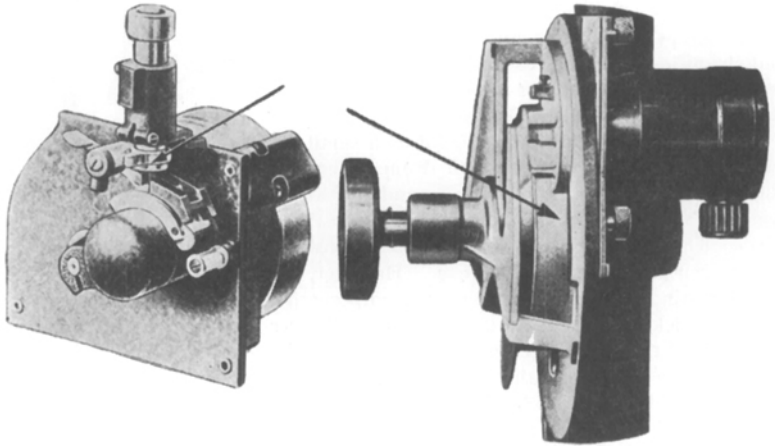

FIG. 3. (*Left*) Sound unit, showing automatic focusing device.
FIG. 4. (*Right*) Casing containing intermittent movement.

where desirable, and no metal stampings are used. The main casting contains the lamp, the motor, and the ventilating fan. The ventilation is unusually efficient, insuring maximal lamp life.

The lamp used is a special 750-watt bulb with offset filament, and burns base up (Fig. 5). Such an arrangement permits using the lamp as a source of light in place of the usual sound exciter lamp. This arrangement provides an unusually great flux of light through the sound optical system; and, as a consequence, the sound slit may be made narrower, thereby improving the quality of the sound and the frequency response. The high temperature of the 750-watt filament causes a lag that virtually eliminates the chance of 60-cycle modulation.

The lamp house and motor housing are die-cast and provided with slots, so

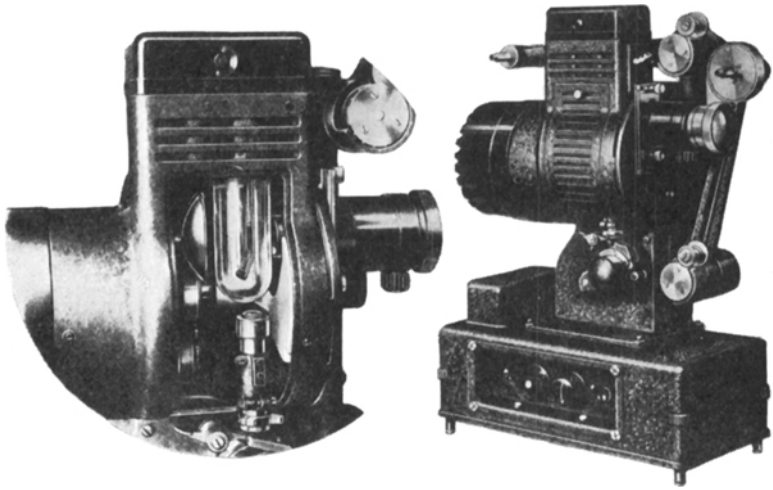

FIG. 5. (*Left*) Lamp house and projection lamp with offset filament, avoiding using a separate lamp as exciter source.
FIG. 6. (*Right*) Projector ready to be placed into carrying case.

that cool air constantly circulates to all working parts of the projector mechanism. The intermittent movement is entirely encased and runs in grease. The optical system is of the direct type and is highly efficient. The large-aperture lens permits projecting a well illuminated picture 12 feet wide at a distance of 90 feet. The driving motor is of the synchronous type, $^1/_{50}$ hp., 110 v. The drive connection between motor and the mechanism is of the friction type, providing protection against emergencies. The ventilating fan is mounted directly upon the motor shaft. Bakelite construction tends to quiet the noise of the fan. The projector is mounted upon a sub-base which contains the pre-amplifier, and also carries the electrical controls, which are arranged on the operating side of the machine, all together and easy of access. Here are located also the amplifier "on-off" switch, the starting switch, the volume control, and the tone control. The starting switch is so arranged that the projector mechanism must come up to speed before the light is turned on.

The power amplifier is a separate unit, and is transported in a separate case together with the speaker. The object of this arrangement is to provide for connecting the system to other amplifiers, such as those in radio receivers, public address systems, existing 35-mm. amplifying equipment, *etc.* The pre-amplifier contains an output transformer which may be matched with any power amplifier transformer impedance. Such an arrangement makes the Debrie projector extremely flexible, since the power amplification can be chosen to suit any special requirement: the radio can be used in the home; industrial companies that already have 35-mm. installations can use their present amplifiers and wiring; churches and schools can use their public address equipment; small theaters also can use their 35-mm. equipment.

For transportation and storage, the entire equipment is compactly contained in two cases, one of which contains the projector and the other the amplifier and speaker (Fig. 6). The simplified, high-precision construction of the projector mechanism produces a very low level of operating noise and permits it to be operated without a housing or "blimp" case, so that all parts are well cooled and at all times accessible. The weight of the entire equipment is 52 pounds.

DEPUE OPTICAL REDUCTION SOUND PRINTER*

O. B. DEPUE**

When building an optical sound printer it is advantageous to adhere to the general path of the film in the conventional continuous film printer because then the operators will encounter no difficulty in threading and operating the machine (Fig. 1).

The system of lenses and the film movement were suggested by the earlier experiments of A. F. Victor. Both the 35-mm. and the 16-mm. sprockets are on a single shaft, one inside the other. This arrangement appeared to offer the advantages of simplicity of construction and convenience in locating the fairly large flywheel. The two films travel in the same direction and at the proper speeds, with a minimum variation of motion of one film relative to the other. The right-angled prism immediately above the 25-mm. copying lens (Fig. 2) corrects for the otherwise reverse movement of the 16-mm. film.

The 16-mm. film upon which the picture is printed at another time has but one edge perforated, the sound-track occupying the other edge. To simplify the construction and operation the 35-mm. sprocket has but one row of teeth, and the 16-mm. drum is fitted next to it in a position corresponding to the space between the two sides of the 35-mm. sprocket, thus greatly simplifying threading the machine. The 16-mm. film is carried past the printing station not by a sprocket but by an accurately made stainless steel drum of exactly the right size to move the film without slippage. A 24-tooth stainless steel sprocket

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** Chicago, Illinois.