

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.

1000-WATT 16-MM. FILMOSOUND PROJECTOR*

R. F. MITCHELL AND W. L. HERD**

The Filmosound 16-mm. sound-film projector is of advanced design, incorporating many unusual features, such as a 1000-watt lamp and *T-12* bulb, motor drive take-up and motor rewind, built-in film humidifier, and many other features. It is being used to show 16-mm. sound pictures to audiences up to 4000 persons (in the auditorium of the National Geographic Society). This is, perhaps, the limit of its capacity; normally it is entirely adequate for an audience of 1000. Despite its power, the complete projector, amplifier, loud speaker, cables, and film for a complete show, all go into two cases, one weighing about 50 pounds and the other about 35, constituting an outfit that is readily portable in an ordinary car. The advantage of this for lecturers who must travel from place to place and talk to audiences of various sizes is evident.

Fig. 1 shows the arrangement of the equipment in its two cases. Figs. 2, 3 and 4 show the essential features of the projectors and amplifier units. The projector consists mainly of die-castings. The intermittent movement is similar to that of the well known *Filmo* projector, being of the harmonic cam type and employing a single-bladed shutter with an unusually large open segment of 216 degrees. The shutter rotates three times for each frame that is projected, thus giving two intermittent flicks in the picture upon the screen. Due to this design, steady and flickerless pictures are readily obtained. The normal screen width recommended is about 10 or 12 feet.

While the projector was being designed, the lamp manufacturers were requested to develop a 1000-watt projection lamp using a *T-12* bulb. It was realized that especially efficient ventilation would be required to permit such a lamp to be used satisfactorily. Accordingly, especial attention was given to the fan and ventilating system of the projector. The 1000-watt lamp in a *T-12* bulb, with the efficient ventilation provided, easily gives its rated life of 25 hours. The main advantage is that the arrangement permits the use of short coupled optics, thus utilizing the maximum amount of light from the lamp. Accordingly, the optical efficiency of the projector is quite high.

As will be seen in the illustrations, the projector is supplied with reel arms large

* Presented at the Spring, 1936, Meeting at Chicago, Ill.

** Bell & Howell Co., Chicago, Ill.

enough to accommodate 1600-ft. reels. A 1600-ft. reel of 16-mm. film is equivalent to a 4000-ft. reel of standard film. One threading of the machine is sufficient for a 50-minute show. The machine can also handle reels of smaller capacity, available in 1200-, 800-, 400-, and 100-ft. sizes.

The speed of the projector is controlled by a centrifugal type of vibrating-reed electric governor of extremely efficient design. Speed is guaranteed to be constant within 2 per cent, with line voltage variation from 100 to 125 volts. As a matter of fact, the governor will compensate for variations from 90 to 130 volts without noticeable change in the pitch of the reproduced sound. The governor is adjustable, having two pre-set positions permitting operation at speeds of

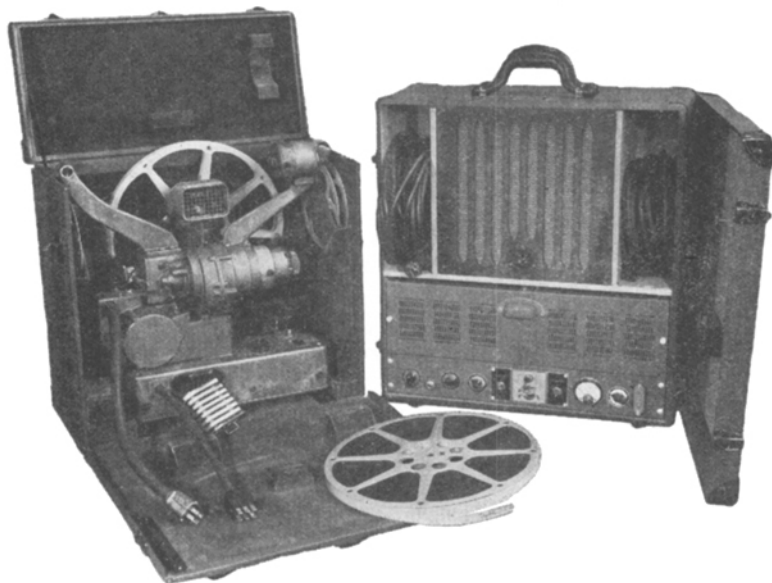


FIG. 1. 1000-watt 16-mm. Filmosound projector, with humidor unit removed to show arrangement.

16 and 24 frames per second. The regulation of the governor is so close that a heavy synchronous motor is not necessary, permitting the projector to be used interchangeably on 25-, 50-, and 60-cycle a-c. or d-c., which is an especially important feature for lecture or road show work.

An unusual feature is the use of a separate electric motor for the take-up. Because of the large variety of reel sizes that can be accommodated, and because of the range of speeds at which the projector will operate, it was found that the conventional types of drive were not sufficiently reliable. Accordingly, a separate take-up motor was designed, the speed of which is controlled by a calibrated rheostat. In conjunction with the take-up a shock-absorbing snubber has been incorporated which effectively prevents film damage due to inaccurate or bent reels, and is really simple in operation and works most efficiently.

Another unusual feature incorporated in the take-up motor is the provision of special windings permitting this motor to run at high speed in the reverse direction for power rewinding. A 1600-ft. reel is rewound in less than one minute. A fool-proof change-over switch, provided to switch the motor from take-up to rewind, is interlocked with the main switch so as to prevent accidentally switching on the take-up motor to rewind during projection. The machine must be turned off, the lever set for rewind, and then the main switch turned on again.

In order to reduce the danger of burning out lamps and to assure the most satisfactory operation under varying voltages, the lamp is connected in circuit

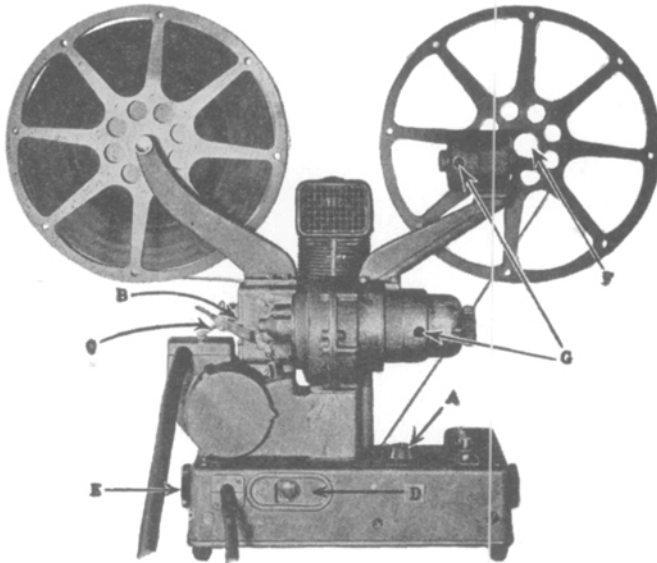


FIG. 2. 16-Mm. Filmosound projector:

- | | |
|--------------------------------|------------------------|
| (A) Take-up tension adjustment | (D) Humidifier |
| (B) Hand setting knob | (E) Front titling knob |
| (C) Gate operating lever | (F) Gear chamber |
| (G) Motor brush screws | |

with a variable rheostat located in the lamp house where it will be effectively cooled. A voltmeter shows the voltage across the lamp. When starting, the rheostat is turned all the way down, and is then brought up until the voltmeter registers correctly. The voltmeter is illuminated by a pilot lamp, the light from which is reflected to the voltmeter by a small polished metal stud to the front left of the voltmeter. The pilot light is shielded, and the shield can be rotated to direct the light to any part of the projector so that the pilot can be lighted during projection without annoying the spectators near the machine.

A unique feature has been incorporated in this machine—namely, an automatic humidifier. Although the cooling system was found entirely adequate to maintain correct operating temperature even when the projector was used in a warm room and with high voltage, it was felt desirable to incorporate a humidi-

fier to restore moisture to the film. This problem is more severe with 16-mm. projection than with theatrical work because 16-mm. film is made of acetate safety stock, which tends to lose and absorb moisture rather readily. The humidifier consists of a series of plates of absorbent material inserted into the back base of the machine. Moist air passes through a channel from the humidifier to a slot through which the film travels. This blast of moist air impinging upon the film immediately after projection has been found to add appreciably to the life of the film.

Incidentally, discussing film life, it may be of interest to mention that, in contrast to theatrical projection, in which three or four hundred projections represent

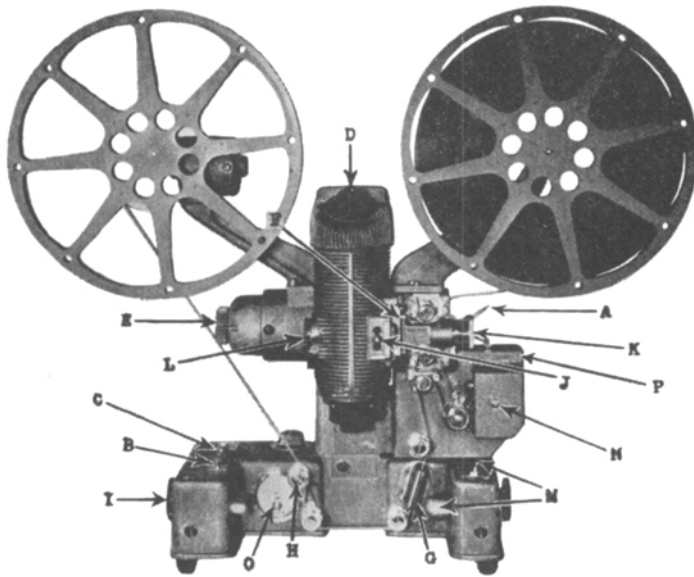


FIG. 3. 16-Mm. Filmosound projector:

- | | |
|----------------------------|----------------------------|
| (A) Motor clutch lever | (J) Rear tilting knob |
| (B) Current supply switch | (K) Condenser |
| (C) Rewind-run lever | (L) Projection lens |
| (D) Lamp voltage control | (M) Reflector |
| (E) Motor speed adjustment | (N) Pilot light and switch |
| (F) Manual framer | (O) Exciter lamp housing |
| (G) Humidifying slot | (P) Voltmeter |
| (H) Snubber | (P) Sound head cover |

good film life, it is now possible to project 16-mm. film more than 1000 times without appreciable deterioration. In fact, some tests have run to 16,000 projections.

For auditorium use, it is usually required that the projector be tilted down from the balcony or up from the main floor. Accordingly, tilt knobs have been provided at both front and back, which operate legs for tilting the projector upward or downward to an angle of about 10 or 15 degrees. The low, stream-line base is

important in this connection because it provides the necessary strength and low center of gravity that permits the projector to be tilted with perfect safety even when using the large 1600-ft. reels.

Sound System.—The projector is arranged to be used with the special amplifier

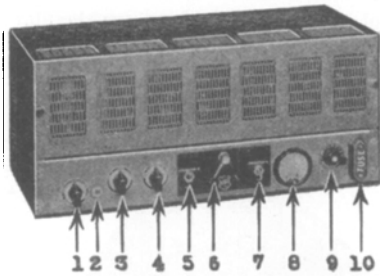


FIG. 4. Filmosound amplifier:

- (1) Microphone volume control
- (2) Microphone jack
- (3) Tone control
- (4) Film volume control
- (5) No. 2 projector switch
- (6) Change-over switch
- (7) No. 1 projector switch
- (8) Amplifier meter
- (9) Amplifier line-switch
- (10) Fuse box

shown in Fig. 4. A shielded cable carries the impulse from the photoelectric cell to the amplifier. Another cord carries the power to the projection lamp, motor, and exciter lamp, which are controlled at the amplifier. The line switch on the projector is left in the "on" position. When operating two projectors, one machine or the other is started with one of the two switches provided, depending upon which machine is being used.

The amplifier embodies all the necessary conveniences as well as several not found in ordinary theater-type amplifiers, made necessary because of the use made of the equipment and, more particularly, because of the relative inexperience of operators. For

example, instead of supplying the usual type of voltmeter and instructing the operator to set the voltage input to the power transformer to a certain voltage, the voltmeter is supplied with a dial that is blank except for a red area within which the pointer is to be adjusted. A line switch is provided with several taps so that the operator merely turns it until the voltmeter needle falls within the red area. The extent of this area is ten volts.

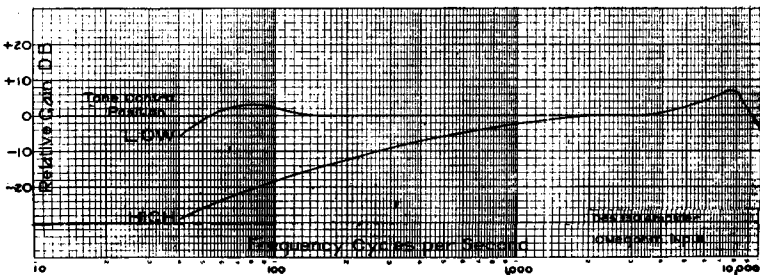


FIG. 5. Response curve of amplifier, showing range of tone control adjustment.

In addition to the conventional volume control, a separate volume control is provided for the microphone. This feature is used extensively for adding comments to films, and also permits the equipment to be used as a public address system. Because the equipment is intended for use in halls of various sizes and

acoustic properties, an extensive tone control is quite necessary for satisfactory operation. With it the operator can adjust the quality of the output to compensate, at least to some extent, for the variable acoustic properties of the auditoriums and for various characteristics of recordings.

The amplifier comprises four stages of amplification, terminating in a class *AB* power stage of four *45* tubes in parallel push-pull. The power stage is driven by a type *42* tube, employed as a triode and coupled to the output stage through a suitable transformer. The first stage of amplification consists of a *6C6* pentode resistively coupled to a *6C6* operating as a triode, Resistance coupling is employed

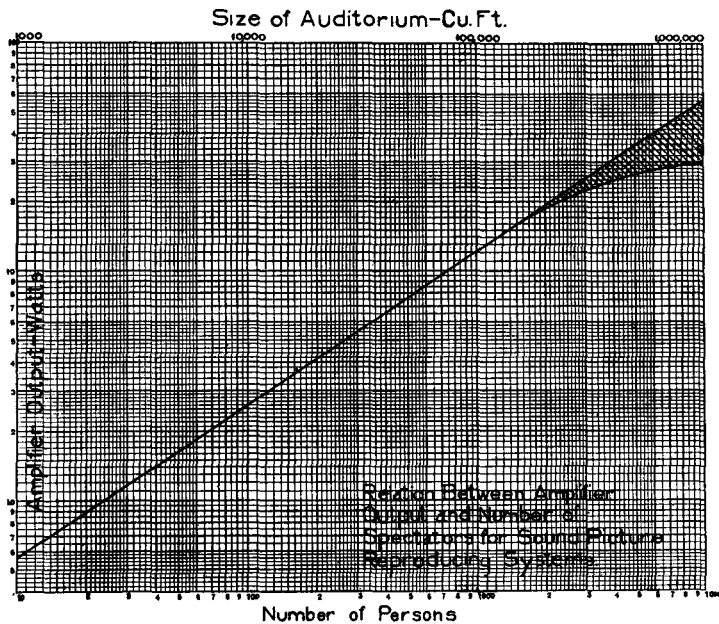


FIG. 6. Relation between amplifier output and number of spectators for sound-picture reproducing systems.

throughout, with the exception of the input and the output circuits of the power stage. Direct current is supplied by a mercury-vapor rectifier. A type *80* rectifier, complete with power supply and filter, is contained within the loud speaker case, and this design permits adequate field excitation for the speaker with no loss of regulation in the amplifier circuit. Careful design has resulted in a high-gain amplifier, which produces a surprisingly realistic output with a minimum of hum and distortion.

Fig. 5 shows the response curve with the tone control in the high and low positions, and indicates the range of control. The normal output of the amplifier is in excess of 25 watts, with a total harmonic distortion of less than 5 per cent. Momentary peaks in excess of 100 watts and without objectionable distortion have

been measured. Considerable difficulty was at first experienced in obtaining a single speaker of satisfactory size and weight that would stand up in actual service. The unit adopted is a Magnavox speaker made especially for the reproducer and possessing a rating of 25 watts in continuous operation. It is a 12-inch electrodynamic unit, mounted rigidly inside the carrying case. The speaker case carries the amplifier and connection cords, and is sufficiently large to constitute a satisfactory baffle without being cumbersome.

Care has been taken to provide all cords with non-interchangeable plugs so that incorrect connections are impossible, which is very important for all portable service.

The amplifier is of the conventional a-c. type. However, the user very often is forced to operate the equipment on direct current, so arrangements have been made to operate the projector motor and lamp on d-c., using only a small portable converter for supplying a-c. to the amplifier.

For certain semi-permanent installations, it has been found desirable to supply more than one speaker. Auxiliary speakers are furnished complete with cases, power supply, and impedance-matching transformers. The circuits have been so arranged that additional speakers may be connected as required, and no thought need be given by the operator to matching impedances. Fig. 6 shows the relation between the size of auditorium and the power necessary to furnish adequate sound. Although the curve is empirical, it has proved a useful guide in practice.

DISCUSSION

CAPTAIN BRADLEY: How accurate is the rehumidifier?

MR. MITCHELL: We have no data that actually show how effective it is. It is largely relative, depending considerably upon the initial condition of the film and upon the conditions under which the film is projected. On a dry day it is very effective.

MR. KELLOGG: How was the original recording of this film made?

MR. MITCHELL: On 35-mm. At least 95 per cent of the commercial pictures are made that way, due to the difficulty of getting the highest sound quality directly on the 16-mm. negative. The investment in actors, lights, and so forth is so great that it is not very safe to make the original negative anything but 35-mm. There is a very decided and definite saving in making the print on 16-mm. The principal saving is in size and portability of equipment. We can get good results from equipment of this kind with audiences up to 4000 persons, even though that is stretching the capacity of the equipment considerably.

MR. KELLOGG: The sound is re-recorded from the 35-mm.?

MR. MITCHELL: Optically reduced, directly.

MR. GREENE: Were the response curves only transmission curves, or with the amplifiers?

MR. HERD: Transmission curves, amplified from the photocells, not including the rest.