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 NEW PROJECTOR MECHANISM*

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During the past few years the Research and Engineering Departments of this company have been searching for a device or devices that would permit changes in the design of projection equipment that would result in greatly improved film presentation. Many ideas were considered and rejected, some because of extreme complications, and all because nothing was found that would compare favorably so far as screen results were concerned, with equipment of our earlier designs. After making this decision approximately two years ago, it was decided to improve, so far as we possibly could, upon what were our earlier conceptions of the best available mechanisms, with the result that about two months ago there was released to the industry the company's latest development in motion picture projectors, the Simplex *E-7* mechanism (Fig. 1).

In considering the design of modern motion picture projection equipment it is necessary to deal with two major requirements: (*1*) greater screen illumination, without increasing the light coming from the arc or other illuminating means, and (*2*) increased steadiness of the projected picture. The means whereby these have been accomplished, together with a brief summary of other changes and improvements, constitute the subject of this paper.

In the conventional motion picture projector mechanism there are a revolving shutter either in the front or in the rear which cuts off the light as the film is pulled down past the aperture plate by the intermittent movement, and openings in the shutter, either front or rear, which allow the light-beam to pass through the film to the screen while the film is at rest in front of the aperture plate. Increased illumination obtained from the *E-7* projector has been brought about by placing a second shutter in front of the lens (Fig. 2), this shutter being attached to the same shutter shaft and revolving in the same direction as the rear shutter or the shutter between the illuminant and the aperture plate. By this design it is possible to cut off half of the light-beam behind the aperture plate, and half of the picture at

* Presented at the 1938 Spring Meeting at Washington, D. C.; received April 14, 1938.

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the same instant in front of the lens, since the image is inverted after passing through the lens. We are thus able (since it is not then necessary, as in the case of one shutter, to cut the entire picture from the screen before moving the next one into position) to cut the top and bottom halves of the picture at the same instant and eliminate approximately 20 degrees from each shutter blade, and hence pass that much more light to the screen. This results in an approximate increase of from 12 to 15 per cent in screen illumination.

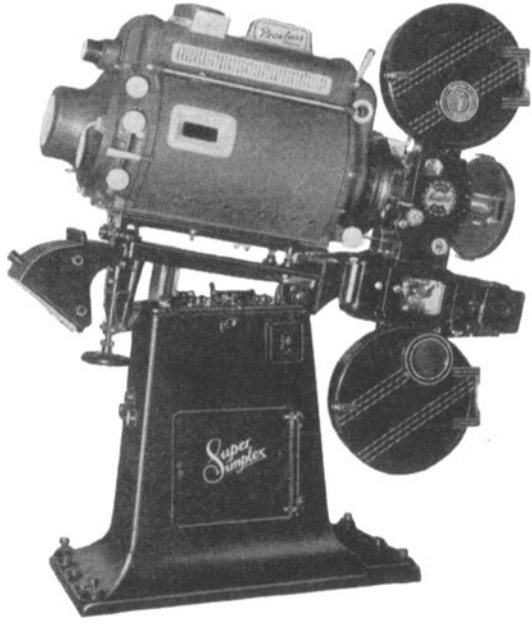

FIG. 1. Simplex *E*-7 projector.

This result is obviously attained without increasing the speed of any part of the mechanism since, as before stated, both shutters revolve at the same speed (1440 rpm.), being attached to the same shutter shaft. Both shutters are housed in suitable protective guards, and means are provided for the easy removal of these guards when necessary for cleaning purposes. Attached to the rear shutter, between the source of illumination and the aperture plate, are specially designed vanes, the function of which is to create a partial vacuum in and around the aperture plate and remove therefrom at high velocity the heat created by the illuminated spot and keep the entire rear of the projector cool enough to touch with the fingers even when using high-intensity arcs.

To set the shutters in exact synchronism and in proper relation to the intermittent movement, a shutter-setting device is supplied with each pair of mechanisms. With this device the shutters may be set in an extremely simple

manner and with a greater degree of accuracy than was possible with earlier equipment.

A steadier picture is obtained both vertically and laterally, first, through new developments in intermittent movement design, which allow far greater accuracy in manufacture, plus a hardened and ground intermittent sprocket on which the 64 radii of the teeth are ground to extreme accuracy; and, second, by the addition of edge-guiding in the film-trap, which maintains the film in a constant lateral position and does not allow the film to weave slightly as in former designs.

To eliminate the possibility of improper or inadequate lubrication, the equipment is provided with the Bijur one-shot oiling system (Fig. 3). This system has proved its merit in the finest types of accounting machines, sewing machines, electric lamp machinery, *etc.*; it is incorporated in the best American trucks and ambulances, and in the highest grade foreign automobiles.

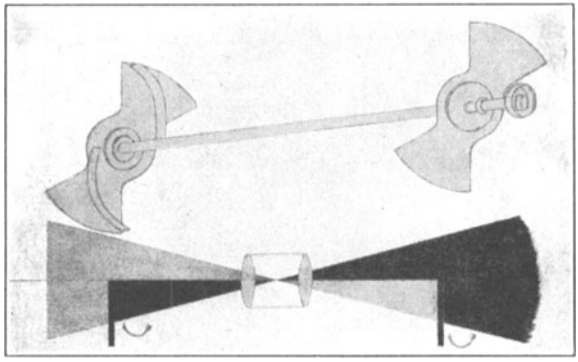

FIG. 2. Synchronized front and rear shutters.

As applied to the new projector, this system consists of a piston pump which delivers at each impulse a metered quantity of filtered oil to a distribution system where, by means of meter units, this measured quantity is proportioned to each bearing in predetermined quantities. Check-valves in the meter units prevent draining the oil lines between "shots." The system is provided with a double set of dense felt filters, the one in the pump being the denser and serving to filter the reservoir oil; the other set of filters is in the individual meter units and is for protection of the units against chips and dirt before and during assembly. This combination of filtering assures a clean supply of oil at every bearing. The Bijur Company advise that they have as yet found no indication of a limit to the life of the filters when used with a straight mineral oil. The pump develops a pressure of 35 pounds per square inch.

The small tubes leading from the meter units to the bearings are so proportioned, as to ratio of wall thickness to bore, that they will not collapse even when bent double in a vise, so there is no way in which they could be stopped up without a type of handling that would also damage the mechanism as a whole. With

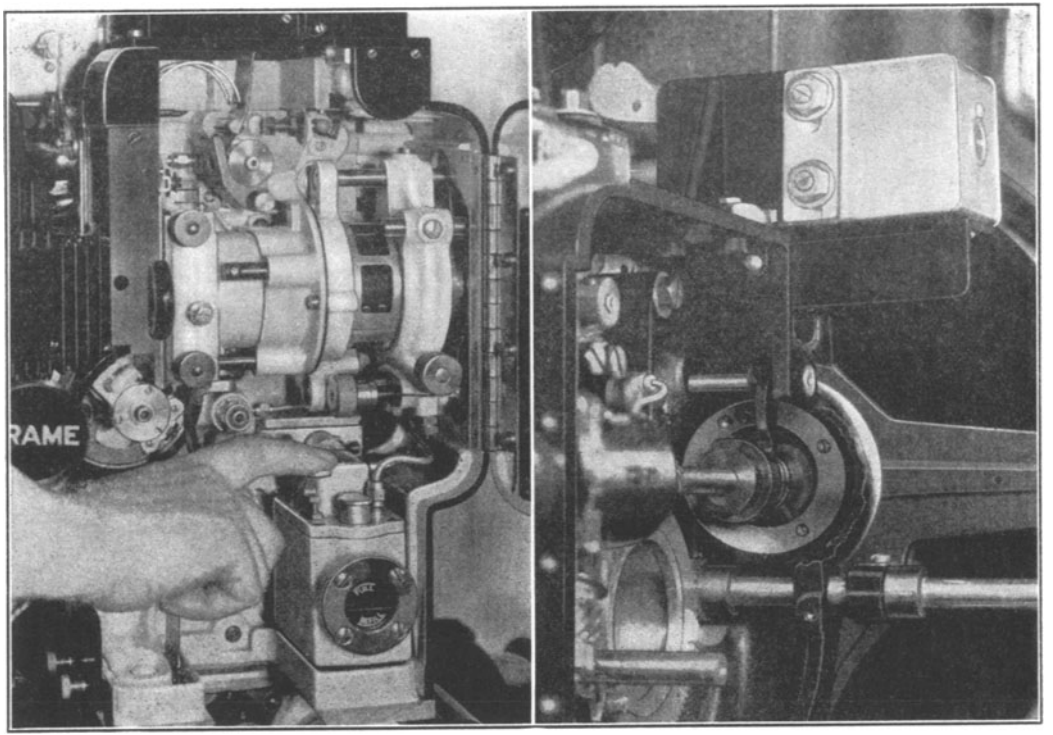

FIG. 3. FIG. 4.

FIG. 3. Operating the Bijur one-shot oiling system.
FIG. 4. Centrifugally operated disk on shutter-shaft for actuating fire-shutter between rear shutter and film aperture.

a lubricating system such as this the only place in which it is necessary to see the oil is in the pump unit, and a sight-glass is provided for this purpose.

Such bearings as are not reached by this lubricating system are the ball bearings that carry the shutter-shaft assembly and the lower bearing of the oblique shaft. These are of the sealed, grease-packed, dustproof type, and do not need attention for a number of years. Oil-can lubrication is required only to fill the oil reservoir of the Bijur system and the intermittent movement, which will be discussed later.

Considering fire protection of paramount importance, the equipment is supplied with a positive-acting fire-shutter between the rear shutter and the film aperture (Fig. 4), which is operated through a centrifugally operated disk mounted on the revolving shutter-shaft. When the projector is at rest this disk lies at an

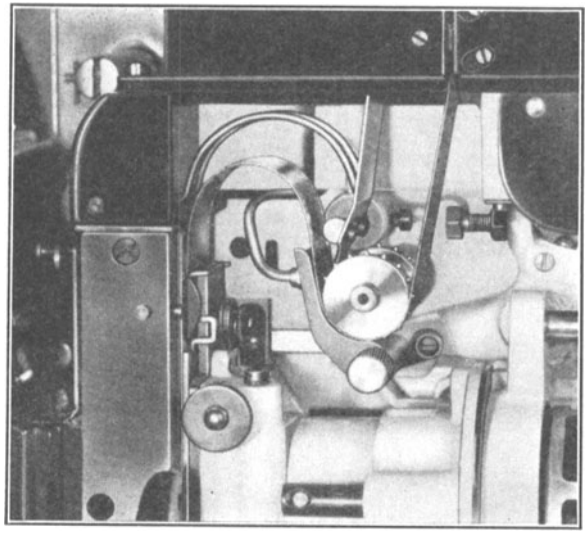

FIG. 5. Automatic fire-shutter safety trip.

angle with relation to the shutter-shaft and when the projector is in operation, centrifugal motion straightens up, so to speak, and through a unique linkage device raises the fire-shutter out of the beam of light.

It is well known that on a properly designed projector mechanism, and one that is kept in good repair, it is not possible under normal circumstances to burn more than one frame of film at the aperture plate should a splice part at the intermittent sprocket, and this, incidentally, is the only time it is possible during normal operation of a projector for any kind of fire to occur. However, to eliminate even this cause of fire, the apparatus is provided with an automatic fire-shutter safety trip (Fig. 5), which operates in connection with the automatic fire-shutter and instantaneously drops the latter should a splice part at the intermittent sprocket. The unit is operated by the slightest increase in size of the upper loop, and the

action is instantaneous, the fire-shutter dropping before the film has a chance to ignite. This means increased protection to the projectionist and theater owner. The device is simply attached and may readily be removed and replaced.

A newly designed film-gate has been provided, of much heavier construction than any of its predecessors and readily removable by simply removing two thumb-nuts and sliding it from its two supporting studs (Fig. 6). This gate is now formed from one heavy steel stamping which supports along its entire length pressure pads of new design, the tension on all of which, through self-equalizing cone

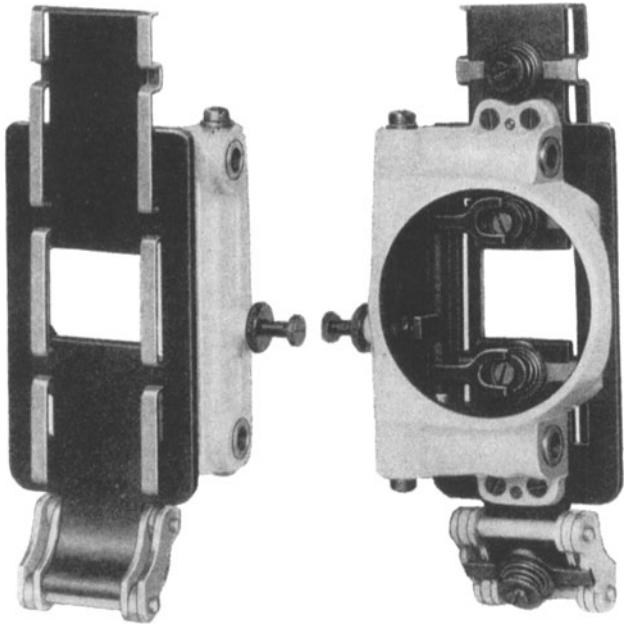

FIG. 6. Film gate: (*left*) rear view; (*right*) front view.

springs, is readily adjusted by the projectionist while the projector is in operation. The base of the gate supports the intermittent sprocket tension shoe which also is provided with an adjustable tension unit. With this type of gate, and due to the proper placement of tension shoes, it has been found possible to lessen the tension considerably and at the same time maintain a much steadier picture than heretofore.

The gate is mounted on an opening and closing unit of entirely new design and is locked solidly in both its open and closed position. Provision is made for removing entirely any lateral displacement of the gate due to wear, and this combination definitely prevents any "jiggling" of the gate such as was sometimes evident in earlier models. The entire gate is provided with a very simple

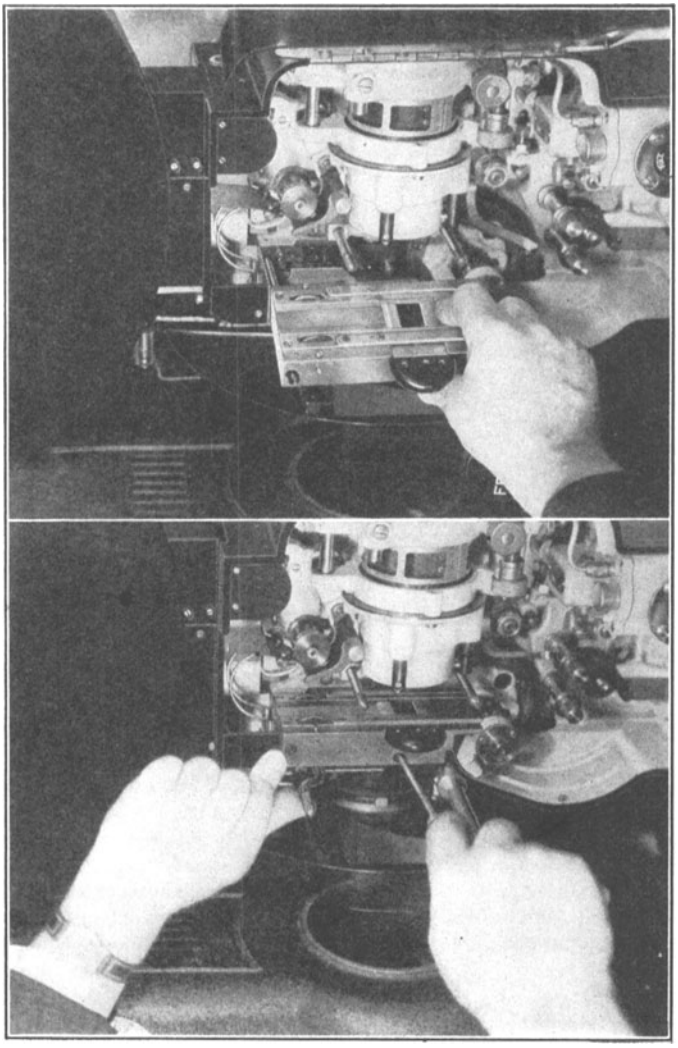

FIG. 7. Showing construction and method of removing film-trap.

lateral adjustment by means of which it may be correctly aligned with the runners on the film-trap.

The film-trap is of completely new and original design and may now be removed entirely for cleaning purposes as may the gate (Fig. 7). This is accomplished simply by the removal of two screws, whereupon the film-trap may be slid off toward the projectionist. The film-trap is provided with the conventional lateral guide-rollers, but, in addition thereto, edge-guiding channels have been added which, in coöperation with the lateral guide-rollers, maintain the edge of the film steadily against the edge of the guide, thus eliminating all sidesway during film travel. The film-handling parts of both the gate and film-trap are readily removable for replacement when wear becomes apparent, and it is no longer necessary to tear down the entire projector when such is the case.

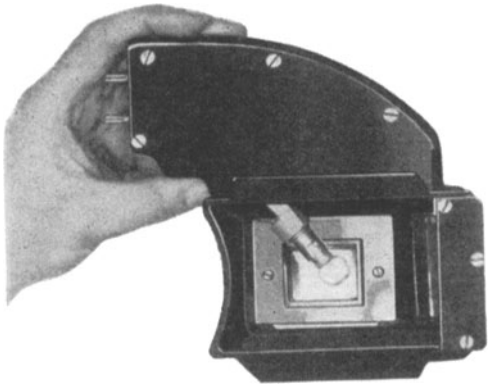

FIG. 8. Framing lamp and spot sight box.

As in the case of previous film-trap and gate design in Simplex projectors, the emulsion side is always toward the film-trap runners; thus, variations in film thickness, as between standard production film and newsreel stock, will not affect the definition of the projected picture; thus, it is not necessary to re-focus the lens to compensate for the difference in the position of the emulsion as is the case with the old Powers projector mechanism and other equipment of similar design.

An ingenious framing lamp and spot sight box assembly is mounted between the rear shutter and the film-trap (Fig. 8). A small incandescent lamp of the bayonet type is pivotally mounted in this assembly and operable only when the fire-shutter is raised manually during the process of threading the film into the projector; thus, a strong, direct beam of light is projected through the aperture plate by means of which the projectionist may accurately select the frame of film to be placed over the latter. The lamp is lighted through a small mercoid switch and extinguished upon release of the fire-shutter lever which automatically takes the framing lamp assembly out of the path of the projection lamp beam and extinguishes it at the same time.

The spot sight box in which this assembly is mounted is provided with a number of air-cooled fins for rapid dissipation of heat from the projection lamp-beam. A highly polished nickel-plated copper baffle, together with two additional copper baffles, form part of the heat-reflecting unit in this assembly, and this helps further to cool the rear of the mechanism. The entire assembly is readily removable for cleaning, and engages the electrical circuit by means of pin plugs when in its proper operating position.

The intermittent movement in this equipment is of the conventional double-bearing type, similar to that provided in earlier Simplex mechanisms (Fig. 9). It has been greatly improved, however, as to oil sealing, and is provided with

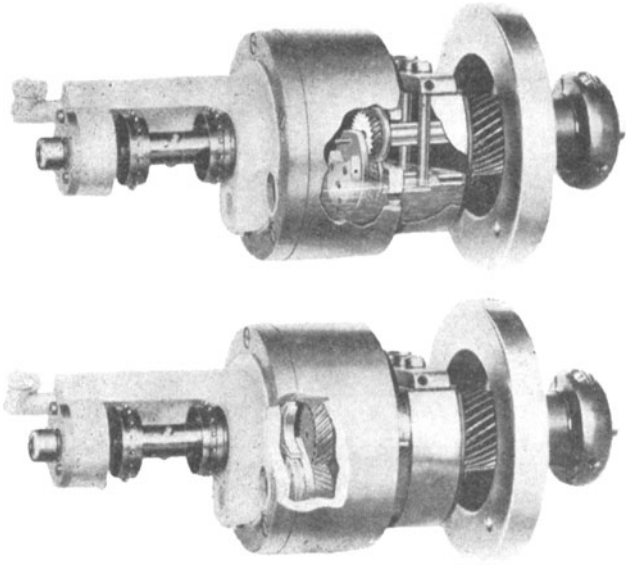

FIG. 9. Cut-away views of intermittent movement.

means whereby it is impossible to insert a greater quantity of oil than is required for proper operation. This eliminates the possibility of the projectionist's overfilling the oil-well and thus allowing the lubricant to spill over; and at the same time makes it possible at all times for him to see through the sight glasses in the movement, that the oil level is correctly maintained.

The entire movement is of considerably heavier construction throughout, and its design, as before stated, allows for far more accurate construction than was possible in any previous movement. In addition to being leakproof it is practically bindproof, since properly designed spiral grooves in connection with oil channels are provided in the revolving shafts and bearings which carry oil to all parts needing constant lubrication. In addition to this, perfect lubrication between the cam ring and the star radius is assured, since oil is forced through two channels in the cam forming a cushion of oil between the star radius and the cam

ring when they lock together while the picture is being projected. This also cushions the blow between the two units and makes for a quiet-running unit. The movement may be lubricated from either the non-operating or operating side.

One of the important features in connection with this intermittent movement is the fact that it may be readily removed for cleaning, or parts replaced without disturbing any of the major parts of the projector mechanism or sound-reproducing unit—and this from the operating side of the mechanism.

Positive synchronism, without backlash or lost motion, is assured between the intermittent movement and the revolving shutters when framing by the uniquely designed assembly now performing this function. The shutter-shaft passes through an assembly similar to a cylinder and piston in automobile design (Fig. 10), and fastened to the piston through a ball-race is the shutter driving gear by means of which the shutter-shaft is driven through a woodruff key. Attached

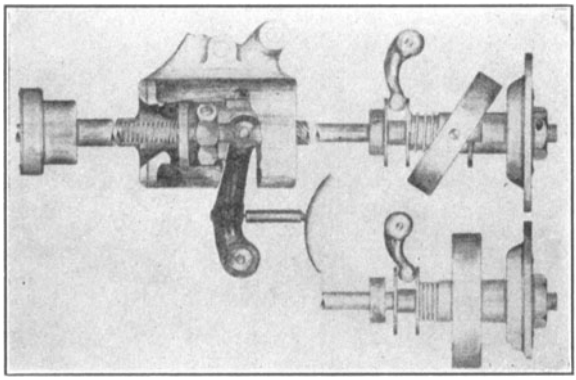

FIG. 10. New ring type governor.

also to the piston is a pivoted arm, the lower end of which fetches up solidly against a plunger pin operated by the framing cam of the intermittent movement assembly.

The entire assembly is held under substantial tension by means of a heavy coiled spring, one end of which is held under tension by a collar on the shutter-shaft and revolving with it, and the other end of which fetches up solidly against the ball-race attached to the gear. This spring performs two functions: it forces the piston rearward at all times, and at the same time removes any slight end-play in the shutter shaft and framing device synchronizing assembly.

In operation, when the framing handle is turned in one direction, the intermittent movement, complete with its framing cam, revolves in its housing, forces the plunger against the pivoted arm, which in turn moves the piston and gear assembly forward against the spring compression, thus revolving the spiral gear and shutter-shaft the exact amount necessary to maintain synchronism between the intermittent movement and the revolving shutters. When the framing handle is turned in the opposite direction, the entire assembly performs exactly the same function, except that the compression spring forces the piston and gear assembly

rearward, and thus the same synchronism is obtained with any position of the framing handle and intermittent sprocket.

All bevel gears have been eliminated and, as a matter of fact, the number of gears has been greatly reduced. Spiral gears alone now form the driving equipment, and thus the noise-level during operation has been tremendously reduced. The face of the main drive gears has been increased in cross-section as a protection against the high starting torque of the modern sound-head, and these gears now operate on hardened and ground studs rigidly attached to the center frame. The area of the bearings of the gears that revolve upon these studs has also been greatly increased, and lubrication is provided through the Bijur one-shot oiling system to the center of the studs, forcing in clean oil all the time and washing any dirty lubricant out on the non-operating side of the projector only; thus rebushing of the main frame in this connection has been eliminated, and much longer life is assured and cost of maintenance reduced.

Wherever the finest accuracy is not required, non-scoring bearing material is used; but where extreme accuracy is required, and this material can not be relied upon satisfactorily, the type of bearings best suited for their proper function, such as ball bearings on the shutter shaft, and burnished cast-iron bearings for hardened and ground shafts, are used.

Lens focusing is accomplished from either inside or outside the mechanism, making it possible at all times to control readily the definition of the projected picture.

The mechanism is designed to fit any existing standard sound-reproducing apparatus. The interior is finished in pearl-gray enamel, to facilitate observation of the film travel. This light interior also lends itself to cleanliness, and is brightly illuminated by the additional threading lamp provided in the upper right-hand corner of the operating side of the mechanism. This latter lamp eliminates the need for the old-fashioned trouble-lamp heretofore necessary for checking during threading operations.