system, capable of producing high-quality sound records. Operation of the channel has been simplified and made flexible by the use of a number of new features. Maintenance is minimized by the easy accessibility of the parts and by the fact that any unit may be quickly removed from the channel and another substituted for it.

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A NEW HIGH-QUALITY FILM REPRODUCER*

J. C. DAVIDSON**

Talking motion pictures became a commercially successful fact in August, 1926, and many of the original Western Electric reproducing equipments installed soon after that date are still in daily use. These machines were the result of a careful analysis of the requirements of the industry as they were then understood.

During the past two years, surveys have been made, concurrently with developmental work, with a view to the production of a reproducer that will meet not only today's requirements as we see them, but will accommodate future developments in recording technic for several years to come.

Requirements.—In order to give to the theater owner full measure of improvement, together with the years of service he is entitled to expect, the film propelling mechanism should be capable of moving the film past a scanning point with a degree of constancy of speed substantially equal to that attained in the more costly studio recording equipment. This accomplished, the equipment should be able to reproduce, without distortion, a far greater volume range than is at present attainable. Machine noise should be reduced to a degree that will

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permit deriving full advantage from the quiet passages, and, in addition, the reproducer should be ruggedly constructed, easy to operate, and simple to maintain. Parts in which unavoidable wear occurs should be readily replaceable. As a whole, the machine should be a complete, compact, symmetrical unit, and should not present the appearance of an appendage to its associated projector head.

Mirrophonic Reproducer Set.—The Mirrophonic heavy duty reproducer set has been designed to fulfill the above-described requirements. It consists of three units which interchangeably fit together to form a single symmetrical unit.

The main film compartment consists of an accurately machined casting containing the film-propelling mechanism, gears, the kinetic scanner, and a sub-

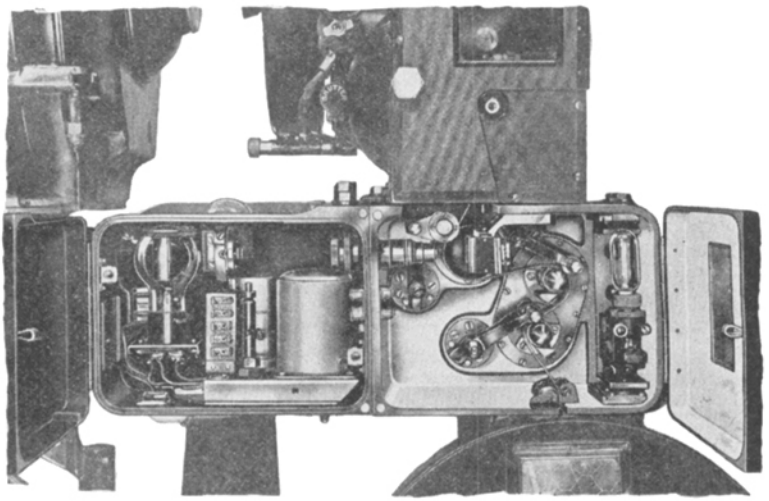

FIG. 1. View of film and photocell compartments.

compartment in which the exciter lamp is located. The photocell compartment is attached to the rear end of the main casting (and is interchangeable). It contains the photocell, the scanning slit, and coupling transformer. Fig. 1 is a view of the film and photocell compartments. The motor assembly (Fig. 2) is attached to the forward end of the main casting as a unit, and is interchangeable, self-aligning, and can be replaced within a few minutes.

The film path is from the hold-back sprocket in the projector head, around the drum of the kinetic scanner, over the drive and hold-back sprockets, and thence to the lower magazine. The mechanical drive consists of a worm directly coupled to the motor, driving a gear at 360 rpm. The gear is on the cross-shaft that supports the main drive sprocket as well as the necessary gears for driving the projector head and the lower magazine take-up. The cross-shaft, as well as the worm shaft, is supported in sealed ball bearings, and their accuracy of alignment is held to very close tolerances. The cross-shaft is coupled to the hold-back

sprocket shaft by means of a set of steel and fiber gears; and in order to minimize noise, the lower magazine take-up is driven by a silent chain.

The lubrication is fully automatic. All shafts but the one bearing the hold-back sprocket, and including the motor shaft, rotate in sealed ball bearings. The worm gear operates in oil in a sealed chamber in the main casting, and the hold-back sprocket shaft is rifle-drilled to permit lubrication from this chamber.

The kinetic scanner (Fig. 3) is a completely sealed unit, consisting of a hardened nitralloy scanning drum, ground to a concentricity of better than 0.0001 inch, rotating on a shaft running in sealed ball bearings. It is a complete unit, mounted in the main frame casting. A two-element film speed governor, mounted upon the rear end of the shaft, insures uniform speed of film propulsion.

The film is held in contact with the scanning drum by a pressure pad roller which serves also to maintain scanning alignment. This assembly consists of a shaft, mounted on ball bearings, upon which is a felt pressure roller built up of a series of felt rings cemented together, thus assuring a uniform hardness of surface capable of maintaining its original concentricity. The felt roller is mounted upon a steel sleeve and is easily replaceable as a unit.

FIG. 2. The motor assembly.

The optical system (Fig. 4) is the projection type of scanner. An exciter lamp is mounted in a pre-focused lamp bracket having the usual adjustments, which is mounted upon a damped chassis merely by being pushed upon two locating studs and locked into place. The light is focused upon the film by a condenser and prism combination monnted in a slot in the main frame casting which is adjustable along the optical axis for optimum setting. The optical axis is fixed throughout by the exceedingly close manufacturing tolerances employed.

The objective lens is a standard microscope objective mounted upon a precision sleeve that provides movement along the optical axis for obtaining a sharp focus. This objective projects an image of the sound-track, magnified ten times, upon a scanning slit in the photocell compartment. Provision has been made for masking the width of the track scanned at the focal plane, thereby insuring against the decrease of illumination at the edges of the beam that occurs when masking is attempted at points other than on the focal plane. The height of the slit is adjusted at the factory to be an optimum for the frequency range to be scanned. The azimuth of the scanning slit is readily adjustable.

The principal immediate advantage of projection scanning is its flexibility and simplicity of adjustment. It bids fair to take the scanning system out of the hands of the optical laboratory and place it with the projectionist, who will find the adjustments as simple as those he has always been accustomed to make in

projecting pictures upon the screen. The magnified image of even an 8000-cycle sound-track is so large that focus and azimuth can readily be adjusted by visual inspection, and will not be more than a decibel or so from the optimum obtained by the more laborious method employing the film loop and volume indicator. A septum is provided at the center of the scanning slit for the reproduction of push-pull recordings. It is mechanically connected to the switch controlling the electrical circuits for reproducing either standard or push-pull sound-track.

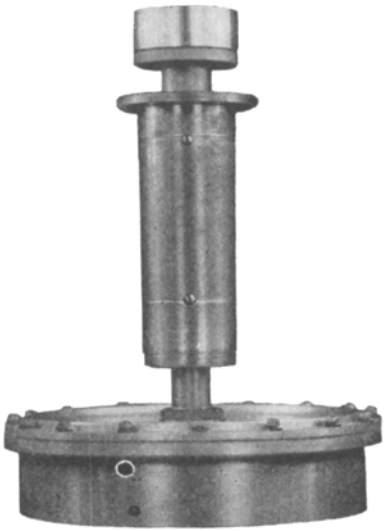

FIG. 3. The kinetic scanner.

The electrical circuit is in the photocell compartment, and consists of the photocell (which may be of the usual single-element type for standard track, or double element type for either push-pull or standard track) and a carefully balanced and shielded transformer having an impedance ratio of somewhat more than a third of a megohm to 200 ohms. The electrical balance between the elements of the cell and the coils of the transformer is such that no provision is required for equalizing the output from the two halves of a push-pull sound-track, so that operation is simplified merely to throwing a switch for the type of sound-track to be scanned.

From the installation and operating standpoints, the question of simplicity has been given serious consideration. With the selection of the correct pedestal

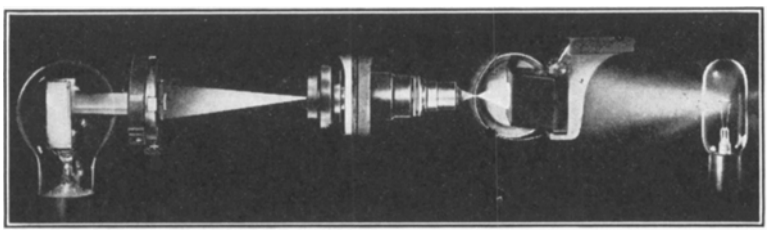

FIG. 4. The optical system.

arm, the reproducer set may be readily mounted upon any of the pedestals manufactured today in the U. S. A. Adapters are provided for the various projector heads in current use. The projector head is fastened to the adapter, which slides into a groove in the top of the main frame casting, providing a simple means of correctly meshing the reproducer and projector gears. It is possible, therefore, to remove the projector head, together with the adapter, by removing four readily

accessible bolts, and to mount the projector head again without in any way changing the focus or alignment of the picture upon the screen.

Performance—The performance of this reproducer set fulfills all requirements indicated by present-day standard of reproduction of sound recorded on film, and also anticipates any future developments that at present can be foreseen. The flutter content of the average machine, measured in production, is about 0.1 per cent; and with special adjustment the machine is capable of bettering this performance. The frequency characteristic conforms to the theoretical response for a scanning beam of the height employed. The introduction of calculated damping materials insures that the machine introduces no noise during the quiet passages of sound-track.

The reproducer set has been designed to have the appearance of a complete symmetrical machine. The inside is finished in white, to promote cleanliness and provide better visibility for threading the film. The materials used, the care in manufacture, and the finishes applied are all of the best, and it is confidently felt that the new reproducer set will give even longer service than its predecessors, many of the earliest of which are, as already mentioned, still in daily use.

RECENT DEVELOPMENTS IN HIGH-INTENSITY ARC SPOTLAMPS FOR MOTION PICTURE PRODUCTION*

E. C. RICHARDSON**

The high-intensity carbon arc affords certain advantages as a light-source for photography that are not possessed by other illuminants. Within the restricted area of its positive carbon is concentrated an intrinsic brilliancy greater than that afforded by any other artificial light-source. Fortunately, the distribution of radiant energy throughout the spectrum of a high-intensity carbon arc coördinates well with the spectral sensitivity of photographic emulsions and the transmission factors of camera lenses.

For the purpose of more effectively utilizing high-intensity arc sources in motion picture photography, two lamps have been recently developed. The *M-R* Type *90* lamp (Fig. 1) operates at 120 amperes. The *M-R* Type *170* lamp (Fig. 2) has a capacity of 150 amperes. The designs of these two lamps, which are in general quite similar, embody many new factors that greatly enhance their utility and add to the convenience of operating them. Fig. 3 shows the mechanism of the Type *90* high-intensity arc lamp, in which the following vital improvements have been incorporated: (*1*) increased rotational speed of positive carbon; (*2*) continuous non-intermittent feeding of both positive and negative electrodes; (*3*) rapid-action positive and negative manual adjustments.

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** Mole-Richardson, Inc., Hollywood, Calif.