A NEW DENSITOMETER*

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The change from variable-density to variable-area sound recording in Europe has made necessary new instruments for film processing control both in the studios as well as in the printing laboratories.

None of the existing density-measuring devices were found capable of meeting the requirements of variable-area recording because they were not sensitive enough to measure very small areas whose density ranged from 1 to 2.5. All instruments that employ an optical system were found to have the additional disadvantage that their indications were influenced by densities immediately adjacent to the area being measured. For example, the smaller the area under measurement, the smaller the density indication as compared to the actual density. This is caused by the diffusion of the light. Consequently these densitometers were useless for measurement of variable-area sound-tracks, which have very high density in some places and low density in others.

The densitometer to be described is not intended for laboratory use where extremely high precision is required, but for frequent checks in processing control; hence stress was given to objective density indications. To accomplish this, the densitometer is provided with a blocking layer type of photocell, and the current measured with a highly sensitive microammeter.

In order to eliminate the error introduced by changes in the lamp and the condition of the battery, a secondary light path is provided which, by means of an adjustable diaphragm, directs to the cell the same amount of light as is received through the primary or measuring path, when no film or a density standard is in place.

The density values do not correspond to those obtained with diffused light. This difference can be neglected without serious error, because all film emulsions employed for variable-area recording are of the fine-grain type, and show the same Callier factor. Therefore, the densities measured with this instrument always vary by a constant amount from the standard density. This factor is 1.18.

It is important that irradiation errors do not occur when measuring very small areas. The measurements made with this densitometer are rendered quite independent of the density of the immediately adjacent areas, by the use of a metal aperture plate held in close contact with emulsion side of the film. The aperture measures 2.5 mm. in the direction of the film and 0.03 mm. at right angles to it.

It is likewise possible to measure finished variable-area negatives and positives because of the ease with which the small aperture can be positioned. In order to facilitate observation of the spot on the film being measured, a magnifying glass with suitable illumination is provided.

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* Presented at the 1938 Spring Meeting at Washington, D. C.; received April 21, 1938.

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The arrangement of the essential parts of the densitometer are shown in Fig. 1. The photoelectric cell *6* is illuminated when, in the checking position, by light from lamp *1* passes through the adjustable diaphragms *2* and *3*. When the sliding member containing the cell is moved to the right, to the film position, the cell receives light from the lamp *1* after passing through the optical system aperture *5* and the film. Clamps hold the film in position. To prevent overloading the galvanometer, a blue glass filter *4* is provided. This can be swung in

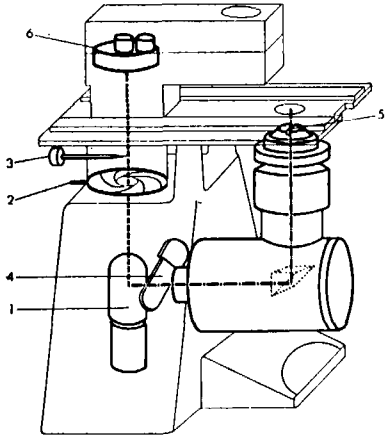

FIG. 1. Arrangement of densitometer.
(*1*) Exciter lamp (*3*) Adjustable diaphragm
(*2*) Adjustable diaphragm (*4*) Blue glass filter
(*5*) Aperture
(*6*) Photocell

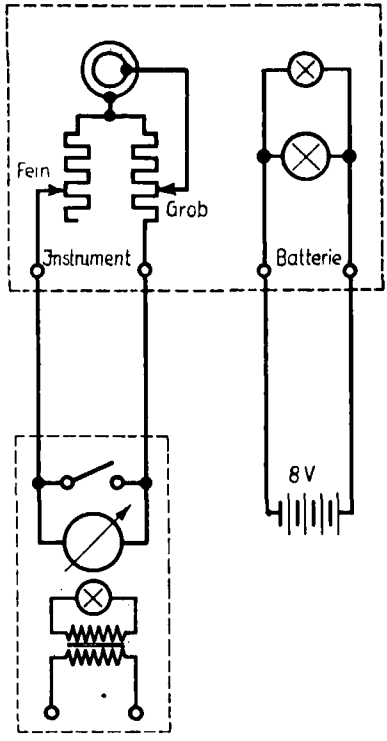

FIG. 2. Wiring and electrical control.

and out of the light beam. Fig. 2 shows the wiring and electrical control arrangements.

The procedure in making density measurements is as follows. The photocell is first moved to the measurement position. Then the indicating meter is set to full deflection by means of both the coarse and fine rheostats, without film. Film is then inserted, causing the meter to deflect to a value corresponding to the amount of light passing through the film. The density can be read on the scale of the instrument.

To increase the accuracy of density measurements for values greater than *d*-1 the full deflection of the galvanometer is adjusted by means of a density standard having a value of unity. Readings obtained with this multiplier in place must be increased by 1.0.

To check constantly this preliminary adjustment, the cell is moved to the secondary light-path and the diaphragms adjusted until the full deflection of the meter is obtained. It is then possible to move the cell to the secondary position at any time during a series of measurements, and thereby correct for any change in the lamp or battery.

There is an intermediate position to the sliding member that brings the magnifying lens over the spot being measured, thus making certain that the sound-track on the film is in the correct position over the aperture.

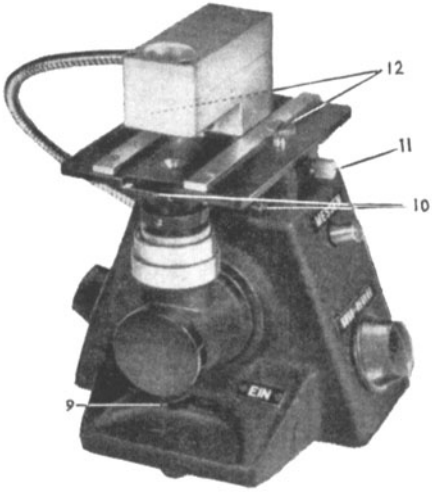

FIG. 3. The complete instrument.

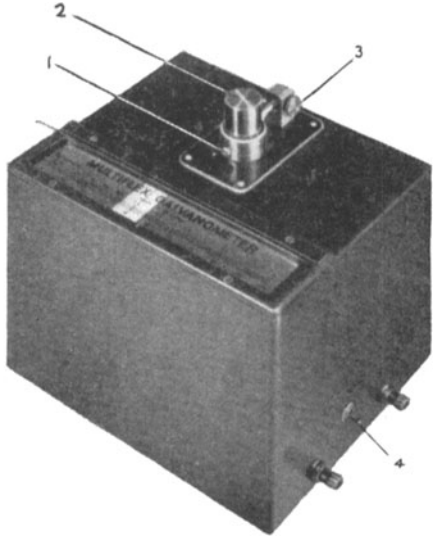

FIG. 4. The galvanometer.

The procedure after calibration is as follows:

(*1*) Insert the film.

(*2*) With magnifying glass in position, place the desired area to be measured over the aperture.

(*3*) Draw the photocell back to the secondary position and readjust for full deflection if necessary.

(*4*) Move the cell over the film and read the density.

Fig. 3 shows the complete instrument and Fig. 4 the galvanometer.