April 22, 1952 R. J. CASHMAN 2,594,122

PHOTOCELL-FILTER COMBINATION

Filed May 10, 1949

Fig-1

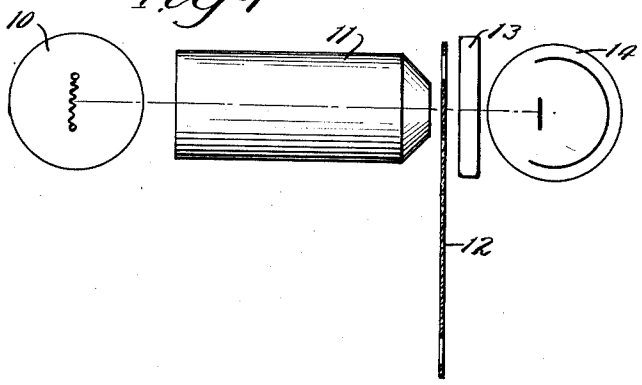
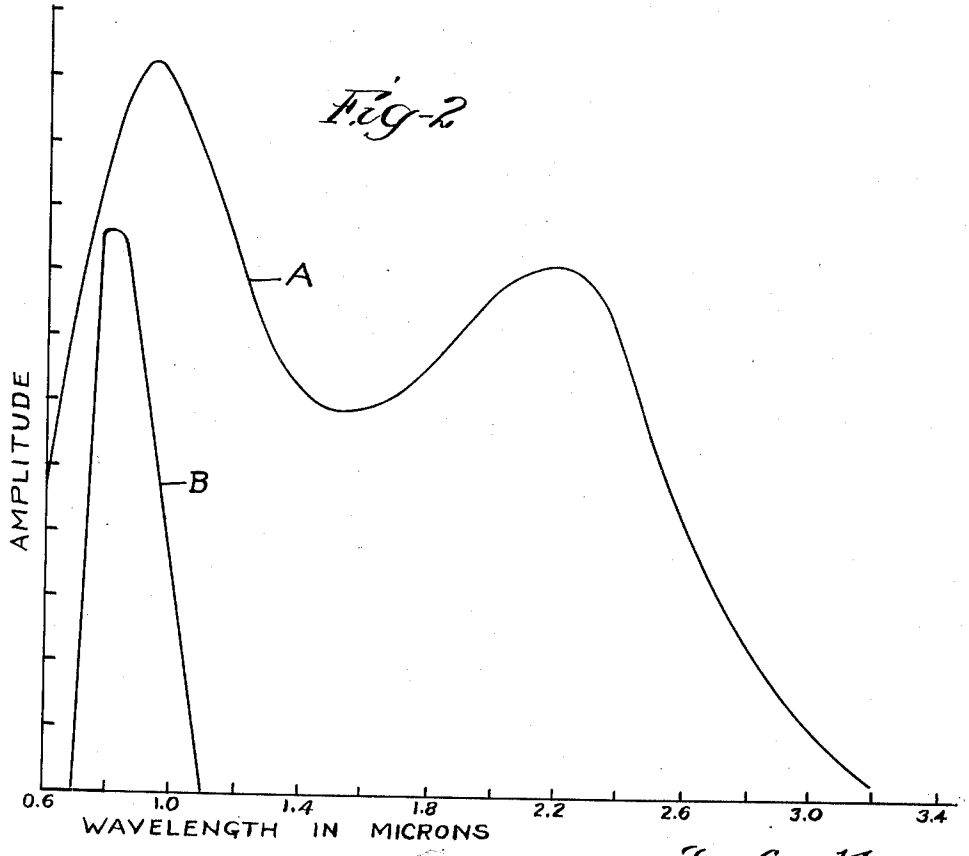


Fig-2



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PHOTOCELL-FILTER COMBINATION

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3 Claims. (Cl. 250—226)

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This invention relates to the use of photoelectric cells with the sound tracks on colored film, and the principal object of the invention is to provide a means for overcoming noise interference sometimes encountered with certain kinds of colored film.

Further objects and advantages will become apparent as the disclosure proceeds and the description is read in conjunction with the accompanying drawing in which

Fig. 1 is a diagrammatic view showing the application of the invention to a colored film sound track; and

Fig. 2 is a graph showing the relationship between the spectral response of the photocell and the transmittance of the filter.

The lead sulfide photoconductive cell disclosed in my Patent No. 2,448,516 has been adopted by a number of manufacturers of 16 mm. and 35 mm. sound motion picture projectors as the photoelectric pickup for the optical sound track. The cells' characteristics of high signal to noise ratio, relatively low impedance and excellent frequency response, together with small size and lack of microphonics, have been responsible for this enthusiastic reception, and, as a result, amplifiers can be made smaller and with less gain, power supplies may be simplified, and the optics for the sound track may be made much simpler and smaller.

With black and white film of the usual silver salt deposit type, the sound is reproduced by the lead sulfide cell disposed in my Patent No. 2,448,516 with great fidelity and brilliance and without the noticeable shot noise which commonly occurs when photoemissive cells are used. This fact alone has caused motion picture studios to favor my lead sulfide cell, because in the process of recording and re-recording sound on film in motion picture studios, the sound may be recorded several times before the final master film is obtained, and the noise generated each time by photoemissive cells becomes cumulative insofar as the final print is concerned.

Although the lead sulfide cell has had striking success in motion picture studios and elsewhere where only black and white sound tracks are used, it has been found that certain types of dye or colored tracks in color film have given trouble. There are many brands of color film, such as Technicolor, Kodachrome, Ciné Color, Magna Color, etc., and the difficulty is not limited to any one brand. As a matter of fact, it is only certain releases of these various types of film which give difficulty. Some prints from a given

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process behave very well while others of the same process set up an excessive amount of noise in the sound track.

This baffling behavior of color film in its relation to sound reproduction has led to much speculation as to the cause of such behavior, and it is thought that it may be due to changes in the density of the deposition on the sound track, or to differences in the amount of each color component therein. It is possible that dirt on the sound track may have something to do with this inexplicable behavior of certain releases of color sound film. Whatever may be the cause, the fact remains that with some releases, the noise level becomes very high—so much so that the intended sound is not discernible over the background noise.

I have discovered that this noise disturbance is associated only with the longer wave lengths of radiation which impinge on the photocell after passing through the sound track. Referring to Fig. 2, it will be seen that a lead sulfide cell of the type disclosed in Cashman Patent No. 2,448,516 has a spectral response as shown by curve A with peaks at approximately 1 micron and 2.5 microns. The cells' response starts in the yellow at about .6 micron and extends into the infra-red to about 3.5 microns. The glass optics for the sound reproduction normally cut off all wave lengths beyond about 2.4 microns so that the cell "sees" only wave lengths in the range from .6 micron to 2.4 microns. I have determined that the objectionable noise encountered with certain types and releases of colored film is almost entirely due to a band of wave lengths lying roughly between 1 micron and 2.4 microns. By cutting off all wave lengths beyond about 1 micron, the noise may be effectively eliminated. A filter glass which serves very well for this purpose, and which can be obtained commercially is Corning 2600, made by the Corning Glass Works at Corning, New York. This filter has a spectral transmittance represented by the curve B in Figure 2, and it will be seen that the transmittance ranges from about .7 micron to 1.1 microns. The filter preferably has a thickness of about 5 millimeters, and the filter may be placed anywhere in the optical path between the exciter lamp and the sensitive surface of the photocell. Preferably, however, the filter is placed between the sound track and the photocell, all of which is diagrammatically shown in Figure 1 in which the exciter lamp is shown at 10, the optical slit at 11, the colored sound film at 12, the filter at 13 and the photocell at 14.

The cutting off of shorter wave lengths below about .7 micron does not unduly attenuate the signal output of the lead sulfide cell, so that the use of the filter would not normally necessitate any change in the amplifier design.

The use of a filter of the type above described has another distinct advantage. In sound projectors using "raw 60 cycle alternating current" for purposes of heating the exciter lamp filament, a 120 cycle hum is produced. This is due to small temperature variations in the filament which cause a slight modulation of the intensity of the shorter wave lengths radiated from the filament. For such projectors, the short wave length cut-off of the Corning 2600 filter or its equivalent greatly reduces this 120 cycle hum.

Although the invention has been described primarily in relation to a lead sulfide photoconductive type of cell, it is equally applicable to any other type of photoelectric cell having infra-red response, and for that reason the representation of a photocell in Figure 1 is of conventional form.

I claim:

1. In combination, a light source, a colored film having a sound track thereon, means for directing light from the light source to the sound track, a photoelectric cell having a spectral response extending into the infra-red region positioned to receive the radiations from the source which pass through the sound track of the film, and a filter interposed between the light source and the photocell, said filter being substantially impervious to radiations from about 1 micron to about 2.4 microns.

2. In combination, a light source, a colored film having a sound track thereon, means for directing light from the light source to the sound track, a photoelectric cell having a spectral response extending into the infra-red region positioned to receive the radiations from the source which pass through the sound track of the film, and a filter interposed between the light source and the photocell, said filter transmitting only between about .7 micron and 1.1 microns.

3. In combination, a light source, a colored film having a sound track thereon, means for directing light from the light source to the sound track, a photoconductive cell having a spectral response that includes that portion of the spectrum lying between .6 micron and 2.4 microns, and positioned to receive the radiations from the source which pass through the sound track of the film, and a filter interposed between the light source and the photocell, said filter transmitting in the region of about .8 micron but being substantially impervious to radiations from about 1 micron to about 2.4 microns.

ROBERT J. CASHMAN.

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