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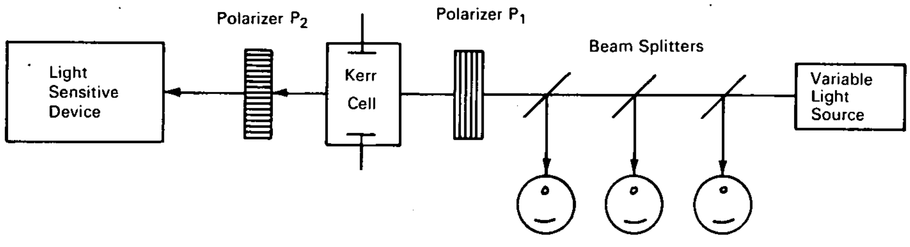
Rapid-Response, Light-Exposure Control System



It is often desirable to study luminous phenomena or light sources whose brightness varies over a wide range during the period of interest. Examples of such phenomena include metal combustion, exploding wires, pulsed gas discharges, laser operation, and nuclear explosions. In many of these phenomena, brightness changes, which occur within milliseconds or even microseconds, often exceed the exposure latitude of presently known photographic materials or the linear ranges of light-sensitive detectors, resulting in either underexposure or overexposure during the period of interest.

One technique that has been used to overcome such a problem requires the use of photographic film which incorporates several emulsions of different sensitivities. The cost of such film and its processing is quite high, a disadvantage which is of particular significance when large amounts of film are required, as in high-speed cinephotography. The types of photoelectrically actuated electromechanical aperture or shutter-speed control, which are used in many commercially available automatic cameras to control film exposure, cannot be used, since such exposure-control devices have a relatively slow response (of the order of seconds), while in many situations exposure control with response times of milliseconds or microseconds is required.

A rapid-response (on the order of a few microseconds) electro-optical, light-exposure control system, which has been devised, will maintain the light reaching a camera film or other light-sensitive detector at essentially constant level, despite wide variations in the brightness of the light source. This system permits detailed photographic or photoelectric recording of the phenomenon under study over a range of many orders of magnitude in brightness. The system includes a pair of crossed light polarizers, P_1 and P_2, with a Kerr cell between them. These three components are positioned in the path of light from the variable light source to be studied to the light-sensitive device (camera or photoelectric detector). Light from the source is transmitted to polarizer P_1 through beam splitters which reflect some of the light to high-voltage vacuum photodiodes. The function of the beam splitters is to direct light to the photodiodes in such a way that the brightness of the light reaching them is proportional to the brightness of the light reaching polarizer P_1. Circuitry that is used to control the voltage across the Kerr cell as a function of the brightness of the light from the source is not shown in the schematic. In this circuitry, the Kerr cell is connected in series with a variable resistor, R_L, across a voltage source (a dc, high-voltage power supply). A series chain consisting of the photodiodes and two resistors,

(continued overleaf)

R_D and R_M, are connected across the Kerr cell. A high-resistance chain of three equalizing resistors is connected across the photodiodes to compensate for differences in dark current among these diodes. R_L, a series of switch-selected resistors, controls the system's sensitivity. The function of R_D is to control the minimum voltage that is applied across the Kerr cell. The voltage across R_M (a low resistance compared to R_D) is used to monitor changes in current through R_M, which are related to the changes in brightness of the light source. When the brightness of the light varies between minimum and maximum levels, the effective resistance of each photodiode varies between infinity and zero. Thus, the voltage across the Kerr cell varies between a maximum and a minimum, and the plane of polarization of light from P_1 varies accordingly between 90° and a minimum angular value. Therefore when the brightness of the light from the light source is below a preassigned level, all of the light which passes through P_1 is transmitted through P_2 to the light-sensitive device. As the brightness increases, the voltage applied to the Kerr cell decreases automatically, so that only a portion of the light which passes through P_1 is transmitted to the light-sensitive device. The net result is that the intensity of the light received by the light-sensitive device is essentially at a constant level.

Note:

Details may be obtained from:

Clearinghouse for Federal Scientific
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Price $3.00
Reference: TSP68-10502

Patent status:

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