TECHNICAL NOTE

AN EXPOSURE CONTROL FOR THE KODAK CAROUSEL
MODEL 700 PROJECTOR¹

A magazine-fed, 2 in. by 2 in. projector is a convenient way to present a sequence of visual stimuli. However, the difficulty of interspersing controllable dark intervals among the slides to be presented limits the usefulness of most commercial projectors. Projectors with controllable dark intervals are available but they tend to be very expensive and difficult to repair.

To minimize these problems a mass-produced, readily modifiable projector, the Kodak Carousel, Model 700, was selected for modification.

A small solenoid-operated latch, consisting of an Allied Control TF154 24 v dc relay coil enclosed in a small rectangular tube which serves as a mounting bracket for both the coil and an "L" shaped armature, was assembled. This assembly was attached to the light frame² so that when the shutter is closed by the projector mechanism it will be caught and held by the solenoid armature until the solenoid is actuated. A schematic view of the solenoid placement is shown in Fig. 1. Any solenoid assembly which will fit into the available space of 1 in. by $\frac{1}{8}$ in. by $1\frac{1}{2}$ in. and has the requisite pulling force may be used.

Removing the lens-mount assembly gives access to the light frame. It is not necessary to remove the mechanism assembly but it must be lifted slightly so that the lens mount can be slipped out. The mounting screws must then be replaced in the mechanism assembly so that the projector can be operated during tests of the modification.

No additional power supply for operating the shutter solenoid is necessary since power can be obtained from the projector itself: a second winding allows the projector motor to operate as a transformer as well. This winding is designed to supply power for the projector control components, *i.e.*, advance solenoid, focus motor (if present), *etc.*, and delivers about 25 v ac. As shown in Fig. 2, this winding also supplies the charging voltage for capacitor C1 which is partially discharged through the shutter solenoid when the switch SW1 is operated to position "A". If the switch is left in this position the projector will operate as

in its normal, unmodified state. Holding current through the shutter solenoid is supplied at a reduced value through R1.

With SW1 in position "B", the shutter solenoid terminals are brought out through a connector and can be operated either by an external power source, or, if pins 1 and 3 are connected and a contact closure provided between 4 and 6, the internal power source can be used. Pins 7 and 8 are in parallel with the projector motor and provide a 115-v ac output when the motor is switched on. A brief contact closure between pins 5 and 6 is equivalent to pressing the forward button. Teflon insulation should be used on internal wiring because of the heat generated by the projector lamp.

The circled numbers in the wiring diagram refer to terminals on the connector, which was mounted together with SW1 on an aluminum plate. This plate replaces the instruction plate on the rear of the projector.

The minimum elapsed time between the arrival of an advance command pulse at the projector and the presentation of the next slide is about 1.1 sec and the shutter closes about 140 msec after the advance command. A time lag of about 30 msec between arrival of the shutter-opening pulse and slide exposure could be reduced by using a solenoid designed for a lower voltage and operating it through a series resistance.

Fig. 1. Rear view of shutter assembly with solenoid mounted on light frame.

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²The language used to describe projector parts is taken from Eastman Kodak parts list No. 769169, Eastman Kodak Company, Apparatus Parts Service, 800 Lee Road, Rochester, New York 14650.

Fig. 2. Complete wiring diagram of Carousel projector showing additions described in the text. It is not necessary to change any existing wiring to accomplish this modification.

A timer that incorporates correction for the time lags in the shutter mechanism is described by Welford (1966).

There is no theoretical limit to the maximum duration of the dark interval obtainable with the modification described. Exposures as short as 20 msec are possible if the shutter opening pulse can be programmed to arrive before the advance command. However, with very short exposures, the field must be restricted because the exposure duration of the lower quarter of the full field is some 15 msec longer than the upper quarter. This time variation is an unavoidable artifact of the bidirectional operation of the shutter. All exposure times can be expected to fluctuate ± 3 msec due to variations in the operating time of the projector advance mechanism.

This device is useful in serial anticipation learning procedures where displays larger than those permissible in standard memory drums are desirable, e.g., when items in the list are pictures or patterns rather than nonsense syllables (see Gollin, 1966a) and precise

control of item presentation time and inter-item time is required. The device has also been used in discrimination learning experiments (Gollin, 1966b) where it permits the precise control of the successive presentation of stimulus patterns.

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JAMES M. CAMPBELL
 Antioch College
 EUGENE S. GOLLIN
 Fels Research Institute