TECHNICAL NOTE

A PNEUMATIC SYSTEM FOR PRESENTING VISUAL STIMULI¹

In spite of the need for devices to program visual stimuli whose characteristics are precisely specified in one or more dimensions, few units are commercially available to meet researchers' needs. Gross (1966) has modified an interference filter to be used with a standard slide holder employed in a Kodak Carousel Universal slide tray. Terrace (1966) has mechanized a monochromator, and Johnson (1966) has designed a solenoid and lever system for presenting visual stimuli.

Although other electromechanical systems can operate relatively silently (e.g., Gross, 1966), they do not provide for both an immediate access to any of the filters and a fast but very silent operation. A pneumatic system allows for operation of the solenoid valves in an area away from the experimental chamber, thereby decreasing opportunity for electrical interferences to be introduced in the experimental chamber during investigations involving physiological measurements.

During recent years pneumatic devices have become quite practical in special-purpose computers and control systems (ASTME, 1965; Trade & Technical Press, 1966). Some of these developments are being successfully applied in psychology laboratories with equipment such as retractable bars, running wheels, and a variety of other mechanical apparatus. For several months a pneumatic device has been employed to determine generalization gradients based on key-pecking behavior of Mallard ducks. Figure 1 shows a cross-section drawing of one complete filter assembly, while Fig. 2 is a picture of the entire 16 assemblies in operation. Each filter assembly encloses a 2 in. by 2 in. Bausch & Lomb narrow-band interference filter secured within a filter frame, C, by a filter retainer bracket, D. For luminance control a neutral density filter may be mounted within a filter frame in place of an interference filter. It is probably more convenient, however, to place it in the frame with the interference filter so that they may be changed together in the same operation. Each filter frame is actuated independently with a positive piston drive, H. The sliding action of each filter frame is accomplished on two 0.250-in. diameter, cold rolled steel guide rods, B, mounted in parallel and firmly fastened to the main baseplate, G. The latter, in turn, is mounted on the cylinder block, I. The piston slides the filter into the operating posi-

Fig. 1. Filter assembly. A, return spring; B, guide rod; C, filter frame; D, filter retainer bracket; E, interference filter; F, rubber grommet; G, main baseplate; H, piston and cup; I, cylinder block; J, air chamber.

tion, allowing the collimated light to pass through the filter, E. When the air under a minimum pressure of 80 lb/sq in. within the cylinder, J, is released, the compression springs, A, return the filter frame to its normal resting position on the rubber grommets, F.

Special care must be given to constructing cylinders and pistons. The piston was made from stock drill

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Fig. 2. Complete system for presenting visual stimuli.

rod 0.250-in. diameter by 2.250-in. length with a 10-32 internal thread for attaching a 0.5-in. diameter molythene thinwall piston cup. The cylinder diameter was machined and honed to 0.525 in. in order to minimize the drag on the piston retraction motion. Piston travel of approximately 1.75 in. is required to slide the filter into the collimated light beam supplied by a light source (Central Scientific Company) mounted directly on the main baseplate. For each filter assembly a Nylo-Seal F hose (Cat. No. C-902, $\frac{1}{8}$ -in. I.D.) is connected at one end to the cylinder chamber with a special fitting (Cat. No. F-P0202 N.B. $\frac{1}{8}$ -in. diameter, nominal size) and at the other end to a Schrader three-way solenoid valve (Cat. No. 20462, 115 v ac or 28 v dc).

The device displayed in Fig. 2 contains 16 complete filter assemblies that may be independently controlled by electric solenoid valves housed in a remotely located, sound attenuated chamber. This pneumatic device is very insensitive to dust and can be operated from any reasonably clean air source supplying a pressure greater than 80 lb per sq in. We have employed low-pressure compressed air storage tanks as well as commercially available high-pressure, compressed air bottles. Both air supply sources are satisfactory.

Air pressure and spring tension (compression) jointly determine how fast a filter's position may be altered. Operating durations less than 1 sec are easily obtained, yet, the system operates very quietly. The grommets, F, effectively absorb shock to a returning filter frame and also decrease operating noise.

Construction costs vary directly as a function of the number of filter assemblies built, labor costs, and material expenses. For the unit described here, fittings, valves, and materials other than interference filters were purchased commercially for approximately \$275.00. Construction estimates and other information may be obtained from Mr. Jed Merrill, Technical Services, Utah State University, Logan, Utah 84321.

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