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By ROBERT R. COX and LAWRENCE KRUGER,
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APPARATUS

A DEVICE FOR OBSERVING ANIMALS IN DARKNESS

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The training of animals to perform somesthetic discriminations in the absence of visual cues has proven to be a long process, even in experiments with primates. The difficulty stems in large part from the need to conceal the discriminanda from view of the animal, thereby forcing the animal to place his arm in an awkward position to reach the objects. One way of obviating this difficulty is to place the discriminanda in a more comfortable position and to exclude visible light. The situation is analogous to the difficulties that a human *S* encounters in performing manipulations behind his back which can be accomplished with ease in a more comfortable position, even in the dark. The purpose of this apparatus, therefore, is to arrange conditions for observing animals performing various manipulations in the dark that they may be more easily trained for behavioral studies in somesthesis. Our experience with this apparatus to date indicates a considerable reduction in the number of trials necessary for a monkey to learn a somesthetic discrimination of form.

Two methods of observing animals in darkness were studied. The first method considered was a tube, popularly known as the "snooperscope," that converted the infra-red image.[1] Our experience with the British (E.M.I. Ltd.) type of tube was disappointing because of the large amounts of infra-red radiation needed, poor picture definition, and instability of the tube. The problem of flooding the animal with too much heat is of extreme importance in view of the deterioration of performance in a hot area.[2] Alternatively, a simple electro-mechanical scanning device was constructed which utilizes the principle of the Nipkow disk. This apparatus has proven to be stable and has required minimal maintenance.

Technical description. The device consists of a 'flying spot' of infra-red

* The apparatus described here was developed under contract with the U. S. Army, DA-49-001-MD-401.

[1] G. A. Morton and L. E. Florey. Infra-red image tube, *Electronics,* 19, 1946, 112-114.

[2] K. H. Pribram. Some physical and pharmacological factors affecting delayed response performance of baboons following frontal lobotomy. *J. Neurophysiol.,* 13, 1950, 373-382.

radiation which scans the field in which the discriminanda are placed across 32 lines at 20 times per sec., thereby preventing continuous flooding of the entire field with heat. The light source consists of a 6-v., 100-cp., DC operated bulb mounted in a modified slide projector. In place of the slide there is a 16-in. metal disk perforated with 32 small holes of equal diameter arranged in a spiral by increments of the hole diameter spaced 11.25° apart,

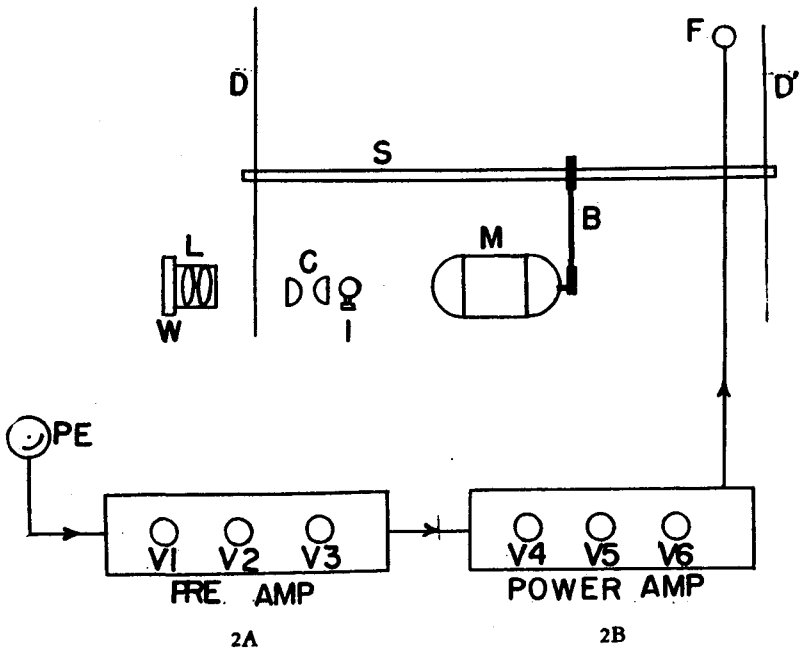

FIG. 1. BLOCK DIAGRAM OF ELECTRO-MECHANICAL INFRA-RED SCANNING DEVICE B = Pulley belt; C = condensor lens; D = scanning disk; D' = viewing disk; F = 14-w. fluorescent lamp; I = 6-v. incandescent lamp; L = projector lens; M = driving motor; PE = photoelectric cell; S = shaft; V1, = 6SJ7 vacuum tube; V2 and V3 = 6SL7 vacuum tube; V4 = 6J5 vacuum tube; V5 = 6V6 vacuum tube; V6 = 6L6 vacuum tube; W = Wratten No. 87 filter.

in close proximity to the edge of the disk. The disk is mounted on the front end of a shaft which rotates at 20 r.p.s. driven by a non-synchronous motor. In front of the disk is the projector lens which is covered with a Wratten No. 87, infra-red transmission filter, shown on the right of Fig. 2A.

The infra-red radiation which is scanning the field is in turn reflected onto an infra-red sensitive photocell (RCA Type 918) which converts the light energy into an electric current proportional to the incident light on

the cell. This small fluctuating current is amplified by a frequency compensated 3-stage battery-supplied preamplifier, the output of which, in turn, is introduced into a 3-stage power amplifier. The position of the photocells and preamplifiers with relation to the stimulus-boxes can be seen in Fig. 2A. The cathode follower output of the power amplifier operates a conventional 14-w. fluorescent lamp whose light output varies in proportion

2A 2B

FIG. 2. TWO PICTURES OF THE SCANNING DEVICE

In Fig. 2A the box at the right contains disks and lamps, the projection-lenses are at the center, the photo-electrical cells with pre-amplifiers are supported over the stimulus-trays. In Fig. 2B, two viewing disks are shown in the foreground and two scanning disks in the rear.

to the amount of infra-red light incident upon the photo cell. Between the fluorescent lamp and *E*, another 16-in. disk with the same spiral arrangement of holes is spun on the same shaft as the transmitting disk, but 180° out of phase, hence the image is re-inverted. The entire system is enclosed in a light-proof shield provided with a suitable aperture for the projector lens and an observational post pictured in Fig. 2A. Observation of the fluorescent lamp through the spinning disk provides a 32-line replica of the scene and enables *E* to see the discriminanda and animal in sufficient detail to make any desired observation. The arrangement of the spinning disks and lamps can be seen in Fig. 2B. The image definition is suitable to enable *E* to determine which animal is in the situation by looking at the animal's facial characteristics.