

## XVI. VISUAL REPLACEMENT PROJECTS

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### RESEARCH OBJECTIVES

As its title implies, this program has as its ultimate objective the development of means for replacement of the visual sense in the performance of certain specific tasks. The areas in which possibilities for visual prosthesis have thus far been conceived are: (a) development of means to enable the blind to walk about safely and independently and at normal speed (4-5 ft/sec) when not passing through vehicular traffic; (b) development of apparatus to enable the blind to read printed or written material; and (c) devising of means to permit the blind to recognize familiar objects at a distance, probably through the conversion of visual patterns into auditory patterns. A small amount of time is occasionally given over to other short-term projects when it can be seen at the outset that a solution is obtainable with a minimum of effort. One such project was the development of the so-called "line and pointer locator," enabling the blind to locate the positions of pointers under glass or borders of printed material on paper (Quarterly Progress Report, July 15, 1953). As the succeeding paragraphs of the present report show, the major emphasis is still concentrated on area (a).

#### A. COMBINED STEP-DOWN AND OBSTACLE DETECTOR

Early in the past quarter it became apparent that the new optical components developed for the step-down detector (Quarterly Progress Report, Oct. 15, 1954) were sufficiently light and compact to warrant the addition of obstacle detection facilities. This was done by constructing an obstacle detection receiver identical with the receiver previously described for step-down detection, except for a decrease of one-eighth inch in its diameter, and the placing of a plastic prism in front of the light source to divert about 20 per cent of the light into an auxiliary beam  $6^\circ$  above the main beam. The complete optical system for the combined obstacle and step-down detector is shown photographically in Fig. XVI-1. All of the elements are supported on an aluminum framework. The light source with its beam-splitting prism is at the bottom, the obstacle detection receiver is approximately 4 inches above it, and the step-down detection receiver about 3 inches farther up. The upper receiver "looks" downward at  $18^\circ$  below the horizontal, so that its image space intersects a level terrain 7 feet in front of the instrument when the center of the receiver is 26 inches above the terrain. The angle of inclination of the axis of the source projector ( $12.5^\circ$  below the horizontal) is such that the main beam passes through the receiver image space on the terrain when the lamp is approximately at the center of its path of angular oscillation. The obstacle detection receiver is inclined  $8^\circ$  below the horizontal so that, for light-source vibration amplitudes up to  $4.5^\circ$ , the main source beam can never intersect the obstacle detector image space. The auxiliary beam produced by the prism can intersect the image space of the obstacle detector at distances of 18 inches to 10 feet ahead of the instrument. At the 10-foot range this intersection is still a few inches above the terrain when the

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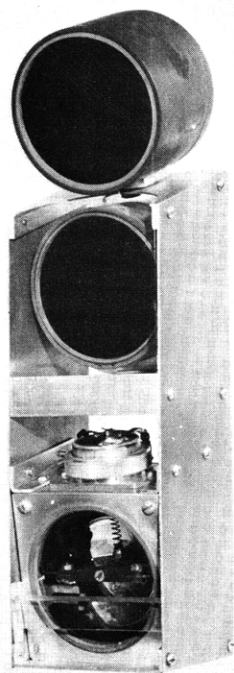


Fig. XVI-1

Optics of combined obstacle and step-down detector.

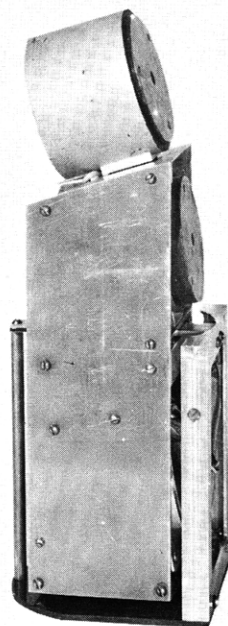


Fig. XVI-2

Optical system in scanning frame.

instrument is held normally, insuring that the obstacle detector will not normally receive a signal from the terrain. The small aluminum box just above the source assembly (Fig. XVI-1) houses the transformer used in driving the source, together with a few condensers and a spindle around which the coaxial cables for the photo cells are loosely wound.

Figure XVI-2 is a photograph of the optical system of Fig. XVI-1 mounted in a supporting frame with a bakelite base. The optical system is pivoted so that it can rotate about a vertical axis through an angular distance of  $30^\circ$  on each side of its midposition. The object of this arrangement is to facilitate automatic azimuthal scanning of the optical system with a scanning period of 0.8 sec to 1.0 sec. The drive for the scanning mechanism has not been constructed, but several simple designs have been considered. It is proposed to house the whole assembly of Fig. XVI-2 in the front end of a carrying case not unlike a brief case, with the remaining components of the system occupying a space about 1 inch thick on the bottom of the case, extending to the rear. The remainder of the case will then be available for normal use as a brief case, and the resulting travel aid will be entirely inconspicuous. It is planned to replace the infrared filters now

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covering the front ends of the obstacle and step-down detection receivers with clear glass plates (chiefly serving as dust covers) and to construct the entire front wall of the carrying case out of laminated plastic containing an infrared filter.

The power supply for which the system is being designed is a single 1.5-volt, 10-ampere-hour "silver" storage cell (Yardney model LR-10). This feature yields one rather pleasing advantage: if the cell becomes discharged while the travel aid is in use, it may be immediately replaced by an ordinary size-D flashlight cell, which will maintain operation until the user reaches a place where his silver cell can be recharged. The information from this system will be transmitted through the handle of the carrying case, which is of the type described in the Quarterly Progress Report of April 15, 1954.