Visual Focus Stimulator Aids in Study of the Eye’s Focusing Action

The problem:
To design an apparatus (Visual Focus Stimulator) for study of the eye’s focusing action by providing a display that can be made to vary in apparent optical distance without change in apparent size, brightness, or color.

The solution:
An optical apparatus that varies the apparent distance of a target image from the eye by means of reflectors that are moved orthogonally to the optical axis between fixed lenses. The apparatus can be pointed at any object, test pattern, or other visual display.

How it’s done:
Light from a visual display passes through the artificial pupil stop and then through lens L1 which is at its focal distance from the stop. The light is then reflected by R1, R2, R3, and R4 through lens L2 which is at its focal distance from the natural pupil of the subject’s eye; thus, an image of the artificial pupil aperture is formed in the plane of the pupil of the eye. Lens L1 also forms a real image of the display somewhere in the optical path between L1 and L2. If the system is adjusted so that lens L1 forms an image of the target in the plane of the dotted line which is at the focal distance from lens L2, the target would appear to the eye to be at infinity, requiring focus at infinity. If the image were formed closer to lens L2, the eye would have to focus at a distance nearer than infinity in order to bring the target into sharp focus.

Reflectors R2 and R3 are the internal surfaces of a 90-degree prism that is mounted on a carriage driven by a servomotor programmed to provide a desired schedule of optical distance variations; R1 and R4 are the mirrored external surfaces of a 90-degree prism. As R2 and R3 are moved, the optical distance between the image of the display screen and lens L1 does not change, but the distance between the image and lens L2 does. For example, if reflectors R2 and R3 are driven closer to R1 and R4, the image of the target approaches closer to lens L2; and the subject’s eye must provide increased refractive strength in order to maintain the target in focus on the retina.

The artificial pupil is at the focal distance from lens L1; hence, rays originating in the plane of the artificial pupil will be collimated in the path between L1 and L2, and the image of the artificial pupil will not move when reflectors R2 and R3 are moved. Since the nodal point of the eye is very close to the plane of the natural pupil, and therefore close to the focal distance from lens L2, the angular size of the retinal image of the target will not change when the two reflectors are moved. As long as the artificial pupil is centered on the optical axis of the system, the retinal image of the target will undergo no translation when the reflectors are moved.

Notes:
1. A related instrument is described in NASA Tech Brief 70-10401.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: TSP70-10568

   Patent status:
   No patent action is contemplated by NASA.
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