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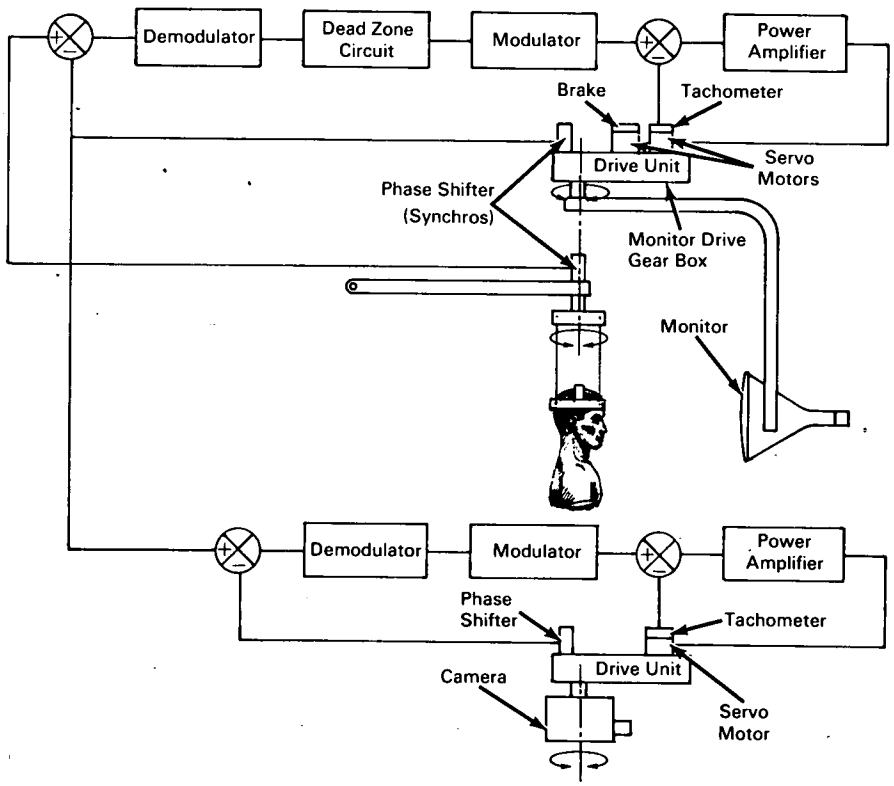
Improved Head-Controlled TV System Produces High-Quality Remote Image



The problem:

To provide a manipulator operator with an efficient system for viewing the remote handling and processing of reactive, flammable, explosive, or contaminated materials. A fast response system, allowing frequent changes of view, operation between far removed points, and close work capabilities with uninterrupted manipulator operation, is desired. Prior techniques, often used in "hot laboratories," require operator viewing with periscopes and telescopes through shielding windows. These conventional optical methods limit the viewing angles and distances, and introduce complications in maintaining a clear sight path. Conventional closed circuit television systems have been used, but they lack the resolution and direction angle mobility required to permit fast, efficient work. Servoed TV remote positioning systems, including head controlled designs, are subjected to

(continued overleaf)

unwanted movement and blurring due to quick, inadvertent movements by the operator. Servoed systems that use a small monitor mounted directly on the operator's headpiece restrict the operator's view of his surroundings, and add to a sense of disorientation associated with these devices.

The solution:

An improved resolution TV camera/monitor positioning system in which the pan and tilt motions of the camera and monitor are slaved to follow the corresponding motions of the operator's head. The system provides the operator with a constant, close range view of his work, requires no line-of-sight viewing paths, and provides the operator with a hands-off viewing capability for uninterrupted remote manipulation. Small, annoying movements of the camera and monitor are substantially eliminated by providing a 7° to 12° dead zone in which inadvertent operator movements do not affect the system.

How it's done:

The improved resolution of this system is accomplished by using narrow camera angle of view. Since the number of elements per inch of image in a given direction increases in inverse proportion to the angle of view in the same direction, the clarity of the object image is improved as the angle of view is decreased. If the angle of view is made too small, however, the efficiency of the operator is hampered. In testing several angles of view, 30° was found to provide a good compromise between resolution and viewing angle. Although this angle is relatively small, the operator can readily shift the view to see throughout a much larger volume.

The remote viewing system consists of a 675-line-per-frame, 30-frame-per-second TV camera, a 14-inch monitor, an operator headpiece, and a servo coupling system. The 14-inch slaved monitor positioned about 23 inches from the operator's eyes provides a 30° angle of view to him. This results in a 1:1 correspondence between the viewing angles, reduces operator disorientation, and permits easy location of items within the working volume.

Small synchros coupled to a low inertia, easily donned headpiece provide command signals for the pan and tilt motions of the monitor. The voltages generated by the headpiece synchros are fed through the demodulator, dead zone, and modulator circuits. They are subtracted from similar voltages generated by the synchros on the monitor drive gear boxes. The resultant voltages ultimately control the position of the monitor. The camera is similarly controlled by comparing the monitor and camera position signals. A near 1:1 positional correspondence is maintained between the motions of the operator's head, the camera and the monitor.

Notes:

1. One of the features of the head-controlled TV positioning system is that the operator can establish and maintain his viewing orientation relative to a remote worksite. After surveying the worksite area, an operator gains a sense of presence in the remote area which permits him to relocate objects and perform work efficiently. Conventional television positioning systems do not have this characteristic and consequently operators have no way of knowing in which direction the camera is aimed until they somehow relate the position of the camera with the scene being viewed.
2. Additional details are contained in *Remote Systems Technology Division, American Nuclear Society (RSTD-ANS) Proceedings,* 1965, p. 57–60 and *RSTD-ANS Proceedings,* 1966, p. 124–128.
3. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B67-10317

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Patent status:

Inquiries about obtained rights for commercial use of this innovation may be made to:

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