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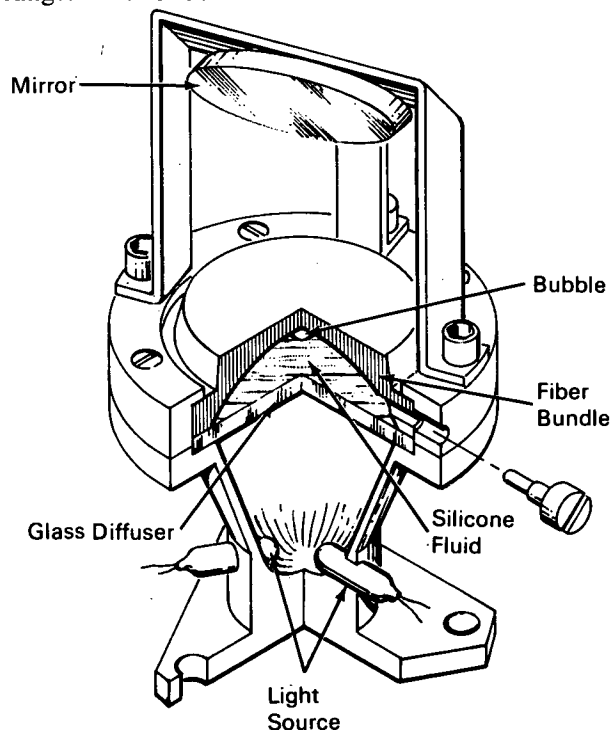
Manned Spacecraft Center



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Modified Bubble Level Senses Pitch and Roll Angles Over Wide Range

The addition of a fiber-optic field flattener enables a simple bubble level to be used as a sensor for determining pitch and roll angles over a wide range. The bubble level sensor is a desirable an-



gular position indicator because it is simple, rugged, and small in size, and is impervious to the effects of temperature and vibration.

The sensor (see fig.) consists of a base, a light source, a diffuser, a silicone fluid and a coherent fiber optic field flattener. The air bubble in the silicone fluid indicates pitch and roll angles by its

position on the spherical surface of the field flatteners. Indicinal marks are placed on the flat surface of the fiber optic bundle to aid in determining the pitch and roll angles from the location of the bundle. The fluid is contained in a spherical segment bounded by the diffuser and the spherical surface of the fiber optic bundle. Since the fibers are coherent, any pattern of light on the spherical surface is transmitted to the flat surface; hence, the fiber optic bundle serves as a field flattener.

In the original application, the sensor was placed inside the body of a camera, and an image of the bubble was directed to the film for the purpose of recording the roll and pitch angles at the time of exposure. Pitch angles from $-\pi/12$ to $+\pi/4$ rad. (-15° to $+45^\circ$) and roll angles of $+\pi/6$ rad. ($+30^\circ$) were determined within $\pi/360$ rad. (0.5°).

Note:

No additional documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer
Manned Spacecraft Center, Code JM7
Houston, Texas 77058
Reference: B71-10085

Patent status:

No patent action is contemplated by NASA.

Source: Edward J. Mattson and
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Category 03