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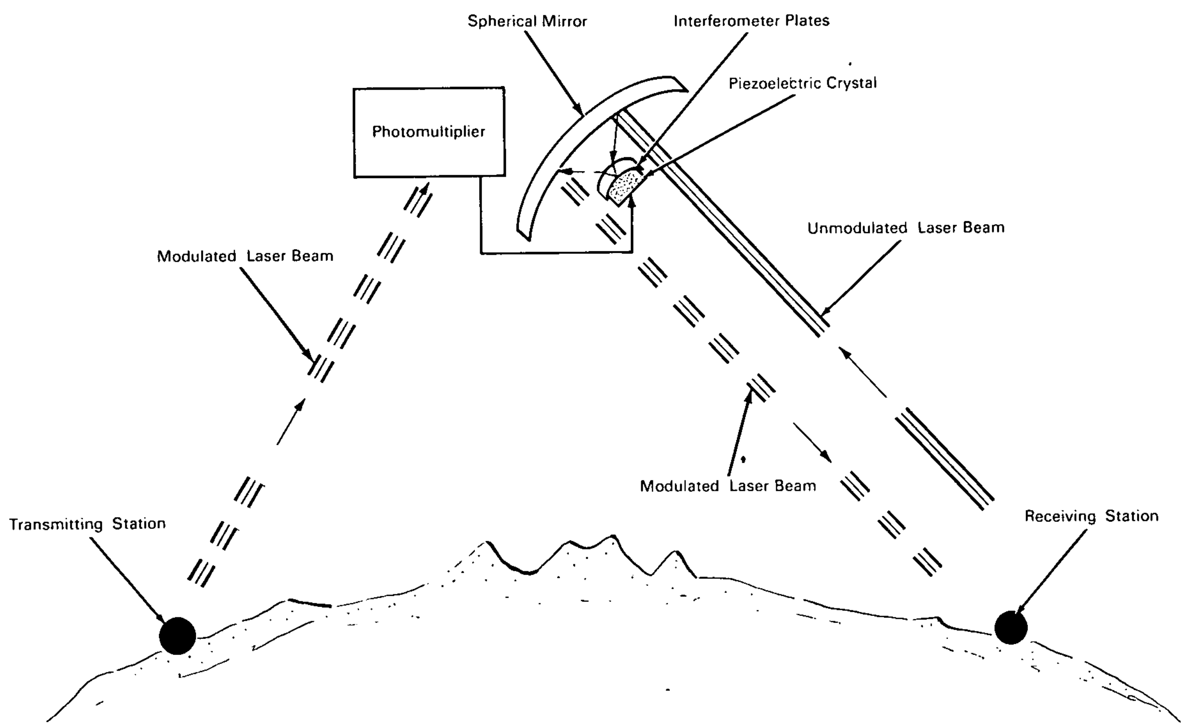
Communication System Uses Modulated Laser Beam



The problem: To develop a laser-beam system for communicating between two remote stations via satellite.

The solution: An electro-optical system employing an essentially passive, retrodirective, laser beam modulator–reflector aboard the satellite.

How it's done: The modulator–reflector consists of a catadioptric lens (combining a spherical mirror and a refractor which corrects for mirror aberration), closely spaced curved interferometer plates mounted in the focal surface of the lens, and a piezoelectric crystal. The spacing between the interferometer plates is made to vary by applying a signal voltage to the piezoelectric crystal. When an unmodulated laser beam parallel to the optical axis of the lens system strikes the surface of the spherical mirror, the beam is reflected to the focal surface where it is modulated by the optical interference patterns generated between the interferometer plates. The modulated beam passes to the spherical mirror from which it is reflected in a direction parallel to, but opposite in sense to, that of the original unmodulated beam.

In operation, a modulated laser beam from a ground station is directed to a receiver on the

(continued overleaf)

satellite. This receiver, consisting of a photomultiplier, converts the laser signal to an electrical signal which is used to drive the piezoelectric crystal in the modulator-reflector at the modulation rate. An unmodulated laser beam from another ground station (the receiving station) is directed to the modulator reflector aboard the satellite where it acquires the modulation (information signal) being transferred by the information-carrying beam to the piezoelectric crystal and interferometer plates. The modulated laser beam from these plates is retrodirected by multiple reflection in the optical system to the receiving station.

Notes:

1. The spacing between the interferometer plates can be varied by other means instead of using an electrically driven piezoelectric crystal.
2. A parabolic mirror could be used, instead of a spherical mirror, to focus the beam on the interferometer.
3. The laser beam retrodirective modulator-reflector could have application in a line-of-sight communication system in situations where weight or power limitations are critical.
4. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland, 20771
   Reference: B65-10333

Patent status: NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

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