NASA TECH BRIEF

Lyndon B. Johnson Space Center

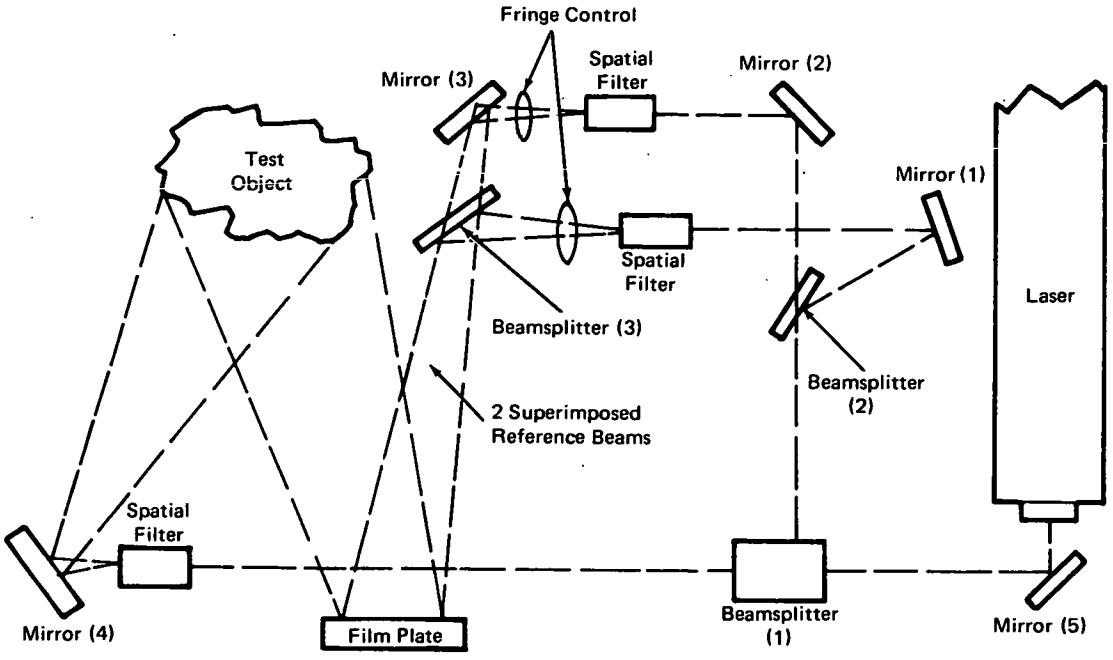
Holographic Testing with a Double Reference Beam

The problem:

Holograms are images made on a photographic plate by the interference patterns of laser beams. They can be three-dimensional images and are used in areas as diverse as magazine covers and optical memory devices for computers. One industrial application involves "taking a picture" of a mechanical object, placing the object under stress, and taking another "double-exposure-picture" of the same object. This results in a pattern of lines around the stressed object called interferometric fringes which may be analyzed to discover the presence of flaws in the tested object. Unfortunately, this technique, as usually done, results in multiple images which interfere with analysis of the fringe pattern.

The solution:

Multiple images in the object focal plane can be eliminated by the use of two reference beams instead of the usual one.



THE FOLLOWING BEAM LENGTHS ARE EQUAL

1. Beamsplitter (1) → Mirror (4) → Test Object → Film Plate
2. Beamsplitter (1) → Beamsplitter (2) → Mirror (1) → Beamsplitter (3) → Film Plate
3. Beamsplitter (1) → Mirror (2) → Mirror (3) → Film Plate

(continued overleaf)

How it's done:

A hologram requires two beams, one is reflected off the test object to be "photographed", and the other, the reference beam, intersects the beam reflected from the test object to provide an interference pattern of light waves on the photographic plate. The image may be reconstituted by placing the plate in its original position with respect to the reference beam and illuminating it with light from the reference beam.

The figure shows how two superimposed reference beams are used to make a double exposure hologram. An image of the unstressed object is taken with the reflected beam and one of the reference beams. The object is then stressed, and a second (double) exposure is made. The developed film plate provides a double exposure hologram that can be projected by simultaneous illumination with both of the reference beams. Because the two reference beams may be adjusted separately, the appearance of multiple images may be eliminated while manipulating the fringe patterns. This is not possible in a single reference beam system.

Note:

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

Technology Utilization Officer
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Houston, Texas 77058
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Patent status:

NASA had decided not to apply for a patent.

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