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NASA TECH BRIEF

Improvement in Recording and Reading Holograms

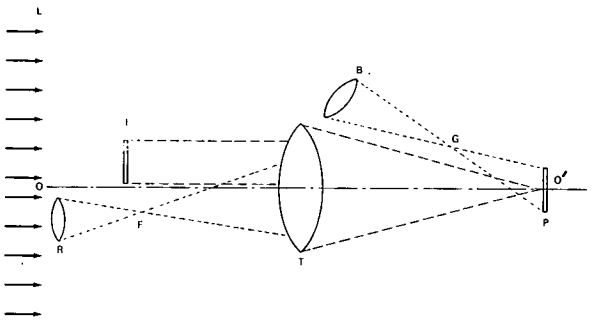

FIGURE 1

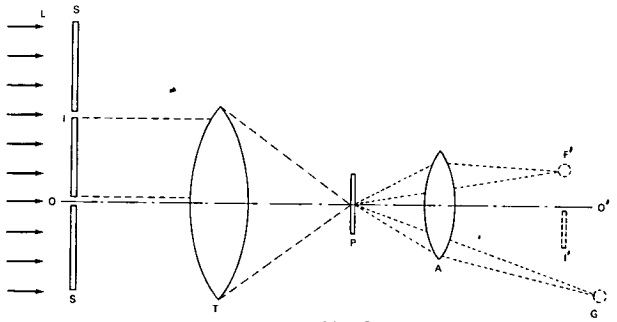

FIGURE 2

A three-beam technique has been developed to superimpose a number of patterns in the same plane of a hologram and then to uniquely identify each pattern by a suitable readout process. In contrast to prior techniques, the developed readout process does not require any movement of parts.

Figure 1 illustrates both the prior art and the technique developed. Coherent collimated light L is incident upon a Rayleigh lens R and upon a pattern I to be holographically recorded. The Rayleigh lens focuses the incident light L to a point F which should appear in the same plane as the input pattern I (plane normal to the 0-0' axis). The light diverges from F to the transform lens T, which is located one focal distance from the plane of pattern I. The light amplitude in the back focal plane of the transform lens T is equal to the Fourier transform of the input pattern I. The interference between the Fourier transform and the beam of light emanating from F is recorded on a photographic plate P placed at the back focal plane of lens T.

The above description is common to both the prior art and the new three-beam method; however, the method for storing additional patterns is different. In the prior art, one would rotate the photographic plate P about an axis perpendicular to axis 0-0' by some finite angle and then repeat the steps outlined above. The three-beam technique introduces another lens B which comes to a focus at a point G in front of the photographic plate P.

When a new pattern is to be stored, the location of lens B is changed in such a manner to keep constant the distance from the center of lens B to the axis 0-0' as well as the distances from the center of the plate P to point G and from point G to the center of lens B (i.e., a rotation about the 0-0' axis). Now there are three beams interfering at the photographic plate P.

The distinct advantage of the three-beam technique can be seen in Figure 2, which displays the readout process of the images stored on the photographic plate P. An unknown pattern is placed in a window formed by the stops S; the collimated coherent light L will pass only through the pattern I. The transform lens T performs the Fourier transform of the pattern, and in the plane of the photographic plate P the Fourier transform is multiplied with the previously recorded Fourier transforms. Lens A then performs another Fourier transform and exhibits the cross correlation of the input pattern I with all the stored patterns as a

(continued overleaf)

point of light F'. Using just the prior art, one would have to rotate the photographic plate P in order to search for the formation of point F', and the angle of the plate P will indicate which of the stored patterns is matched by the input pattern I. In the three-beam technique, point F' will be present without any movement of plate P; there will also be another point of light G' which is the image of point G of Figure 1. The position of point G' indicates which of the stored patterns matches the input pattern I (if any). (As noted in Figure 2, there is also an image I' of the input pattern I.) F' and G' come to a point focus in different planes which is convenient for readout purposes. Thus, the new three-beam technique allows one to interrogate the stored patterns for a matching pattern in one operation, without the previously required need for moving the photographic plate P.

Note:

Details may be obtained from:

Technology Utilization Officer
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Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D. C. 20546

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