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(54) **THREE DIMENSIONAL OPTICAL SWITCHES AND BEAM STEERING MODULES**

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(52) **U.S. Cl.** **359/290**; 359/226; 385/17; 385/18

(58) **Field of Classification Search** 359/290, 359/291, 292, 223–226, 295, 298, 296; 385/17, 385/18, 16

See application file for complete search history.

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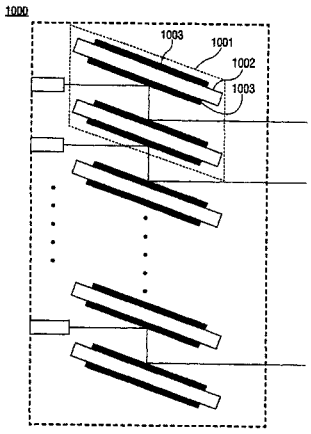
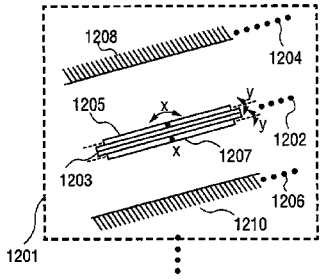
(57) **ABSTRACT**

A beam steering module comprised of a mirror stack array in close proximity to a collimator array controllably steers photons along two axis and in a direction substantially less than 90 degrees to the collimator orientation. Several configurations of the module are described using single and double axis mirror rotation and relay optics. Optical telecommunications switches are shown using modules coupled to each other along flat and curved surfaces, with and without use of fold mirror and enabling a plurality of configuration options including photodetector optical power monitoring schemes that require no external power taps.

43 Claims, 26 Drawing Sheets