

#### US006449103B1

# (12) United States Patent

# Charles

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(54) SOLID CATADIOPTRIC
OMNIDIRECTIONAL OPTICAL SYSTEM
HAVING CENTRAL COVERAGE MEANS
WHICH IS ASSOCIATED WITH A CAMERA,
PROJECTOR, MEDICAL INSTRUMENT, OR
SIMILAR ARTICLE

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### Related U.S. Application Data

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- (51) **Int. Cl. G02B 13/06** (52) **U.S. Cl. 359/725**; 359/366; 359/729;

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### 57) ABSTRACT

The present invention relates to an omnidirectional wide angle optical system, which is associated with a sensor, camera, projector, medical instrument, surveillance system, flight control system, robotic command and control or sensing system, home entertainment system, conference area, virtual reality suite, theater, or similar article. The optical system consists of an external refracting surface which may be strongly curved, an strongly curved internal primary reflector surface, a secondary reflector surface (in most embodiments), central wide angle refracting optics (in some embodiments), a modular or integral imaging and correcting lens system which may have aperture adjustment means, and mounting components. Optical surfaces associated with the formation of an omnidirectional virtual image are typically integrated into a single solid catadioptric optic in some embodiments, but central or peripheral wide angle refracting optics which may provide supplemental coverage are separate optical elements in other embodiments.

# 137 Claims, 37 Drawing Sheets

