

US007777972B1

(12) United States Patent Chen et al.

(10) **Patent No.:** (45) **Date of Patent:**

US 7,777,972 B1 Aug. 17, 2010

| (54) | IMAGING OPTICAL LENS ASSEMBLY |
|------|-------------------------------|

(75) Inventors: Chun-Shan Chen, Taichung (TW);

Hsiang-Chi Tang, Taichung (TW)

(73) Assignee: Largan Precision Co., Ltd., Taichung

(TW)

(*) Notice: Subject to any disclaimer, the term of this

patent is extended or adjusted under 35

U.S.C. 154(b) by 0 days.

(21) Appl. No.: 12/483,748

(22) Filed: Jun. 12, 2009

(30) Foreign Application Priority Data

Feb. 19, 2009 (TW) 98105232 A

(51) **Int. Cl. G02B 9/34** (2006.01) **G02B 13/18** (2006.01)

See application file for complete search history.

(56) References Cited

U.S. PATENT DOCUMENTS

| 7,477,459 1 | B2 * 1/2009 | Liao | 359/773 |
|--------------|-------------|----------|---------|
| 7,492,532 1 | B2 * 2/2009 | Shin | 359/773 |
| 2004/0136097 | A1* 7/2004 | Park | 359/773 |
| 2007/0188890 | A1* 8/2007 | Jo et al | 359/773 |

| 2009/0009889 A1* | 1/2009 | Teraoka et al 359/773 |
|------------------|--------|-----------------------|
| 2009/0015944 A1* | 1/2009 | Taniyama 359/773 |
| 2009/0207507 A1* | 8/2009 | Shinohara 359/773 |

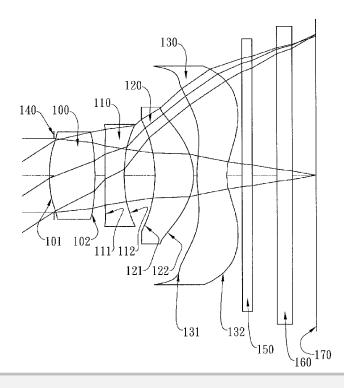
* cited by examiner

Primary Examiner—Evelyn A. Lester (74) Attorney, Agent, or Firm—Birch, Stewart, Kolasch & Birch, LLP

(57) ABSTRACT

The present invention provides an imaging optical lens assembly including, in order from the object side to the image side: a first lens group comprising a first lens element with positive refractive power, no lens element with refractive power being disposed between the first lens element and an imaged object, the first lens element being the only lens element with refractive power in the first lens group; and a second lens group comprising, in order from the object side to the image side: a second lens element with negative refractive power; a third lens element; and a fourth lens element; wherein focusing adjustment is performed by moving the first lens element along an optical axis, such that as a distance between the imaged object and the imaging optical lens assembly changes from far to near, a distance between the first lens element and an image plane changes from near to far; and wherein the number of the lens elements with refractive power in the imaging optical lens assembly is N, and it satisfies the relation: $4 \le N \le 5$. The abovementioned arrangement of optical elements and focusing adjustment method enable the imaging optical lens assembly to obtain good image quality and consume less power.

19 Claims, 16 Drawing Sheets





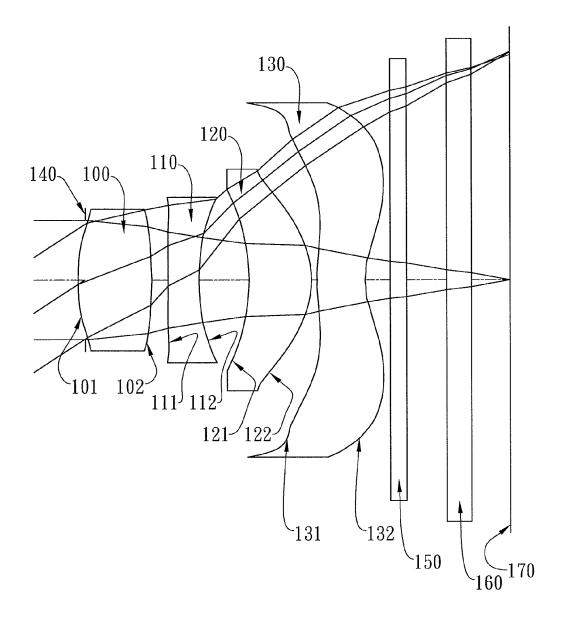
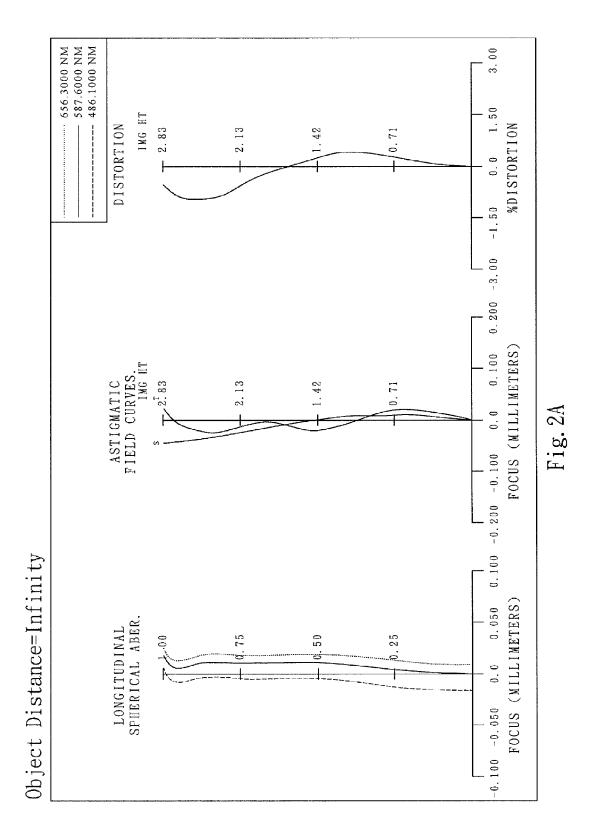


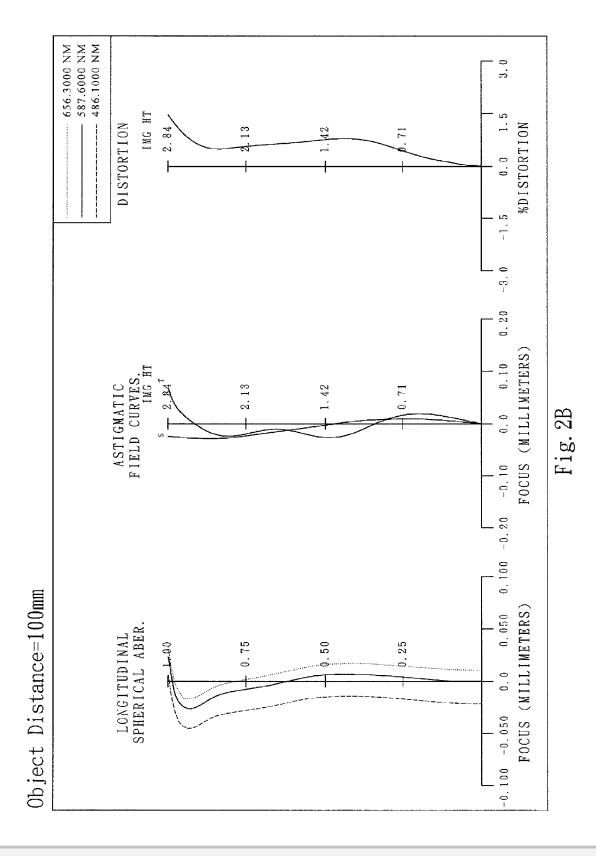
Fig. 1







Aug. 17, 2010



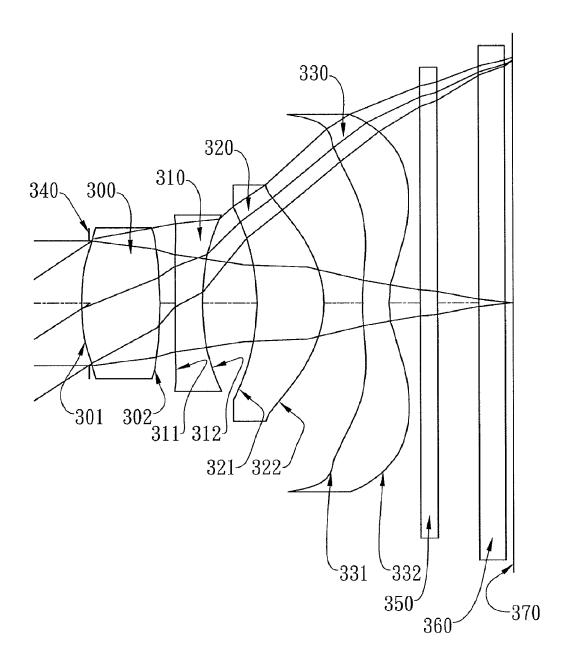


Fig. 3



DOCKET A L A R M

Explore Litigation Insights



Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time** alerts and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.

