Certification of Translation

I, Teresa Sumiyoshi, do hereby certify that:

1. I am fluent in the English and Japanese languages, and have worked as an interpreter and translator of these two languages for over 25 years.

2. The attached English translation is a true and accurate translation of the original Japanese document, identified as WO2013125248.

I declare under penalty of perjury under the laws of the United States of America and the State of California that the foregoing are true and correct and that this Certification was executed on this 20th day of July, 2020, in Moraga, California.

I declare that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Teresa Sumiyoshi

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(12) International Application Published Under The Patent Cooperation Treaty (PCT)

(19) World Intellectual Property Organization International Bureau

(10) International Publication Number WO 2013/125248 Al

(43) International Publication Date August 29, 2013 (29.08.2013)

WIPO I PCT

(51) International Patent Classification: G02B 13/04 (2006.01) G02B 13/18 (2006.01)

(21) International Application Number: PCT/JP2013/001035

(22) International Filing Date: February 22, 2013 (22.02.2013)

(25) Filing Language: Japanese

(26) Publication Language: Japanese

(30) Priority Data: 2012-039330 February 24, 2012 (24.02.2012) JP

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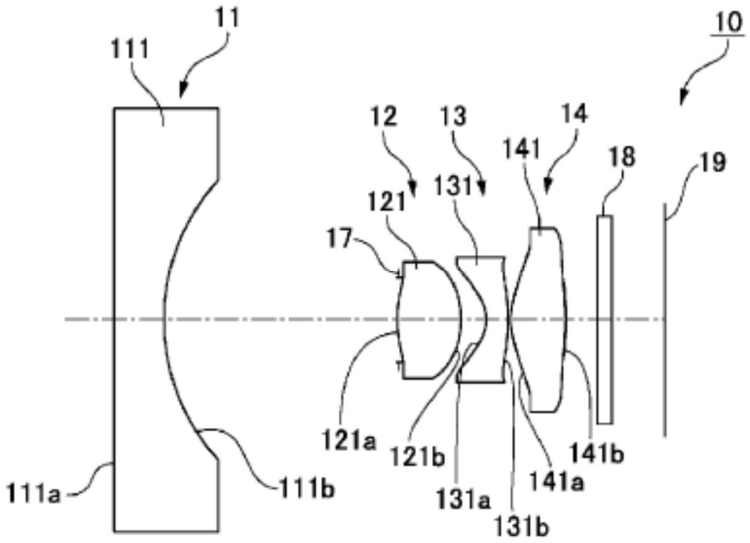
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Article 21(3))
- with amended claims (Article 19(1))

(54) Title: WIDE-ANGLE LENS AND IMAGING DEVICE



(57) Abstract: An imaging lens (10) is formed from a first group lens (11) having negative power, a second group lens (12) having positive power, a third group lens (13) having negative power, and a fourth group lens (14) having positive power, disposed in order from the subject side to the image side. Letting f be the focal distance for the entire lens system and ff2 the focal distance for the second group lens (12), $1.0 \leq ff2/f \leq 2.0$ is satisfied; therefore, the entire length of the lens system can be kept short and image curvature can be suppressed. In addition, each of the subject side lens surfaces and the image side lens surfaces for the second group lens (12), third group lens (13), and fourth group lens (14) are provided with aspherical surface shapes; therefore, the imaging lens (10) is constituted to be bright.

[TN: Original document includes Japanese-language abstract, which is duplicative of the above English-language abstract]

Specification

Title of the Invention: Wide-angle lens and imaging device

Technical Field

[0001]

The present invention relates to a compact, high resolution, wide-angle lens composed of four to six lenses.

Background Art

[0002]

Patent document 1 discloses a wide-angle lens mounted on, for example, a vehicle camera or a monitoring camera. The wide-angle lens of document 1 is formed from a first lens having negative power, a second lens having positive power, a third lens having negative power, and a fourth lens having positive power, arranged in order from the object side to the image side. The wide-angle lens of document 1 has a diagonal viewing angle of about 65°.

Prior Art Documents

Patent Documents

[0003]

Patent document 1: JP 2009-14947 A

Summary of the Invention

Problem to be Solved by the Invention

[0004]

For a wide-angle lens mounted in an imaging device, such as an on-vehicle camera or monitoring camera, there is a demand for compactness, and for higher resolution in conjunction with an increase in the number of pixels of imaging elements incorporated into such imaging devices. It then becomes necessary to suppress, more than up to now, aberration such as curvature of field, in order to improve the resolution of a wide-angled lens.

[0005]

In light of such matters, the problem addressed by the present invention is to provide a compact and higher resolution wide-angle lens, and to provide an imaging device incorporating such a wide-angle lens.

Means for Solving the Problem

[0006]

In order to solve the above-mentioned problem, a wide-angle lens of the present invention is characterized by:

comprising a first group lens having negative power, a second group lens having positive power, a third group lens having negative power, and a fourth group lens having positive power arranged in order from an object side toward an image side;

the first group lens comprising one lens having negative power or two lenses both having negative power;

the second group lens comprising one lens having positive power or two lenses both having positive power;

the third group lens comprising one lens having negative power;

the fourth group lens comprising one lens having positive power;

the lens constituting the first group lens being provided with a concave shape for the image-side lens surface;

the lens, in the second group lens, disposed adjacent to the third group lens being provided with a convex shape for the image-side lens surface;

the third group lens being provided with a concave shape for the object-side lens surface;

at least one lens among the lenses constituting the second group lens, the third group lens, and the fourth group lens being made to have an aspherical shape for at least one lens surface among the object-side lens surface and the image-side lens surface; and

the following conditional expression (1) being satisfied when f is the focal distance of the entire lens system, and ff2 is the focal distance of the second group lens:

$$1.0 \leq ff2/f \leq 2.0 \quad (1).$$

[0007]

Because the wide-angle lens of the present invention satisfies the conditional expression (1), the total length of the lens system can be kept short, and curvature of field can be suppressed. In addition, providing the lenses constituting the second group lens, the third group lens, and the fourth group lens with an aspherical shape makes it easy to increase the numerical aperture. If the upper limit of the conditional expression (1) is exceeded, curvature of field increases on the positive side and becomes difficult to correct. Below the lower limit of the conditional expression (1), curvature of field increases on the negative side and becomes difficult to correct. In addition, if the upper limit of the conditional expression (1) is exceeded, the positive power of the second group lens becomes relatively weaker, making it difficult to keep the total length of the lens system short. Note that "wide-angle lens" refers to an imaging lens with a diagonal angle of view of 60° or greater.

[0008]

In the present invention, when ff3 is the focal distance of the third group lens,

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