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 WO 2013/145989 A1.

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 12th day of August, 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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[TN: Original document includes the title and abstract in both Japanese and English. The following is a translation of the Japanese.]

(54) Title: imaging lens, imaging device, and portable terminal

(57) Abstract:
Provided is an imaging lens with a three-lens configuration that, for a wide-angle bright lens which has a field angle of 65° or greater and an F-number of three or less, corrects various aberrations while having lower error sensitivity, better moldability, etc., than conventional types. Also provided are an imaging device and a portable terminal which use said imaging lens. The imaging lens comprises, in order from the object side, a first lens, an aperture stop, a second lens, and a third lens. The first lens is a positive lens with a convex object-side face. The second lens is a positive meniscus lens with a concave object-side face. The third lens is a negative lens with an image-side face which is concave near the optical axis, has an inflection point within an effective radius, and is an aspheric face which becomes a convex face at the periphery of the lens. The imaging lens satisfies the following conditional expressions:
$-5.0 < r3/f < -0.4$ (1) and
$0.0 < f1/f2 < 5.0$ (2),
where r3 is the radius of curvature (mm) of the second lens object-side face, f is the focal length (mm) of the entire system, f1 is the focal length (mm) of the first lens, and f2 is the focal length (mm) of the second lens.

Specification

Title of the Invention: Imaging lens, imaging device, and portable terminal

Technical field

[0001]

The present invention relates to an imaging lens suitable for an imaging device using a solid-state imaging element such as a Charge Coupled Device (CCD) type image sensor or a Complementary Metal Oxide Semiconductor (CMOS) type image sensor, and to an imaging device and a portable terminal using said lens.

[Background Technology]

[0002]

In recent years, in conjunction with the increase in performance and miniaturization of imaging elements using a solid-state imaging element such as a CCD (Charge Coupled Device) type image sensor or a CMOS (Complementary Metal Oxide Semiconductor) type image sensor, portable phones and portable information terminals equipped with an imaging device are becoming widespread. In addition, there is an increasing demand for further miniaturization and higher performance of imaging lenses mounted on these imaging devices. Recently, there are many cases in which such portable terminals incorporate two cameras: a high pixel, a high performance main camera; and a compact low pixel sub-camera.

[0003]

Because of the need for high performance, imaging lenses with a configuration of three to five lenses have been proposed as imaging lenses for use in a main camera. Meanwhile, for the sub-camera, the number of pixels has generally been in the VGA class until now, and the main imaging lenses have had a configuration of one to two lenses. However, most recently, in conjunction with an increase in size and increased resolution of image display elements in portable terminals, increasing pixels to the 2M class is progressing even for sub-cameras, and the performance demanded of imaging devices is increasing. Therefore, proposed is an imaging lens with a three-lens configuration, which is capable of higher performance compared to a one or two-lens configuration. However, because a three-lens configuration has more elements than a two-lens configuration, there is significant performance degradation due to an accumulation of manufacturing errors of the elements, so manufacturing must be carried out with higher accuracy than for an imaging lens with a two-lens configuration, and increasing performance is difficult. Therefore, in the optical design of and imaging lens with a three-lens configuration, there is a demand for designs which have low error sensitivity and which are exceptional from a productivity perspective. Imaging lenses with a positive-positive-negative configuration, as in patent documents 1 and 2, are known as imaging lenses with a three-lens configuration.

Prior art documents

[Patent documents]

[0004]

Patent document 1: JP 2004-326097A

Patent document 2: JP 2007-322561A

Summary of the invention

Problem to be solved by the invention

[0005]

However, in the imaging lens described in Patent Document 1, the curvature of the object-side face of the second lens is too strong, so a large one-sided blur occurs when the optical surface is decentered from the optical axis. Accordingly, it becomes necessary to accurately manage the eccentricity that occurs between the optical axes of the first lens and the second lens, and there are concerns with productivity. In addition, in the imaging lens described in Patent Document 2, the curvature of the object-side face of the second lens is similarly too strong, so axial coma aberration generated when the optical surface is decentered from the optical axis is large, and there are concerns with productivity. Further, in the technology disclosed in both of Patent Documents 1 and 2, when an imaging lens with a maximum image height of two mm or less is used, the thickness of the lens becomes too thin and lens molding becomes difficult.

[0006]

The present invention was created in view of such problems, and with the purpose of providing: an imaging lens with a three-lens configuration that, for a wide-angle bright lens which has a field angle of 65° or greater and an F-number of three or less, corrects various aberrations while having lower error sensitivity, better moldability, etc., than conventional types; and an imaging device and a portable terminal which use said imaging lens.

[0007]

Here, although it is a measure of a small imaging lens, the present invention aims for miniaturization of a level satisfying the following expression. By satisfying this range, it becomes possible to reduce the size and weight of the entire imaging device.

$$TTL/2Y < 1.10 \quad \ldots \quad (14)$$

[0008]

Here, the image-side focal point refers to an image point when a parallel light beam parallel to the optical axis is incident to the imaging lens.

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