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Date: June 19, 2020

Document description: 688266.0071

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(19) Japanese Patent Office (JP) **(12) Unexamined Patent Gazette (A)** (11) Unexamined Patent Application No:

Kokai Hei 10-115778

(43) Date of Publication: May 6, 1998

(51) Int. Cl.[6]	Class. Symbols	FI	
G 02 B 13/04		G 02 B 13/04	D
13/18		13/18	

Request for Examination: Not yet submitted Number of Claims: 9 OL (Total of 11 pages [in original])

(21) Application No.: Hei 9-201903

(22) Date of Filing: July 28, 1997

(31) Priority No.: Hei 8-222394
(32) Priority Date: August 23, 1996
(33) Priority Country: Japan (JP)

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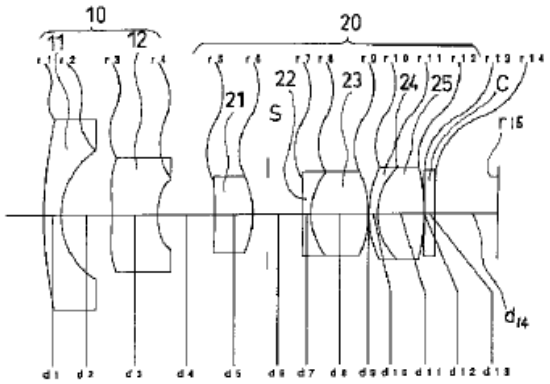
(54) [Title of the Invention] Super Wide-Angle Lens System Using Aspherical Lens

(57) [Summary]

[Object] To obtain a retrofocus type of super wide-angle lens system comprising front-group lenses [sic, and hereinafter] having a negative power and rear-group lenses [sic, and hereinafter] having a positive power, in order from the object side, wherein a fast lens system has an angle of view of approximately 120˚ to 140˚ and an F-number of approximately 1.2 to 1.4, without the radius of curvature of the second surface of a negative-meniscus first lens being reduced.

[Solution] The front-group lenses have a negative-meniscus first lens having a convex surface facing the object side, and a second lens having at least one aspherical surface. The second lens having an aspherical surface is shaped such that it is biconcave in the vicinity of the center of the optical axis and becomes a negative-meniscus lens that is convex on the object side at the edges.



(1)

[Claims]

[Claim 1] A retrofocus type of super wide-angle lens system comprising front group lenses having a negative power and rear group lenses having a positive power, in order from the object side;

said super wide-angle lens system using an aspherical lens, characterized by the above-mentioned front-group lenses having a negative-meniscus first lens with a convex surface facing the object side and a second lens having at least one aspherical surface, in order from the object side, and

the above-mentioned aspherical second lens is shaped such that it is a biconcave lens in the vicinity of the center of the optical axis and becomes a negative-meniscus lens that is convex on the object side at the edges.

[Claim 2] The lens system of claim 1, said super wide-angle lens system, wherein rear group lenses include at least a single lens and a diaphragm, in order from the the object side.

[Claim 3] The lens system of claim 2; said super wide-angle lens system, wherein the rear-group lenses provided with two pairs of combined lenses, each pair having a positive lens and a negative lens thus combined, behind the diaphragm.

[Claim 4] The lens system of any one of claims 1 to 3; said super wide-angle lens system, wherein the aspherical second lens has aspherical surfaces on both sides.

[Claim 5] The lens system of any one of claims 1 to 4; said super wide-angle lens system, wherein boundary portions of the aspherical second lens, between the biconcave lens part in the vicinity of the center of the optical axis and the edge negative-meniscus lens parts, are located substantially on outer peripheral parts of an axial bundle of light defined by an F-number.

[Claim 6] The lens system of any one of claims 1 to 5; said super wide-angle lens system, wherein a surface of the second lens on the object side comprises an aspherical surface and satisfies the following Conditions (1) through (4):

$$(1)\ -12 \leqq R_3 / f \leqq -6$$

$$(2)\ 2.0\times10^{-2} \leqq A_4 / f^3 \leqq 1.0\times10^{-1}$$

$$(3)\ -3.0\times10^{-2} \leqq A_6 / f^5 \leqq -2.0\times10^{-3}$$

$$(4)\ 2.0\times10^{-4} \leqq A_8 / f^7 \leqq 1.0\times10^{-2}$$

wherein

R_3 denotes the radius of curvature of a paraxial spherical surface of the aspherical surface of the second lens on the object side;
A_4 denotes a fourth-order aspherical factor of the aspherical surface of the second lens on the object side;
A_6 denotes a sixth-order aspherical factor of the aspherical surface of the second lens on the object side; and
A_8 denotes an eighth-order aspherical factor of the aspherical surface of the second lens on the

object side.

[Claim 7] The lens system of any one of claims 1 to 6; said super wide-angle lens system, wherein the rear-group lenses comprises two pairs of combined lenses, each pair having a positive lens and a negative lens thus combined, behind the diaphragm, in order from the object side.

[Claim 8] Claim 7 [sic]; said super wide-angle lens system, wherein the front-group lenses comprises a negative-meniscus first lens in which the convex surface faces the object side, and a second lens having at least one aspherical surface, and the rear-group lenses comprise a positive single third lens, a diaphragm, a combined lens having a negative fourth lens and a positive fifth lens, and a combined lens having a negative sixth lens and a positive seventh lens, and further, satisfies the following conditions (5) through (8):

$$(5)\ 2.50 \leqq R_8 / f \leqq 3.10$$
$$(6)\ 2.35 \leqq R_{11} / f \leqq 2.55$$
$$(7)\ 1 \leqq f_{7\text{-}9}$$
$$(8)\ 4 \leqq f_{10\text{-}12} \leqq 5$$

wherein

R^8 denotes a radius of curvature of the surface of the fourth lens on the image side;
R_{11} denotes a radius of curvature of the surface of the sixth lens on the image side;
$f_{7\text{-}9}$ denotes a combined focal length of the fourth and fifth lenses;
$f_{10\text{-}12}$ denotes a combined focal length of the sixth and seventh lenses; and
f denotes a focal length of the entire system.

[Claim 9] The lens system of claim 8; said super wide-angle lens system, wherein the third lens comprises a positive-meniscus lens that is convex on the image side; the fourth lens comprises a negative lens that is concave on the image side; the fifth lens comprises a biconvex positive lens; the sixth lens comprises a negative-meniscus lens that is convex on the object side; and the seventh lens comprises a biconvex positive lens.

[Detailed Description of the Invention]

[0001]

[Technical Field] The present invention pertains to a super wide-angle lens system that can be used for a surveillance camera (CCTV), etc.

[0002]

[Prior Art and Problems Thereof] In general, a super wide-angle lens system is used for a lens used in a surveillance camera or the like to be able to view or monitor a wider range. A retrofocus type having negative front-group lenses and positive rear-group lenses and is advantageous to increase the angle width and increase the back focal distance is used widely for a super wide-angle lens system. With this retrofocus type, the angle of view can be widened by increasing the negative power of the front-group lenses. Thus, the negative power could be

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