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APPARATUS FOR DEFINING THE SIZE OF
AN IMAGE IN A CAMERA

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Generally, the size of an image plane in a camera is standardized in accordance with a predetermined standard, e.g., ISO or JIS (i.e., the Japanese Industrial Standard). The largest size of an image plane for 35 mm film is as follows: 24.8 mm ~ 24.0 mm X (i.e., by) 36.8 mm ~ 36.0 mm. The size of the image plane is restricted by the fixed aperture in conventional cameras. Such fixed apertures, which cannot be varied, have not been disadvantageous in present cameras, even those having a zoom lens. This is due to the fact that lens systems including a zoom lens are designed such that the size of the image plane cannot be influenced by the exit pupil, even where the exit pupil most closely approaches the image plane. In conventional cameras, the size of the image plane is restricted in the vertical direction by upper and lower inner rails which virtually come into contact with upper and lower edges of the film; and, in the lateral or horizontal direction, by an aperture formed in an aperture defining or restricting plane which lies in front of the inner rails.

The aperture defining plane is positioned in front of the inner rails in order to minimize damage which would otherwise be caused to the film by virtue of contact between the film and the inner rails. The distance between the aperture defining plane and the inner rails is generally about 0.5 mm. Such type of film plane size restriction

mechanism is not disadvantageous in conventional cameras, e.g., even those having zoom lens systems, and therefore is capable of satisfying requirements such as the JIS.

5 However, it has been found that the size of the image plane can be larger than the standard in a zoom lens developed by the present applicant. This zoom lens has an exit pupil which very closely approaches the film plane at one extreme focal length, so that one or more rays of light
10 will defract outwardly through the aperture. The aperture is restricted along its vertical extent by inner rails which come into contact with the film, and in a lateral direction by frames which have aperture defining surfaces spaced from the film plane, and which serve to define the aperture.
15 Accordingly, because of the separation or spacing of the aperture defining surfaces from the film plane, enlargement of the image plane will occur in the lateral direction.

Fig. 1 illustrates the enlargement of the image plane in the lateral direction. In Fig. 1, Q represents the
20 aperture defining surface, R represents the aperture formed in the aperture defining surface Q, and F represents the film plane. The actual image plane size of an image formed on film plane F, when exit pupil E is located at position L, and the actual image plane size of an image formed on film
25 plane F when exit pupil E is moved to a position S closer to film plane F than position L, are defined by rays of light (a) and (b), respectively. As seen in Fig. 1, the actual size of the image plane is larger than the maximum standard size 36.8 mm when exit pupil E is in a position S which is
30 closer to film plane F. There is a tendency for the exit pupil to more closely approach film plane F when the zoom lens increases magnification and when the size of the lens system is minimized. Conventional fixed apertures cannot solve this problem of enlargement of the actual image plane
35 which arises when the exit pupil so closely approaches the film plane.

The film and, accordingly, film plane F, move within a tunnel-like space defined by and between a pressure plate 10, which ensures that the film plane will be flat, and inner rails 12, which restrict/abut the upper and lower edges of film plate F, as shown in Fig. 2. In Fig. 2 outer rails 14 are provided which restrict the position of pressure plate 10, which plate is pressed against the film via spring 10a. As seen and understood in Fig. 2, the vertical right hand and left hand edges of film plane F are not subjected to a force which cause the film to be pressed against pressure plate 10. Thus, any pressing force applied to the right and left hand side edges of film plane F is small, so that only the right and left edges themselves of the film plane are prevented from separating from pressure plate 10.

Fig. 3 is a similar (albeit enlarged) representation of an image plane in the lateral direction. As shown in Fig. 3, an aperture defining plane 16' is illustrated having an aperture 17'. Film plane F' is also shown with respect to the position of aperture defining plane 16'. Assuming that the complete image plane area receives 100% of the rays of light which pass the lens system of the camera and reach the film plane F', and that the incomplete image plane area receives only part of the rays of light which pass through the lens system and which reach the film plane F', when exit pupil P' is located at position A'; and, further, assuming that rays of light a' define the complete image plane area and that rays of light b' define the incomplete image plane area, the actual image plane size (i.e., the actual image plane area) can then be defined by rays of light which correspond to a bisector of light rays a' and b'. The actual image plane size defined by rays of light c' can then be larger than the standard, as noted above. This tendency, resulting from the rearward motion of exit pupil P', i.e., towards film plane F', increases as the zoom lens increases magnification and as the size of the

lens system is minimized. Conventional image plane size restriction mechanisms are not capable of solving this problem of enlargement of the actual image plane.

5 One primary object of the present invention, therefore, is to provide an apparatus for controlling image plane size within a predetermined standard size even when using a zoom lens system in which an exit pupil will very closely approach the film plane.

10 In order to achieve the above-noted objects, in accordance with the present invention, the right-hand and left-hand peripheral edges of the aperture frame which define the aperture in the aperture defining plane located between the upper and lower inner rails will at least
15 partially project or extend towards the inner rails.

Only the right and left-hand peripheral edges of the aperture frame need to project towards the inner rails, because the solution of the problem noted above lies in decreasing the distance between the aperture defining plane
20 and the film plane, i.e., it will be necessary to displace the aperture defining plane towards the film plane. However, displacement of the entirety of the aperture defining plane towards the inner rails would decrease the passage area of film between the inner rails and the
25 aperture defining plane, thereby resulting in an increase in the possibility of damage to the film plane. Accordingly, it has not been advisable, nor practicable, to move the entire aperture defining plane towards the inner rails. Under such circumstances, only a portion of the aperture
30 defining plane, i.e., the aperture frame, projects towards the inner rails; and such structure alone is capable of restricting the actual image plane size within a predetermined standard or range.

According to the present invention there is provided a camera having an apparatus for defining the size of an image on film adapted to be positioned along a plane in the camera, said apparatus comprising an aperture frame defining an aperture, said aperture frame comprising at least first and second oppositely disposed transverse surfaces which are arranged together with a film support surface in the camera to define a film guide channel along which the film is adapted to transport through the camera, wherein the distance between the transverse surfaces of the aperture frame and the support surface increases proceeding from each of the aperture edges in a direction parallel to the film transport directions and directed away from the aperture.

Embodiments of the the present invention will now be described by way of example, with reference to the following drawings, wherein:

Fig. 1 is a graph illustrating the disadvantages of the prior art;

Fig. 2 is a longitudinal sectional view of a pressure plate and inner rails in a known camera;

Fig. 3 is an enlarged view of an image plane of a camera illustrating a disadvantage of the image plane size in a known device;

Fig. 4 is a rear view of a die case camera body

formed in accordance with an embodiment of the invention;

Fig. 5 is a sectional view of the die cast camera body taken along line XXI-XXI of Fig. 4;

Fig. 6 is a sectional view taken along line XXII-XXII of Fig. 4; and

Fig. 7 is an enlarged view of the image plane of a camera illustrating the operation of the image plane size control device of Figs. 4-6.

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10 In an embodiment of the present invention, which is illustrated in Figs. 4-7 film is charged into a patron chamber 511 and is wound by a winding spool 513 in a winding spool chamber 512.

Between patron chamber 511 and film winding spool
15 chamber 512 are provided respective pairs of upper and lower outer rails 514 and inner rails 515, respectively, having the front elevational shapes which are illustrated in Fig. 4. Specifically, outer rails 514 are adapted to contact a pressure plate (not illustrated in Fig. 4) on the back
20 cover of a camera in order to restrict and define the position of outer rails 514. Inner rails 515 are adapted to abut the upper and lower edges of a front face or emulsion surface of the film. The distance between outer rails 514 and inner rails 515, as measured along the optical axis
25 direction, is usually about 0.2 mm. As a result, a tunnel-like space or gap is formed between the inner rails and the pressure plate. The film is adapted to move in the tunnel-like space created between the pressure plate and rails 514 and 515. Upper and lower inner rails 515 define
30 between them a film defining plane 516 which is provided, along its center, with an aperture 517 which serves to determine the image plane size.

According to one main feature of this embodiment, the right and left-hand peripheral edge portions of the aperture
35 frame which defines aperture 517 are inclined so as to project towards inner rails 515. Fig. 7 illustrates an enlarged view of a portion of aperture 517. Projections 518

are provided along right-hand and left-hand edges of the aperture defining plane 516 of aperture frame 550, which define aperture 517. Since projections 518 determine the image plane size along both the right and left hand sides, width(s) of the projections (see Fig. 7) 518 is as small as possible, so that there will be no substantial change in the size of the image plane. Projections 518 are smoothly and continuously connected to film defining plane 516 via inclined surfaces 551. The projecting length of projections 518 from film defining plane 516 can be determined in accordance with the position and size of the exit pupil when the zoom lens system moves into its rearmost position. The projecting length of projections 518 towards inner rails 515 will now be illustrated by way of a specific example.

In Fig. 7 , the position or positions of the exit pupil when the zoom lens system comes closest to the film, and when the lens system is moved farthest away from the film, respectively, have been assumed to be represented by S (closest) and L (farthest), respectively. The actual sizes of the image plane when the exit pupil is located at the positions S and L are defined by rays of light cS and cL , respectively. The radii of the exit pupil at positions S and L are rS and rL , respectively.

The value of the distance l_1 between the projections 518 and film F is determined in accordance with the distance dS or dL and between the film F and position S or position L, radius rS or rL of the exit pupil, and aperture size A_p , in order to satisfy the requirement of the JIS.

As one example, when $dS = 20.2$ mm, $dL = 49.25$ mm, $rS = 0.79$ mm, $rL = 3.6$ mm, and $A_p = 35.9 - 36.0$ mm, the distance l_1 will be calculated as follows: $l_1 = 0.44 - 0.14$ mm. In view of the irregularity of the dimensions of the portions of die cast camera bodies, influences on the emulsion layers of film, and the irregularity in lens systems, if $A_p = 35.9$ mm and $l_1 = 0.35$ mm, the sizes of the image plane at positions S and L will be 36.52 mm and 36.16 mm,

respectively. These values will be within the standard values of the JIS.

When the values mentioned above are selected, e.g., the 5 35 mm film (which usually has a thickness of 0.12 ~ 0.16 mm) which has the relatively large resilient characteristics discussed above when the film has directly emerged from patrone chamber 511 and is moving into the relatively larger space or gap defined between inner rails 515 and film 10 defining plate 516 there will accordingly be no possibility that the film will contact film defining plane 516. On the other hand, when the film closely approaches aperture 517, the flatness of the film will be increased by outer rails 514 e.g., by their engagement with the pressure plate, 15 and by inner rails 515. The film will pass through the narrow space or gap between inner rails 515 and projections 518, while maintaining the film in a relatively largely flat position. This will prevent the emulsion layer of the film from contacting projections 518 and since this ensures that 20 the film is in an area adjacent to projections 518 (i.e., near the periphery of aperture 517), the image plane size along the right and left-hand directions will become stabilized, regardless of the position of the exit pupil of the lens system.

25 As should be understood from the foregoing discussion, in accordance with the present invention, even when the exit pupil approaches the rearmost position, the image plane size along the left and right-hand directions should be maintainable within a predetermined standard.

30 The apparatus of the present invention can be applied to any camera having a zoom lens in which the image plane size can be varied in accordance with the positional displacement of an exit pupil of the lens in order to 35 restrict the image plane size within predetermined limits, and in order to take a properly sized photograph; the embodiments of the invention need not necessarily be used

with a zoom lens, however.

It is obvious to those of ordinary skill in the art that the above embodiments have been described as specific
5 representative examples of the present invention, and that other features and embodiments within the scope of the claims would be within the skill of those of ordinary skill in the art to which this invention pertains.

UK Patent Application No. 9012776.2 published under No. GB 2235542, and UK Patent Application No. 9012777.0, published under GB 2235543 have been divided out of this application, and thus this application describes matter also discussed in application No. 9012776.2 and No. 9012777.0. Attention is therefore drawn to application No. 9012776.2 and No. 9012777.0



CLAIMS

1. A camera having an apparatus for defining the size of an image on film adapted to be positioned along a plane in the camera, said apparatus comprising an aperture frame defining an aperture, said aperture frame comprising at least first and second oppositely disposed transverse surfaces which are arranged together with a film support surface in the camera to define a film guide channel along which the film is adapted to transport through the camera, wherein the distance between the transverse surfaces of the aperture frame and the support surface increases proceeding from each of the aperture edges in a direction parallel to the film transport direction, and directed away from the aperture.
2. A camera according to claim 1, wherein said aperture frame further comprises upper and lower rails, each of said transverse surfaces further comprises a first flange section spaced from said support surface, along an optical axis of the camera, by a predetermined distance, and a second flange section located directly adjacent to said aperture edge, said second flange section being located along said optical axis, between said first flange section and said upper and lower rails.
3. A camera according to claim 2 wherein each first flange section is substantially parallel to said support surface.
4. A camera according to claim 3 wherein each second flange section includes at least one portion which is



substantially parallel to said support surface, wherein said at least one portion of said second section is attached by an angled second flange portion to said first flange portion.

5. A camera according to claim 4, wherein one portion of said second flange section is attached to said first flange section by another portion of said second flange section which is inclined with respect to said optical axis.

6. A camera according to any one of claims 2 to 5, wherein said second flange section comprises at least one angled surface extending towards said support surface from said first flange section.

7. A camera according to any one of claims 2 to 6 wherein each of said second flange sections includes a portion directly adjacent said aperture edge, said portion comprising means for limiting the size of an image on said film plane.

8. A camera according to any one of claims 2 to 7, wherein said frame includes at least two additional members spaced from said support surface, along said optical axis, between said first and second flange sections.

9. A camera according to any one of claims 2 to 8, wherein each of said second flange sections includes a projection defining opposite edges of said aperture.

10. A camera according to claim 9, wherein each of said projections is inclined with respect to said support surface.



11. A camera according to claim 9, wherein each projection includes a substantially flat surface which is generally parallel to said support surface.

12. A camera according to any one of claims 2 to 11, wherein said second flange section is substantially narrower than said first flange section.

13. A camera according to any one of the preceding claims, wherein said aperture is substantially rectangular.

14. A camera according to claim 1, wherein said aperture frame is positioned at a predetermined angle with respect to an optical axis of said camera, said aperture frame further comprises upper and lower surfaces adjacent said film, and each of said transverse surfaces comprises a first section spaced from said support surface by a predetermined distance, and a second section located adjacent said aperture edges, said second section being located, along said optical axis, between said first section and said upper and lower surfaces.

15. A camera according to claim 14, wherein said predetermined angle comprises a right-angle.

16. A camera according to claim 14, wherein at least one of said sections is inclined with respect to said support surface.

17. A camera according to claim 14, wherein each of said second sections includes at least one portion which is inclined with respect to said support surface.



18. A camera according to claim 14, wherein at least one of said sections includes at least one portion which is inclined with respect to said film support surface.

19. A camera according to claim 14, wherein each of said second sections includes a portion directly adjacent to said aperture edges, said portions comprising means for limiting the size of an image on said film.

20. A camera according to claim 1 wherein the aperture frame has longitudinal surfaces facing the support surface and longitudinally extending in parallel to the film transport direction, and have longitudinally extending upper and lower inner rails for determining for the positioning of the film.

21. A camera according to claim 20 wherein in the aperture frame transverse surfaces having a peak section extending from the aperture edge, protruding out with respect to a frame main plane and merging into the frame main plane via a slope section.

22. A camera according to claim 21 wherein the peak section has a surface being substantially flat and parallel to the frame main plane.

23. A camera according to any one of the preceding claims in combination with said film.
