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(54) RANGE FINDER AND CAMERA INCLUDING RANGE FINDER

(71) We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America of 343 State Street, Rochester, New York 14650, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to rangefinders and, in particular, to coincidence rangefinders in which two images of a scene are brought into coincidence.

Rangefinders which utilize coincident images of a scene are known. In such rangefinders, a first image of a scene is produced in a plane. A second image of the scene is reflected by a movable ranging mirror into superposition with the first image. By adjustment of the ranging mirror, the two images are brought into coincidence and the range is determined from the angular position of the ranging mirror.

In many such rangefinders, the images of vertical lines in the scene are brought into coincidence for range determination. The correct orientation of the ranging mirror must be maintained throughout the extent of movement of the ranging mirror since misorientation may result in erroneous range information. In particular, a misorientation which produces a coincidence or horizontal image alignment error will result in the wrong range being indicated. A misorientation which results in a vertical image alignment error will make ranging more difficult and may, when a slant line rather than a vertical line is being brought into coincidence, result in a wrong range indication. Moreover, ranging is usually achieved by small displacements of the ranging mirror, with a typical mirror moving less than one degree in rotation over the entire focus range. Consequently, relatively complex structures are required to ensure proper positioning of the ranging mirror and to provide the necessary sensitivity to displacement of the ranging mirror.

It is an object of the present invention to provide an improved rangefinder of the coincidence type.

According to the present invention there is provided a rangefinder comprising a beam combiner and a reflector wherein light rays from a scene are transmittable along a direct first path via the combiner and a second path via both the reflector and the combiner to provide first and second images of the scene simultaneously visible in a viewfinder, and support means, on which both the beam combiner and the reflector are mounted in fixed relative positions, the support means being rotatable about a pivot axis to bring the first and second images into coincidence.

Reference will now be made to the accompanying drawings, in which:

Figure 1 is a schematic view of one embodiment of a rangefinder according to the present invention; and

Figure 2 is a schematic view of a further embodiment of a rangefinder according to the present invention.

Referring now to Figure 1, a rangefinder 10 comprises a housing 12 which includes viewfinder windows 14 and 16 and a rangefinder window 18. For simplicity of illustration, no optical elements, such as the lenses which may be desirable for the functioning of the rangefinder, have been illustrated. The viewfinder windows 14 and 16 are optically aligned along a primary optical path 20 which is directed toward the desired scene by the operator, who then may view one image of the scene through the viewfinder windows 14 and 16 along the primary optical path 20.

A plate or other mounting member 30 is rotatably mounted within housing 12 by means of a pin 32 fixed to housing 12. Pin 30 is preferably but not essentially located along primary optical path 20. A beam combiner 34, comprising for example a partially silvered mirror, and a ranging mirror 36 are securely mounted on plate 30 with a known angle of orientation, α , between their respective planes, the beam combiner 34 and the ranging mirror 36 being not parallel.

Ranging mirror 36 lies on a second optical path 38, separated at the mirror from the first optical path by a distance d . Consequently the optical axis 38 will not be parallel to the primary optical axis 20 and will intersect the optical axis 20 at a constant angle which is equal to twice the angle α between the beam combiner 34 and the ranging mirror 36. When the optical path 38 is also directed toward the desired scene, a second image along optical path 38. That viewed by the ranging mirror 36 and the beam combiner 34 along the optical path 20 through the ranging window 18 and the second image will be visible through the viewfinder window 16 to the observer at a viewing position.

As is conventional in coincidence rangefinders, the two images combined by the beam combiner 34 and seen through the viewfinder window 16 by the observer will be superimposed and should appear to be a single image, that is be in coincidence, when the rangefinder 10 is properly adjusted. In order to adjust the rangefinder 10, it is necessary only that the plate 30 be rotated about the pin 32. It may be seen by comparison of Figures 1 and 2 that such rotation changes the effective range base distance d of rangefinder 10 and therefore changes the point at which optical path 20 and optical path 38 intersect. Thus, the preferred rangefinder when the rangefinder mechanism is properly adjusted, will coincide with the desired scene. For operation of the present rangefinder, the operator will merely rotate plate 30 about pin 32 until the two images of the photographic scene are coincident in viewfinder window 16. Ranging information may then be determined by the relative rotational position of plate 30 about pin 32.

The rangefinder illustrated in Figure 1 will operate within a limited range which is dependent upon the maximum range base distance d and the orientation angle α . As an example, a rangefinder having a maximum angle α of 15 minutes will be characterized by a far focus distance of about 20 feet. The range to scenes at that distance or closer to the rangefinder may be determined. However, the double images of scenes at a greater distance cannot be brought into coincidence which is determinable range is limited to 20 feet. In addition, the rangefinder also has a minimum distance at which the double images may be brought into coincidence and the maximum range, in part, by the necessity of providing a second image of the scene will be provided, the configuration of the optical elements in the rangefinder must provide an unobstructed view of the scene along optical path 38 when plate 30 is in the near focus position shown in Figure 1. For the example

given above, this will result in a near distance of about three feet.

In a preferred embodiment of this invention, the usable limits of the rangefinder are increased by mounting a negative lens 42 within the rangefinder window as illustrated in Figure 2. Lens 42 need only be a weak lens of 0.30 diopter power being satisfactory in operation with the example described above. Because lens 42 will have an effect on image size, a negative lens 40, of equal power, should be mounted within the front viewfinder window. The effect of lens 42 is to increase the usable limits because of its refractive power. When plate 30 is positioned as in Figures 2, lens 42 will produce coincidence between the rays travelling along optical path 20 and an optical path 38 which is now parallel to optical path 38 intersect. The intersection point will have coincident images for indefinite subject distances. Lens 42 will also move the near distance closer to the rangefinder because of its refractive power with a further increase in the ranging limits.

The rangefinder of the present invention is relatively simple to construct and mount within a camera, since only one moving part, plate 30, is necessary. Movement of plate 30 in a vertical direction about pin 32, while not desirable, does not produce any noticeable halving error. Moreover, no coincidence or halving errors will develop during operation because beam combiner 34 and ranging mirror 36 are fixed in relationship to each other. The sensitivity of the rangefinder has also been improved since ranging mirror 36 is moved through an angle appreciably greater than the one degree available in typical coincidence rangefinders. Thus, a longer scale may be provided with finer divisions of the range information.

The rangefinder of the present invention may be either of the coupled or the uncoupled type. In an uncoupled type, a scale may be provided adjacent to plate 30 with the range information indicated by the position of plate 30 with respect to the scale. A coupled type requires the addition of coupling mechanisms which are known in the art to adjust the lens system of the camera to a focus adjustment appropriate to the range information determined by the rotational position of plate 30.

WHAT WE CLAIM IS:—

1. A rangefinder comprising a beam combiner and a reflector wherein light rays from a scene are transmittable along a direct first path via the combiner and a second path via both the reflector and the combiner to provide first and second images of the scene simultaneously visible in a viewfinder, and support means on which both the beam

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combiner and the reflector are mounted in fixed relative positions, the support means being rotatable about a pivot axis to bring the first and second images into coincidence.

2. A rangefinder as claimed in Claim 1 further comprising a negative lens positioned along the second path prior to the reflector.

10 3. A rangefinder as claimed in Claim 1 or 2, wherein the pivot axis is on the first path.

4. A camera comprising a rangefinder as claimed in Claim 1, 2 or 3.

5. A camera as claimed in Claim 4, the rangefinder being coupled to the camera 15 focussing means.

6. A rangefinder as hereinbefore described with reference to and as illustrated in Fig. 1 or Fig. 2.

7. A camera, including a rangefinder as 20 hereinbefore described with reference to and as illustrated in Fig. 1 or Fig. 2.

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