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Range finding system

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GB A 2038586
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GB 1524587

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H4D

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FIG 1

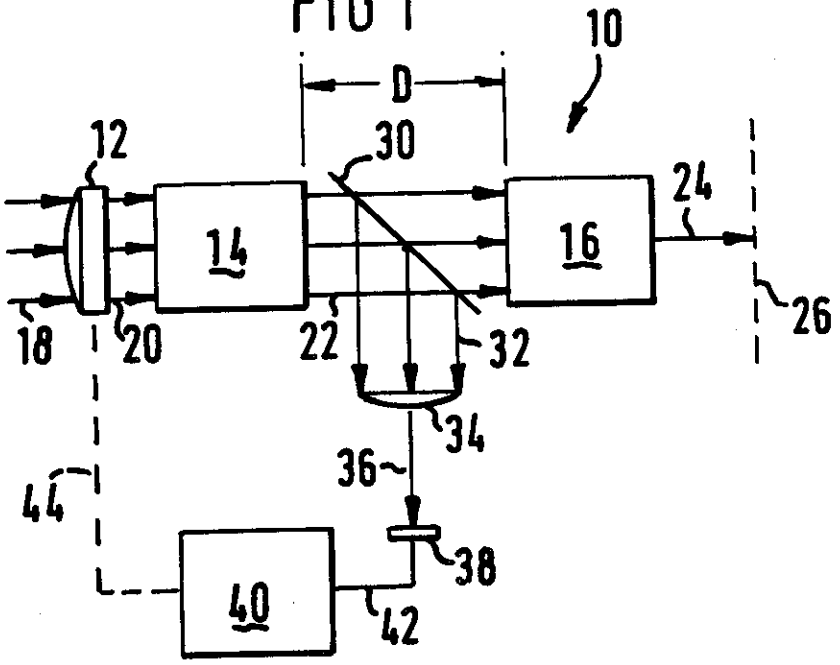


FIG. 2

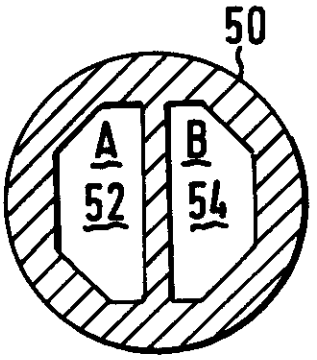


FIG. 3

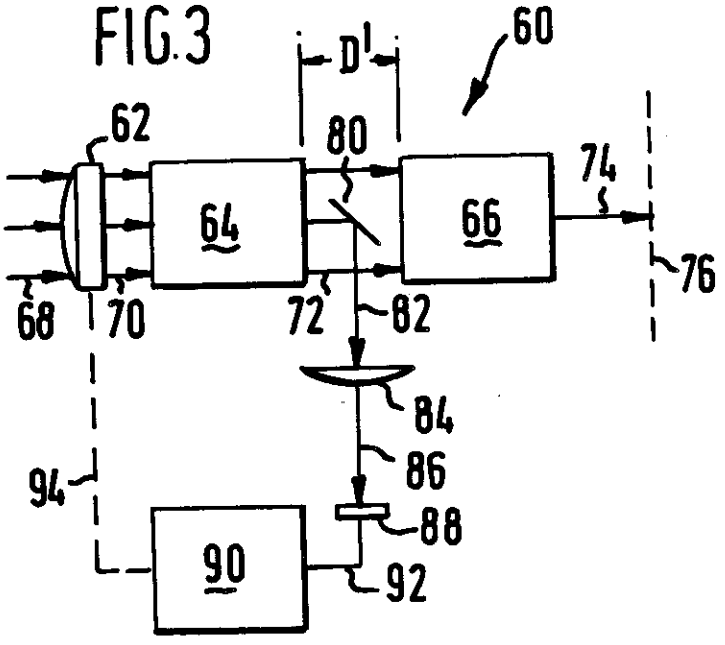


FIG. 4

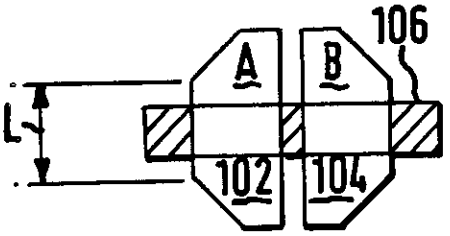
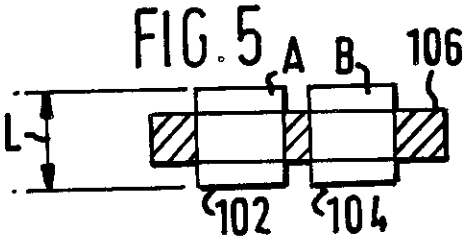


FIG. 5



2123642

RANGE FINDING SYSTEM

In the art of range finding systems and, more particularly, the art of auto focus cameras, radiation received from a remote object through the taking lens of the camera is often split into two portions. The first, and usually major portion of the radiation, passes to the film or to the electronics of the video camera, while the other portion of the light is directed to the auto focus circuitry to produce a signal indicative of the focus condition of the camera lens. Systems of this type may be seen, for example, in US Patent No. 4,185,191.

It is common in the prior art systems to employ a partially silvered mirror in the optical path so as to direct about twenty percent of the radiation to the auto focus circuitry, while passing about eighty percent of the radiation to the image plane of the camera. It is desirable to maximize the amount of radiation that passes through to the camera image plane and accordingly, efforts have been made in the past to increase the efficiency of the auto focus detectors by shaping them so as to occupy as much of the image of radiation at the detection plane as possible. As is seen, for example, in US Patent No. 4,230,942, the detectors may have their corners clipped to approximate a semicircle and the radiation image may be distorted to form an oval pattern. Shaping the detectors to fit within the radiation image or altering the image to extend the area thereof has, however, required additional effort and equipment and has created problems with respect to positioning and adjustment because the radiation image and the detector pairs have to be adjusted extremely carefully in order to maximize the radiation used. Because of this difficulty, a compromise is usually reached where the size of the radiation image is increased so that the detector pairs can more easily fit within the confines thereof, but in doing so, additional radiation is wasted resulting in less radiation being available for exposing the camera film or video camera circuitry.

Finally, when utilizing zoom lenses, for example, in motion picture or video cameras, a problem arises due to the fact that the partially silvered mirror must be placed between the afocal zoom portion of the lens, and the master lens. The length of the partially-silvered mirror unnecessarily increases the length of the zoom lens in an undesirable fashion.

According to the present invention there is provided a range finding system comprising a taking lens operable to direct a main radiation beam from a remote object to an image plane along an optical path, a long and narrow reflector positioned in that path with its long axis perpendicular to that path to reflect a focussing beam from the main beam along a second optical path, and a plurality of radiation elements placed side by side along the long transverse axis of the focussing beam to provide an output signal indicative of the range of the remote object.

Embodiments of the invention will now be described by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic representation of prior art auto focus system utilizing a zoom lens;

Figure 2 shows the arrangement of the detectors within the radiation image, for the apparatus of Figure 1;

Figure 3 shows a schematic representation of an auto focus system of the present invention;

Figure 4 shows the arrangement of the detectors and the strip radiation image of system of Figure 3, and

Figure 5 shows a more convenient form of the detectors of Figure 4.

Figure 1 shows a prior art auto focus system including a zoom lens arrangement 10 (comprising a focus lens 12, an afocal zoom lens 14 and a master lens 16) arranged to receive radiation from along a path such as shown by arrows 18, 20 and 22; which arrangement produces an image along a path shown by arrow 24 on an image plane 26, which may be the film plane of a still or motion picture camera, or the detector plane of a video camera.

In order that the focus lens 12 be positioned at the proper distance to create a focused image on the plane 26, a partially-silvered mirror 30 is inserted at a 45-degree angle between the afocal zoom lens 14 and the master lens 16 so as to direct radiation along a path such as is shown by arrow 32 to a lens 34, and thereafter along a path such as is shown by arrow 36 to a detector array 38 of an auto focus circuit 40. The output of the detectors on the array 38 is presented to the auto focus circuit 40 by a conductor 42, and the auto focus circuit operates to produce an output shown as a mechanical connection 44, which positions the focus lens 12 of the zoom system 10 at a proper position to cause the image on plane 26 to be in focus.

The partially silvered mirror 30 is usually made so that enough of the available radiation passes to the auto focus detector 38 to enable it to work, while the remainder of the radiation passes to the master lens 16. Preferably the distance "D" between the lens 14 and 16 should be minimized in order to make the overall zoom lens length reasonably small.

Figure 2 shows an image 50 representing the radiation transmitted by the mirror 30 and lens 34 to the detector array 38. The detector array 38 comprises a plurality of detection pairs, one of which is shown in Figure 2 by reference numerals 52 and 54, representing detectors A and B. As is discussed in the above mentioned US Patent No. 4,230,942, in order to have the greatest output from detectors A and B, they should be shaped so as to fit within the circular image 50, and accordingly as shown in Figure 2 the detectors are portions of octagons sized so as to fit fairly closely within the circular image 50. In order to prevent great difficulty in adjusting the system, however, the image 50 is necessarily somewhat larger than the detectors A and B, and the cross-hatched areas within the circular area 50 is therefore representative of radiation which is wasted and is not used by the detectors A and B. It is desirable to minimize the amount of wasted radiation, since to do so will increase

the amount of radiation that can pass in Figure 1 from the afocal zoom lens 14 to the master lens 16.

Referring to Figure 3 the present auto focus system includes a zoom lens arrangement 60 (including a focus lens 62, an afocal zoom lens 64 and a master lens 66) operable as the elements were in Figure 1 to direct radiation from a remote object along a path such as is shown by arrows 68, 70, 72 and 74 to a detection plane 76 which may be the film-plane of a still or motion picture camera or the detectors of a video camera.

A small substantially fully-reflecting strip mirror 80 is shown substituted for the large partially silvered mirror 30 of Figure 1. Strip mirror 80 is rectangular in shape, and its long dimension extends into the plane of the paper in Figure 3. Radiation is reflected from mirror 80 downward along a path shown by arrow 82 to a lens 84, and along a path shown by arrow 86 to a detector array 88 in a manner similar to that shown in Figure 1. The detector array 88, like array 38 of Figure 1, consists of a plurality of detector pairs which produce outputs to an auto focus circuit 90, along a conductor 92. The output of auto focus circuit 90 is shown as a mechanical connection 94 being connected to the focus lens 62 so as to position it at the correct position to create a focused image on the detection plane 76. It should be noted that the distance D' between the afocal zoom lens 64 and the master lens 66 is considerably smaller than the distance "D" shown in Figure 1. This advantage occurs since the mirror now occupies much less axial space between the afocal zoom lens 64, and the master lens 66 allowing the two to be moved closer together.

Since the mirror is substantially totally-reflecting, none of the light passing to the mirror 80 reaches the master lens 66, but all of the light around the mirror 80 is passed on to master lens 66. By adjusting the size of the totally-reflecting mirror 80, it is seen that the percentage of light required may be transmitted down to the auto focus

detectors with the remainder passing to the master lens 66. If, for example, twenty percent of the light from the remote object is desired for the auto focus detectors, then the strip mirror 80 should be made to block twenty percent of the cross-sectional area of light between the zoom lens 64 and the master lens 66. Furthermore, as will be described hereinafter, the adjustment of the position of the detectors with respect to the radiation image transmitted by the mirror 80 is less critical and less of the radiation will be wasted. Accordingly, the auto focus circuitry can operate on a smaller amount of light than was required in Figure 1 and thereby the amount of light passing through to master lens 66 is increased.

Referring to Figure 4 the detectors A and B of Figure 2 are indicated by reference numerals 102 and 104 respectively, and the image of the radiation being reflected by the mirror 80 is shown as a rectangular strip 106 falling across the central portion of the detectors A and B. It is seen that image 106 falls between the cutoff corners of detectors A and B, as is seen in Figure 4 by the distance "L". Accordingly, all that is necessary for the detectors A and B to receive the proper amount of radiation is that the image 106 lie somewhere in the distance L so it is seen that the difficulty of close adjustment is reduced. While, in Figure 4, the area of radiation to which detectors A and B are exposed is less than in Figure 2, the amount of radiation they receive is as great or greater because mirror 80 in Figure 3 is substantially totally reflective while mirror 30 in Figure 1 reflects only about twenty percent of the radiation. Furthermore, it is seen in Figure 4 that the cross-hatched area representing that amount of radiation which is wasted is now considerably reduced from that shown in Figure 2, and accordingly, more of the radiation can pass through to the master lens 66 of Figure 3 than was the case in Figure 1.

Figure 5 shows the same arrangement as Figure 4, except that detectors A and B are now shown to be, themselves,

square or rectangular which is a configuration easier to manufacture than the octagonal configuration of Figure 4. With the configuration of Figure 5, the detectors still receive the same amount of radiation as the detectors in Figure 4, with the same amount of lost radiation involved, but the whole arrangement is easier to manufacture.

It is therefore seen that we have provided an auto focus camera which reduces the amount of lost radiation in the region of the detectors while taking up less space and allowing easier manufacturing and adjusting procedures to be employed.

CLAIMS

1. A range finding system comprising a taking lens operable to direct a main radiation beam from a remote object to an image plane along an optical path, a long and narrow reflector positioned in that path with its long axis perpendicular to that path to reflect a focussing beam from the main beam along a second optical path, and a plurality of radiation detector elements placed side by side along the long transverse axis of the focussing beam to provide an output signal indicative of the range of the remote object.
2. The system of Claim 1, includes means operable to move the taking lens in response to the output signal to a focused position.
3. The system of Claim 1 or 2, wherein the detector elements comprise a pair of elements arranged so that each element extends beyond the long edges of the focussing beam and the short edges of the focussing beam lie beyond the outer edges of the elements.
4. The system of Claim 1, 2 or 3, wherein the reflector is positioned between the afocal and master lenses of a zoom lens system.
5. A range finding system substantially as herein described with reference to Figure 3 taken in conjunction with Figure 4 or Figure 5 of the accompanying drawings.

C+K

CERTIFICATE OF GRANT OF UNITED KINGDOM PATENT

In accordance with Section 24(2) of the Patents Act, 1977, it is hereby certified that a patent having the specification No 2123642 has been granted to Honeywell Inc (USA-Minnesota) in respect of an invention disclosed in an application for that patent having a date of filing of 17 June 1983 being an invention for "Range finding system".

Dated this Thirtieth day of July 1986

P. J. COOPER
Comptroller-General of Patents
Designs and Trade Marks

THE ATTENTION OF THE PROPRIETOR IS DRAWN TO THE IMPORTANT NOTES OVERLEAF

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IMPORTANT NOTES FOR PROPRIETORS OF UNITED KINGDOM PATENTS

1. DURATION OF PATENT & PAYMENT OF RENEWAL FEES

(i) A patent takes effect on the date shown at the foot of the certificate overleaf. Subject to the payment of renewal fees, it can be kept in force until the end of a period of 20 years from the date of filing the application for a patent.

(ii) To maintain the patent in force, it is necessary for the proprietor or someone on his behalf to pay a prescribed annual renewal fee. Payment may be made not more than three months before the expiration of the fourth or relevant succeeding year from the date of filing the application for a patent and should be accompanied by Patents Form 12/77.

(iii) **The proprietor is responsible for ensuring that effective renewal arrangements are set up and maintained and that fees are paid on time.** He should not await any communication from the Patent Office before paying the fee; an official reminder sent to the last recorded address for service within six weeks **after** the anniversary of the date of the patent is intended to alert the proprietor to possible failure of his renewal arrangements.

(iv) If the form with the fee is not lodged in the Patent Office on or before the anniversary date of the patent, the fee cannot be accepted unless application for an extension of time to a maximum of 6 months is made and paid for on Patents Form 13/77. Thereafter if no renewal fee is received and no extension of time is requested, the patent will cease. No reduction of extension fees is made in the case of a patent endorsed "Licences of Right". When paying a renewal or extension fee it is advisable first to check the current scale of charges as these may change from time to time.

2. PROCEDURE FOR PAYMENT OF FEES

Patents fees are payable direct to the Patent Office by means of cash, money order, postal order, banker's draft or cheque. (Adhesive stamps will not be accepted in payment of fees). The prescribed fee must be submitted together with the appropriate completed Patents Form; in addition each form or batch of forms should be accompanied by a fee sheet (FS. 1) showing details of the form(s) and the amount(s) of the fee(s). Cheques, money orders, etc., should be made payable to "The Comptroller-General, Patent Office", and crossed. Patents Forms, together with the fees and fee sheet (FS. 1) may be delivered to the Patent Office in London either by hand or post; those sent by post should be addressed to "The Cashier, The Patent Office, State House, 66-71 High Holborn, London WC1R 4TP".

Blank Patents Forms and fee sheets (FS. 1) can be obtained from the Clerk of Stationery, The Patent Office, 25 Southampton Buildings, London WC2A 1AY".

3. REGISTRATION OF OWNERSHIP AS EVIDENCE OF ENTITLEMENT

Any person who claims to have acquired the property in a patent by virtue of any transaction, instrument or event shall be entitled as against any other person who claims to have acquired that property by virtue of an earlier transaction, if application is made to the comptroller for registration in the register of patents (see Sections 32 and 33 of the Patents Act 1977). Particulars as to the manner of making such application may be obtained from the Patent Office.

Publication No.
2123642 A dated 1 February 1984

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WITH EFFECT FROM SECTION 25(1) 30 JUL 1986

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Title:
Range finding system

Applicant:
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Classified to:
H4D

Examination requested 14 AUG 84

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