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(54) **Binoculars having an automatic focussing system**

(57) A pair of light entrance windows 6 and 6' are provided in a housing H of a pair of binoculars outwardly of respective objectives 1 and 1', and a fixed reflector 7 and a movable reflector 7' project images of an object being viewed onto a focus detection unit 11. The movable reflector 7' is oscillated so that its projected image is scanned laterally with respect to the image projected by the fixed reflector 7, and the unit 11 produces a control signal when the two images are in mutual alignment, Oculars 3*b* and 3'*b* are moved by a motor 5 to effect automatical focussing of the binoculars in dependence upon the control signal from the unit 11.

FIG. 2

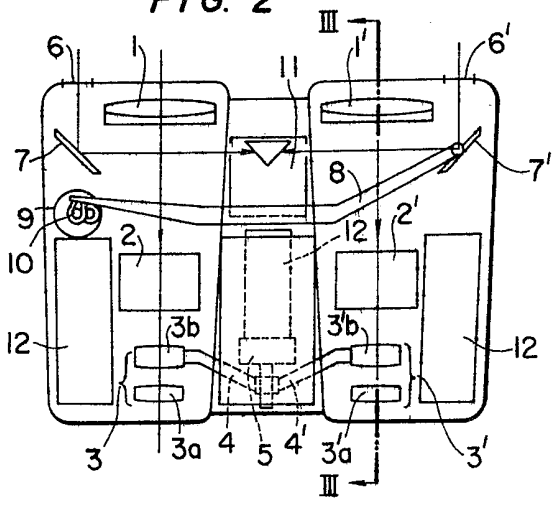

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FIG. 1

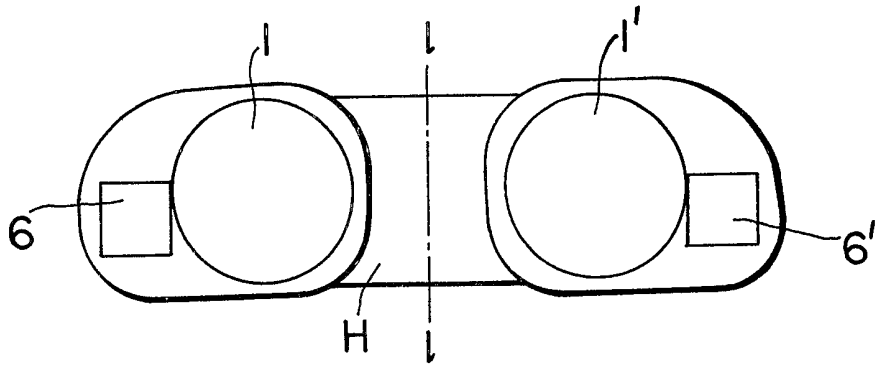

FIG. 2

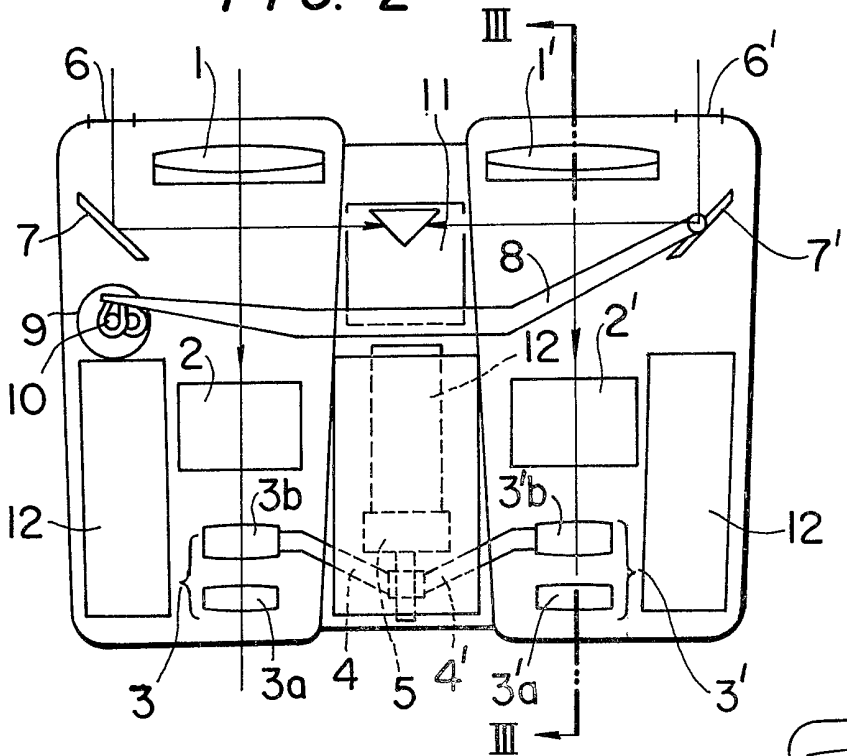

FIG. 3

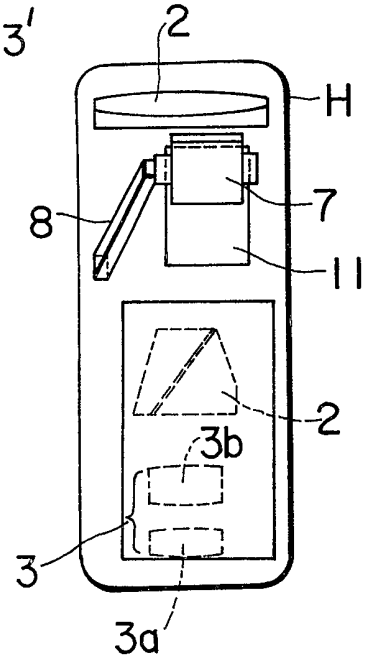

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FIG. 4

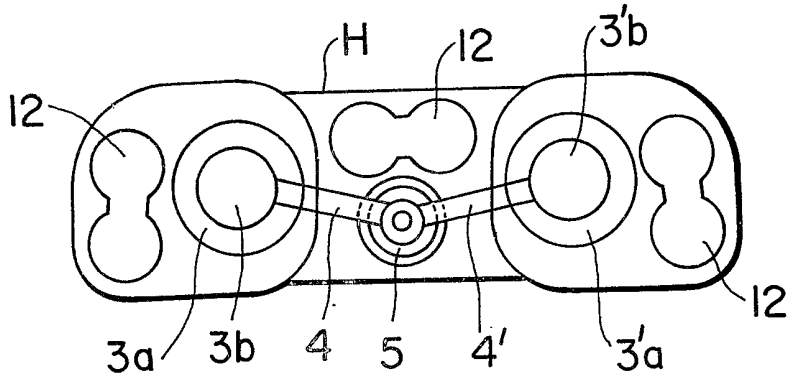
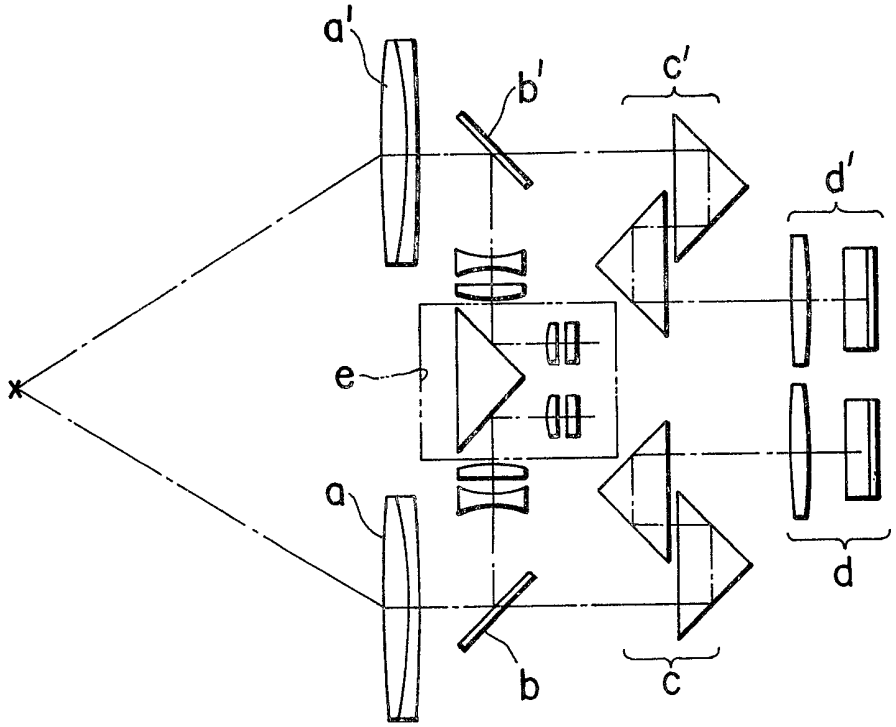


FIG. 5



SPECIFICATION

Binoculars having an automatic focussing system

This invention relates to binoculars having an automatic focussing system.

In most types of conventional binoculars, focussing is effected manually by turning an adjustment ring until the front focal point of each ocular lies in the focal plane of the respective objective. However, focussing in this manner is time-consuming and can be somewhat inaccurate.

In order to overcome this problem, it has been proposed to provide binoculars with an automatic focussing system, for example in the manner disclosed in the applicant's co-pending British Patent Application No. 7930940. (Serial No. 2030725) Binoculars as disclosed in this application are indicated in Figure 5 of the accompanying drawings, in which a fixed semi-transparent reflector *b* and a movable semi-transparent reflector *b'* are respectively disposed behind objectives *a* and *a'* of the binoculars. Light rays passing through the semi-transparent reflectors *b* and *b'* are transmitted to oculars *d* and *d'* through prism groups *c* and *c'* respectively, while at the same time light rays reflected by the reflectors *b* and *b'* are projected onto a focus detection unit *e* to form respective images thereon. The movable reflector *b'* is moved so that the image projected onto the unit *e* thereby coincides with the image projected by the fixed reflector *b*, and simultaneously therewith the oculars *d* and *d'* are moved (for example by step-up motors) to effect automatic focussing of the binoculars.

These binoculars are, however, somewhat disadvantageous because the total light entering through the objectives *a* and *a'* is divided between the ocular lenses and the focus detection unit. As a result, the brightness of the image viewed through the binoculars is reduced, and the amount of light supplied to the focus detection unit may be insufficient to ensure accurate focussing, particularly in low light levels.

It is an object of the present invention to overcome this disadvantage.

According to the present invention, there is provided binoculars comprising a housing having a pair of light entrance openings therein, a fixed reflector and a movable reflector disposed behind the light entrance openings respectively and arranged to direct light passing through the openings onto a focus detection unit, the focus detection unit being arranged to produce an output signal dependent upon the distance from the binoculars of an object being viewed, a pair of oculars which are movable relative to the housing to effect focussing of the binoculars, and moving means arranged to move the oculars in accordance with the output signal from the focus detection unit, the light paths through the light entrance openings to the focus detection unit being independent of the light paths through the binoculars in which the oculars are disposed.

Also according to the present invention, there is provided binoculars comprising a focus detection unit, a movable reflector and a fixed reflector for directing respective light rays towards the focus detection unit, first and second oculars, means for moving the oculars according to a control signal produced by the focus detection unit to focus the binoculars, and first and second light entrance windows for distance metering and arranged to supply light to the movable and fixed reflectors respectively, the light paths through the light entrance windows being independent of the light paths through objectives of the binoculars.

Further according to the present invention, there is provided binoculars comprising a pair of objectives, a pair of oculars, a pair of light entrance openings adjacent the objectives respectively, a focus detection unit, a fixed reflector and a movable reflector arranged respectively to direct light passing through the light entrance openings onto the focus detection unit, means operable to oscillate the movable reflector, and means arranged to move the oculars to focus the binoculars in response to a control signal produced by the focus detection unit when the images reflected by the fixed and movable reflectors are aligned with each other on the focus detection unit.

Preferably, the light entrance openings or windows are disposed outwardly of the objectives.

An embodiment of the present invention will now be described, by way of example, with reference to the remaining Figures of the accompanying drawings, in which:-

Figure 1 is a front view of binoculars according to the present invention;

Figure 2 is a schematic plan view of the binoculars shown in Figure 1;

Figure 3 is a schematic sectional view taken along the line III-III in Figure 2; and

Figure 4 is a schematic rear view of the binoculars shown in Figures 1 to 3.

The illustrated binoculars comprise a pair of objectives 1 and 1' behind which prism groups 2 and 2' are respectively disposed, and a pair of oculars 3 and 3' to which light passes from the prism groups 2 and 2' respectively. Each ocular 3, 3' includes a fixed lens 3*a*, 3'*a* and a movable lens 3*b* and 3'*b*. All of these components are disposed within a housing H. The movable ocular lenses 3*b* and 3'*b* are mechanically connected to an output shaft of a driving motor 5 through a conventional gear mechanism and driving pins 4 and 4', so that the lens 3*b* and 3'*b* are movable back and forth by the driving motor 5 to vary the position of the front focal points of the composite oculars 3 and 3'.

A light entrance window 6 is formed in the housing H to the right of the objectives 1 and a light entrance window 6' is similarly formed in the housing H to the left of the objective 1'. Desirably, the light entrance windows 6 and 6' are provided symmetrically with respect to a centre line 1 of the binoculars as shown in Figure 1. In the illustrated embodiment, the light entrance windows 6 and 6' are disposed outwardly of the objectives 1 and 1': however, they may instead be provided inwardly of the objectives 1 and 1' or in the vertical direction. A pair of reflectors 7 and 7' are disposed behind the windows 6 and 6' respectively, the reflector 7 being

fixed in position while the reflector 7' is movable relative to the housing H. One end of a drive lever 8 is connected to the movable reflector 7', and the other end of the lever 8 co-operates with a drive motor 9 for moving the reflector 7'. An eccentric cam 10 is attached to an output shaft of the drive motor 9, and contacts the adjacent end of the drive lever 8 so as to move the latter periodically. The lever 8 is spring biased into engagement with the eccentric cam 10.

Light entering the housing H through the windows 6 and 6' is reflected by the reflectors 7 and 7' respectively towards a focus detection unit 11, so that respective images are projected onto the unit 11 by the reflectors. The focus detection unit 11 is of a type well known in the field of automatically focussing cameras. When the respective images projected onto the unit 11 coincide, corresponding to a properly focussed image, a control signal is generated both to arrest operation of the motor 9 driving the movable reflector and to halt the motor 5 driving the movable ocular lenses 3*b* and 3'*b*. The motors 5 and 9 are powered by means of one or more dry batteries housed in a cavity or cavities 12 in the housing H, the cavity or cavities 12 utilizing otherwise unused space in the housing.

The binoculars described above operate as follows. Rays of light entering the binoculars through the objectives 1 and 1' pass through the prism groups 2 and 2' and are focussed by means of the oculars 3 and 3'. At the same time, light rays entering the housing H through the windows 6 and 6' are reflected by the reflectors 7 and 7' onto the focus detection unit 11. Because the movable reflector 7' is continuously reciprocated or oscillated by the motor 9 and the lever 8, the image projected thereby onto the focus detection unit 11 is reciprocatingly moved across the image projected by the fixed reflector 7. At the instant when the movable reflector 7' passes through an angle proportional to the distance of the binoculars from an object being viewed, these two images coincide and the aforementioned control signal is produced by the focus detection unit 11.

When the binoculars are not focussed properly on the object being viewed, the front points of the oculars 3 and 3' do not coincide with the focal planes of the objectives 1 and 1'. Focussing movement of the ocular lenses 3*b* and 3'*b* is controlled by electronic circuitry in response to the control signal from the focus detection unit 11, so that the ocular lenses 3*b* and 3'*b* are moved by an amount corresponding to the distance of the binoculars from the object being viewed, i.e. to a position corresponding to the angle of the movable reflector 7' at which the two images projected onto the focus detection unit 11 coincide. At this point, the lenses 3*b* and 3'*b* are positioned so that the front focal points of the oculars 3 and 3' coincide with the focal planes of the objectives 1 and 1', and the binoculars are correctly focussed on the object.

Since movement of the ocular lenses 3*b* and 3'*b* is controlled according to a signal produced by the electronic circuitry, such movement may be commenced immediately after the images coincide. By using a memory circuit, the moving operation can be initiated any time after the control signal has been generated by the focus detection unit 11. As is obvious from the foregoing description, by repeated operation a correctly focussed image can always be maintained even if the distance of the binoculars from the object is varied.

As is apparent from the above, in binoculars according to the present invention, sufficient amounts of light are provided both to the distance metering optical system and the objective and ocular optical systems independently. This is because light entrance windows are providing independently of the objectives, thereby providing a bright and accurately focussed image. Especially in the case where the light entrance windows are provided outwardly of the objectives, the distance between the right and left windows may be widened and the metering accuracy of the binoculars can be greatly enhanced.

Also, the separation between the objective optical system and metering optical system eliminates the need for semi-transparent reflectors between the objectives and the prism groups, so that the construction of the optical system is simplified thereby reducing the chance of mechanical failure while enhancing the mechanical strength and simplifying the assembly of the binoculars.

CLAIMS

1. Binoculars comprising a housing having a pair of light entrance openings therein, a fixed reflector and a movable reflector disposed behind the light entrance openings respectively and arranged to direct light passing through the openings onto a focus detection unit, the focus detection unit being arranged to produce an output signal dependent upon the distance from the binoculars of an object being viewed, a pair of oculars which are movable relative to the housing to effect focussing of the binoculars, and moving means arranged to move the oculars in accordance with the output signal from the focus detection unit, the light paths through the light entrance openings to the focus detection unit being independent of the light paths through the binoculars in which the oculars are disposed.

2. Binoculars as claimed in claim 1, wherein the light entrance openings are disposed outwardly of objectives of the binoculars.

3. Binoculars as claimed in claim 1 or 2, further comprising oscillating means operable to oscillate the movable reflector.

4. Binoculars as claimed in claim 3, wherein the oscillating means includes a motor, a cam rotatable by the motor, and a lever having one end thereof engaged with the cam and the other end thereof operatively coupled to the movable reflector.

5. Binoculars comprising a focus detection unit, a movable reflector and a fixed reflector for directing respective light rays towards the focus detection unit, first and second oculars, means for moving the oculars according to a control signal produced by the focus detection unit to focus the binoculars, and first and second light entrance windows for distance metering and arranged to supply light to the mov-

able and fixed reflectors respectively, the light paths through the light entrance windows being independent of the light paths through objectives of the binoculars.

6. Binoculars comprising a pair of objectives, a pair of oculars, a pair of light entrance openings adjacent the objectives respectively, a focus detection unit, a fixed reflector and a movable reflector arranged respectively to direct light passing through the light entrance openings onto the focus detection unit, means operable to oscillate the movable reflector, and means arranged to move the oculars to focus the binoculars in response to a control signal produced by the focus detection unit when images reflected by the fixed and movable reflectors are aligned with each other on the focus detection unit.

7. Binoculars substantially as hereinbefore described with reference to Figures 1 to 4 of the accompanying drawings.

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