

The subject of the present invention is a binocular-type optical device allowing observation by day as well as by night.

5 A few daytime binoculars exist currently which display qualities of compactness by virtue of the use of Porro prisms of the first or second kind, or alternatively Péchan-Schmidt prisms.

10 Likewise, night-vision goggles exist which comprise one or two image-intensifier tubes allowing x 1 magnification vision for driving, tracking or working at night, or night-vision binoculars with greater magnification for night observation.

15 Combining these two functions into a single item of equipment would have obvious advantages for military personnel on operations, these having to carry on them many items of equipment impeding their mobility.

20 However, this would only be so if this day/night vision equipment were to provide a weight and size saving compared to two separate items of equipment and if the performance characteristics of each of the functions were to remain at a level comparable to those of current equipment.

25 According to the Patents WO-A-86/05281 and WO-A-89/04008, day/night binocular-type systems are known which comprise daytime and night observation optical means, part of the respective optical paths being common. Pivoting mirrors, in order to switch between a day path and a night path, are known from Patent DE-A-2,054,387. However, no possibility of two-path binocular daytime vision associated with single-path binocular night vision is known.

35 The present invention relates to such a system, allowing, by virtue of a novel mechanical optical device, reconciliation, within a single compact and lightweight item of equipment, meeting all the required military constraints (mechanical strength, sealing, etc.), of daytime observation and night vision, this being achieved by combining a double-objective daytime system with a single-objective system for night vision, both systems

interacting respectively with a binocular system.

The device which is the subject of the present invention is characterized in that it is structurally constituted by a central body containing optical components, an objective, an intensifier tube and a collimator, which are necessary for night observation and, mounted so as to rotate on the said central body, two lateral bodies each containing, on the one hand, an objective part and an image-righting prism system which are necessary for daytime observation and, on the other hand, an eyepiece part common to the daytime and night observation means and, finally, deflecting mirrors and a focusing unit which are necessary for night vision.

According to a preferred embodiment of the invention, the central body of the day/night observation optical device comprises two lateral holes substantially facing each other, one of the holes, which has a substantially circular shape in projection, cooperating, in superposition, with a hole of corresponding shape made in a lateral body fixedly joined to the central body, while the other hole, of oblong shape, in the central body cooperates with a circular hole made on a lateral body mounted so as to rotate on the said central body.

The said central body contains the night objective, the intensifier tube and the collimator, while each lateral body comprises a daytime objective, a righting prism, an eyepiece common to night and daytime vision, a lateral deflecting mirror, a focusing unit and a central deflecting mirror.

Mechanical switching and retracting means allow the change from daytime observation to night observation and vice versa. They are constituted by a ring that is mounted so as to rotate on the central body and is capable of also being shifted in translation so as, by means of an internal linkage system, to communicate an appropriate rotation to the lateral deflecting mirrors

- in order to intercept the light beams coming from the night observation optical means and to direct them to the eyepiece means in the lateral bodies, in

night-observation mode,

- and to retract these mirrors, thus allowing the light rays coming from the objective means, in daytime-observation mode, to pass through directly. These means
5 also allow, by reverse translation, the said mirrors to be appropriately positioned and the tube intensifier to be switched on.

The invention is furthermore noteworthy as regards the following points:

- 10 - the linkage system for controlling each mirror is constituted by a transmission bar provided, at one end, with a pin snapped into a peripheral groove in the ring, capable of translationally driving the transmission bar without preventing rotation of the ring, and of an
15 end stud engaging with a corresponding notch on a disc;
 - the mirrors are mounted directly on the discs;
 - the discs engage with structure [sic] driving mirrors, which are fixedly joined to them, in a pivoting motion;
- 20 - the discs are acted upon in the locked-in position by means of elastic means, for example springs;
 - the mechanical means are actuated automatically by motor means associated with a photoelectric cell;
 - the ring has an internal threaded structure
25 that engages with a corresponding structure of the body 1 so that, when rotating, it can impart an appropriate translational motion to the control rods;
 - the prism systems are Porro-prism or Péchan-Schmidt-prism systems, or any system allowing appropriate
30 inversion for daytime-vision binoculars.

Other advantages and features of the invention will appear on reading the following non-limiting description of preferred embodiments of the invention, with reference to the appended drawings, in which:

35 Figure 1 is a perspective view of the day/night observation device of the present invention;

Figure 2 is a diagrammatic view of the arrangement of the various elements inside the device of Figure 1, according to a first embodiment;

Figure 3 is a diagrammatic view of the elements constituting the optical device of Figure 1, according to a second embodiment; and

Figure 4 is a diagrammatic view of the mechanical means allowing retraction, by rotation, of the system of movable deflecting mirrors.

As depicted in Figure 1, the optical device according to the present invention comprises a central body 1 which accommodates the night objective 2 and, as depicted in Figure 2, the intensifier tube 3 and the collimator 4. Provided on each side of the central body 1 are two lateral bodies 6 and 7, each comprising an objective 8, 9, a Porro-prism device 10a, 10b; 11a, 11b, an eyepiece device 12, 13, a lateral deflecting mirror 14, 15, a focusing unit 5c, 5d and a central deflecting mirror 5a, 5b. The body 6 is mounted so as to pivot on the body 1, while the body 7 is fixedly joined to the body 1, this choice not being absolutely critical: it is possible to envisage a reverse arrangement with respect to the axis of the central body 1, carrying out the interpupillary adjustment in the same way. In order to allow interpupillary adjustment, the central body 1 is provided with an oblong hole 1a (depicted by the broken lines in Figure 1) cooperating with a hole of substantially circular shape (not depicted in the drawing) provided on the lateral body 6. Limit stops (not depicted in the drawings) allow the rotation of the body 6 with respect to the body 1 to be limited to an angle of approximately 45°.

The equipment is sealed in this region, between the central body 1 and the lateral body 6, by an O-ring seal placed in a groove surrounding the oblong hole 1a, on which O-ring seal that portion of the cylindrical surface of the lateral body 6 in contact with the cylindrical central body 1 slides.

The mirrors 14, 15 are retractable so as to provide night vision in an active position (broken lines) and daytime vision in the other, retracted, position (solid line), allowing in this case the light beams

coming from the righting prisms 10a, 10b, 11a, 11b to pass directly to the eyepieces 12, 13.

In the embodiment of Figure 3 are also depicted the same elements constituting the device of Figure 2, except that the Porro-prism devices 10a, 10b; 11a, 11b are replaced with Péchan-Schmidt-prism devices 16a, 16b; 17a, 17b. Obviously, other embodiments with prisms or other means of righting the image may be used in the optical device according to the present invention.

Figure 4 depicts the device allowing retraction of the mirrors 14, 15. This device includes a ring 18 having an external peripheral groove 18a in which are housed the end studs 19a; 20a of the corresponding rods 19; 20, the other end zone of which bears studs 19b; 20b, the free end of which engages with a hollowed structure 21a; 22b made on the periphery of the discs 21; 22 which are acted upon respectively in the locked-in positions depicted by the broken lines by the action of a spring 23; 24 respectively, as a function of the translational motions of the rods 19; 20.

The optical device according to the present invention can operate according to the daytime and night optical paths in the following way:

As depicted in Figure 2, when the mirrors 14 and 15 are positioned as depicted by the broken lines, the light beam, after having passed through the objective 2 and then having been intensified in the tube 3, reaches a collimator 4 where it is split by a system of mirrors 5a, 5b and then treated respectively by the focusing units 5c, 5d. The two resulting beams end up at the mirrors 14 and 15 which direct them, via the eyepiece devices 12, 13, as far as the observer's eyes, represented by E_1 , E_2 . In this translational position of the ring 18, the tube 3 is obviously switched on, for example by a microswitch placed in the vicinity of one of the discs 21 or 22, on which is made locally a flat closing off the microswitch for the night-operation position of the disc. It may be seen that this position of the mirrors 14, 15 (in the broken lines) cuts off the

photon beams coming from the objectives 8, 9 and passing via the Porro-prism devices 10a, 10b; 11a, 11b or else Péchan-Schmidt-prisms 16a, 16b; 17a, 17b towards the respective eyepieces 12, 13.

5 If it is desired to change into the position for daytime observation, the ring 18 is subjected to a translational motion in the opposite way to that necessary for positioning into night observation, so that the respective mirrors 14, 15 are positioned as depicted by
10 the solid lines in Figure 2. These mirrors 14 and 15 are appropriately mounted on the discs 21 and 22 or else on pivoting structures (not depicted in the drawings) engaging respectively with the discs 21 and 22. The
15 position of the discs, which is depicted in Figure 4, is an intermediate position in which the disc may be locked-in by the action of the corresponding springs 23 or 24 in the positions P_1 and P_2 depicted by way of indication by the broken line in the drawing. It may be seen that the motion of the ring 18 communicates, by means of the pins
20 19a, 20a of the corresponding actuating rods 19 and 20 which engage via studs 19b, 20b with the discs 21, 22, a rotational motion to the said discs, forcing them to adopt, under the action of the springs 23 and 24, the aforementioned positions P_1 and P_2 which correspond,
25 respectively, to retraction or else repositioning of the mirrors 14 and 15.

Therefore, a certain number of operations and adjustments for use, which are capable of being carried out easily even if the observer is wearing thick gloves,
30 are resolved according to the present invention:

- the interpupillary adjustment is made by angularly positioning the lateral body 6 of the binoculars with respect to the central body 1, thus allowing very accurate adjustment indispensable for daytime vision
35 because of the small size of the exit pupils;

- the respective focusing operations of the night objectives and the eyepieces is [sic] made by rotating notched rubber rings attached to these eyepieces;

- the day/night switching, as well as the

switching-on of the infrared diode provided for auxiliary illumination are respectively carried out by translation and rotation of the notched ring 18, independently of the relative angular position of the lateral bodies corresponding to a given interpupillary adjustment.

It is obvious that the invention is in no way limited to the embodiments described hereinabove with reference to the appended drawings, but that it encompasses all modifications and variants within the scope of the person skilled in the art. Thus it is possible to perform concomitant rotation and translation of the ring 18 by an appropriate thread on the internal surface of the ring 18 and on the bearing surface of the body 1. Likewise, it is also possible to envisage the incorporation of a mini-motor controlled by a photo-electric cell and allowing the discs bearing the mirrors 14 and 15 to move rotationally as a function of the ambient brightness. The binocular-device bodies may, moreover, be manufactured from any material meeting the mechanical requirements and the requirements of resistance to chemicals and to foul weather that the optical device of the invention might be exposed to. The invention finds all kinds of surveillance applications (police, customs, guarding, etc.). It also finds application for military purposes and the day/night observation optical device may be fixed by means of suitable strapping devices to an infantryman's helmet.

CLAIMS



1. Binocular-type optical device allowing observation by day as well as by night, comprising:

- optical means (8, 10a, 10b; 16a, 16b; 9, 11a, 11b; 17a, 17b) allowing daytime observation

- optical means (2, 3, 4, 5a, 5c; 5b, 5d; 14; 15) allowing night observation, these means having a part (12; 13) common to the daytime observation means and

- mechanical means (18) allowing the change from daytime observation to night observation,

characterized in that it is structurally constituted by a central body containing optical components, an objective (2), an intensifier tube (3) and a collimator (4), which are necessary for night observation and, mounted so as to rotate on the said central body (1), two lateral bodies (6, 7) each containing, on the one hand, an objective part (8; 9) and an image-righting prism system (10a, 10b, 11a, 11b; 16a, 16b, 17a, 17b) which are necessary for daytime observation and, on the other hand, an eyepiece part (12; 13) common to the daytime and night observation means and, finally, deflecting mirrors (14, 15) and a focusing unit (5c, 5d) which are necessary for night vision.

2. Device according to Claim 1, characterized in that the central body comprises two lateral holes substantially facing each other, one of the holes, which has a substantially circular shape in projection, cooperating with a hole of corresponding shape made in the lateral body (7) fixedly joined to the central body (1), while the other oblong hole (1a) in the central body (1) cooperates with a circular hole provided on the second lateral body (6).

3. Device according to either one of Claims 1 and 2, characterized in that the mechanical means allowing the change from daytime observation to night observation and vice versa are constituted by a ring (18) that is mounted on the central body (1) of the optical device and is



capable of being shifted in translation so as, by means of a control linkage system (19a, 19, 19b; 20a, 20, 20b), to communicate an appropriate rotation to the said deflecting mirrors (14, 15) which, in their functional position, allow night observation, while, in their retracted position, they allow daytime observation.

4. Device according to Claim 3, characterized in that the linkage system for controlling each deflecting mirror (14; 15) is constituted by a transmission bar (19; 20) provided, at one end, with a pin (19a; 20a) snapped into a peripheral groove (18a) in the ring (18) and an end stud (19b; 20b) engaging with a corresponding notch (21a, 22b) on a disc (21, 22).

5. Device according to Claim 4, characterized in that the mirrors (14, 15) are mounted directly on the discs (21, 22).

6. Device according to Claim 4, characterized in that the discs (21, 22) engage with structures driving the said deflecting mirrors (14, 15), which are fixedly joined to them, in a pivoting motion.

7. Device according to any one of Claims 4 to 6, characterized in that the discs (21, 22) are acted upon in the locked-in position (P_1 ; P_2) by means of elastic means, for example springs (23; 24).

8. Device according to Claim 1, characterized in that the mechanical means (18) are actuated automatically by motor means associated with a photoelectric cell.

9. Device according to Claim 1, characterized in that the ring (18) has an internal threaded structure that engages with a corresponding structure of the body 1 so that, when rotating, it can impart an appropriate translational motion to the control rods (19; 20).

10. Device according to Claim 1, characterized in that the said prism system is a Porro-prism or Péchan-Schmidt-prism system, or any system allowing appropriate inversion for daytime-vision binoculars.