US 20140340669A1

(19) United States

(12) Patent Application Publication

Dobschal et al.

(10) Pub. No.: US 2014/0340669 A1

(43) Pub. Date: Nov. 20, 2014

(54) UNKNOWN

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(21) Appl. No.: **14/260,398**

(22) Filed: **Apr. 24, 2014**

Related U.S. Application Data

(60) Provisional application No. 61/816,963, filed on Apr. 29, 2013.

(30) **Foreign Application Priority Data**

Apr. 29, 2013 (DE) 102013207852.8

Publication Classification

(51) **Int. Cl.**

G01S 17/08	(2006.01)
G01S 7/481	(2006.01)
G01S 7/51	(2006.01)
G02B 5/18	(2006.01)
G02B 5/32	(2006.01)

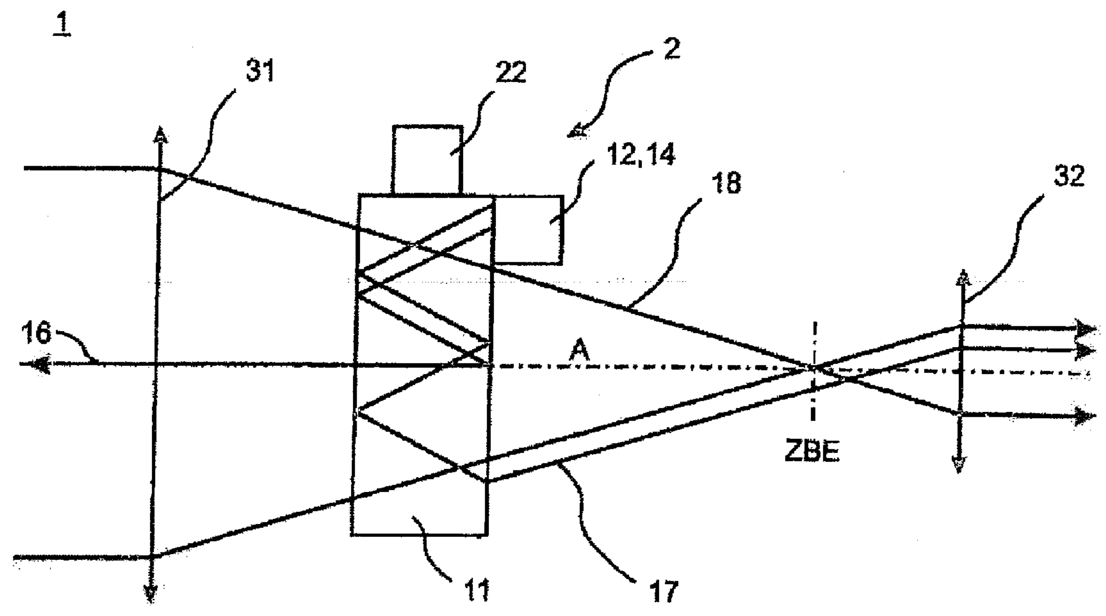
(52) **U.S. Cl.**

CPC . ***G01S 17/08*** (2013.01); ***G02B 5/18*** (2013.01); ***G02B 5/32*** (2013.01); ***G01S 7/51*** (2013.01); ***G01S 7/481*** (2013.01)

USPC **356/4.01**; 356/3

(57) **ABSTRACT**

A long-range optical instrument comprises at least one observation beam path and an apparatus for laser ranging comprising at least one transmission apparatus with a transmission beam path and at least one reception apparatus with a reception beam path, moreover comprising an image rendering unit. The transmission beam path of the transmission apparatus and/or the reception beam path of the reception apparatus are combined using at least one optical support element for superposition with the at least one observation beam path. The image rendering unit generates the light of an image to be superposed and likewise guides said light using the at least one optical support element for superposition with the at least one observation beam path. Moreover, for beam shaping and/or beam guidance, at least one diffractive optical coupling element is arranged at the optical support element in the transmission beam path and/or in the reception beam path.



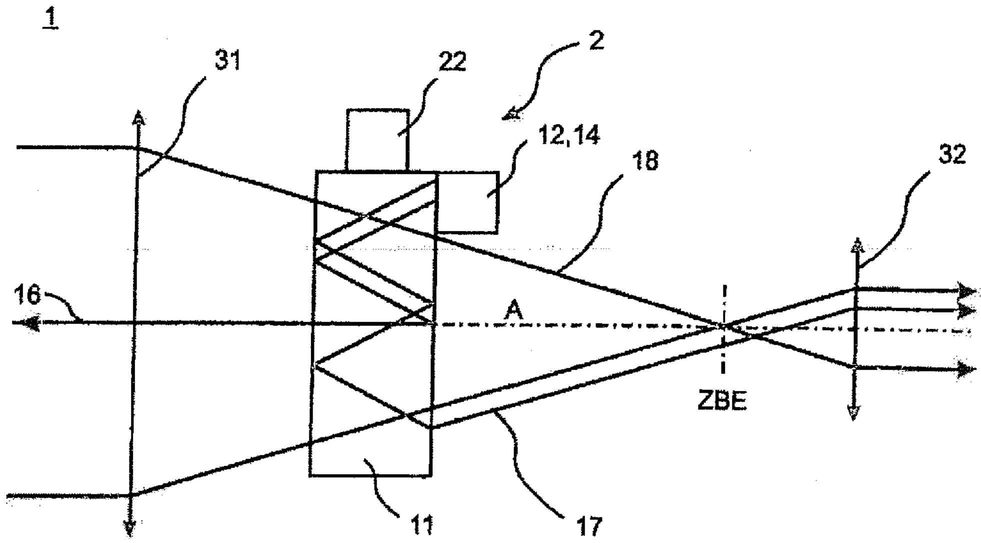


Fig. 1

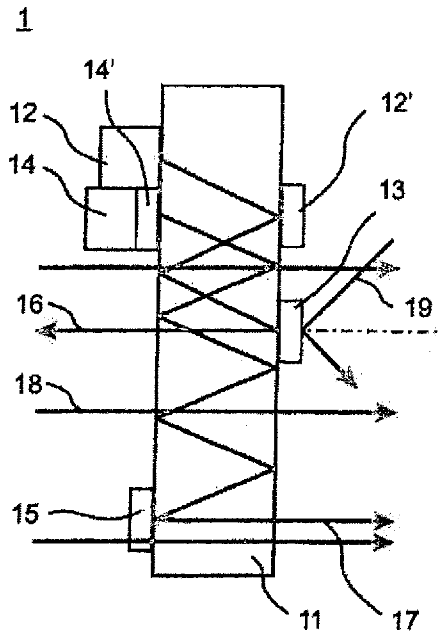


Fig. 2

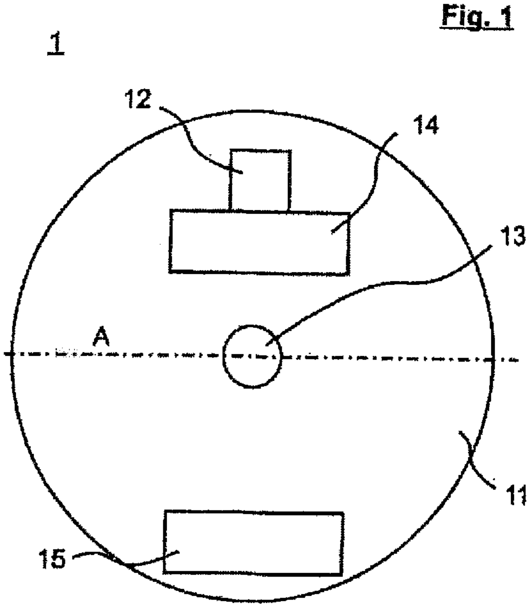


Fig.2a

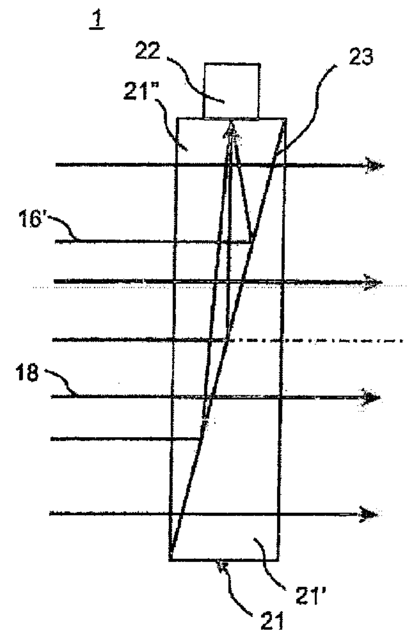


Fig. 3

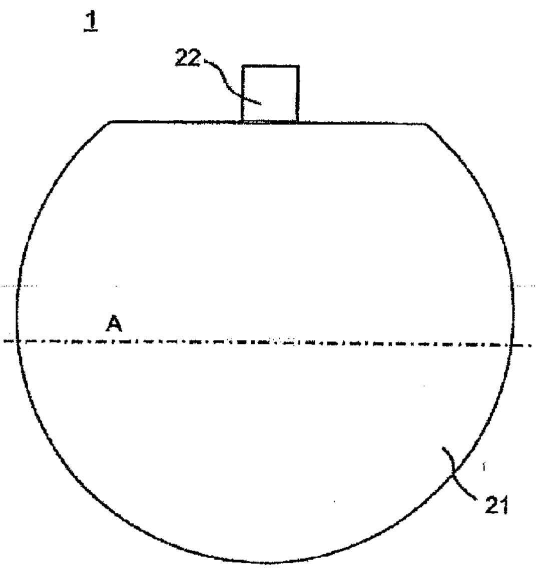


Fig. 3a

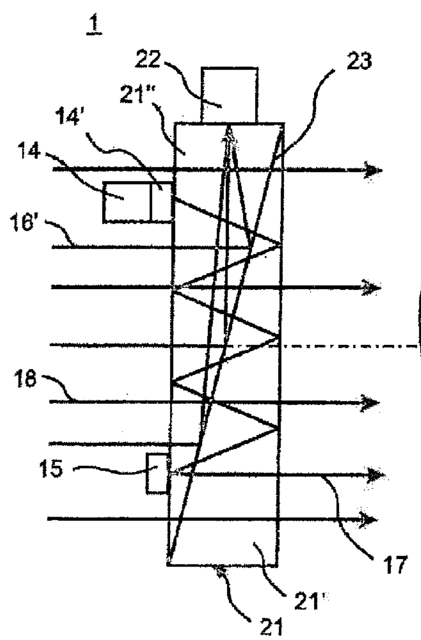


Fig. 4

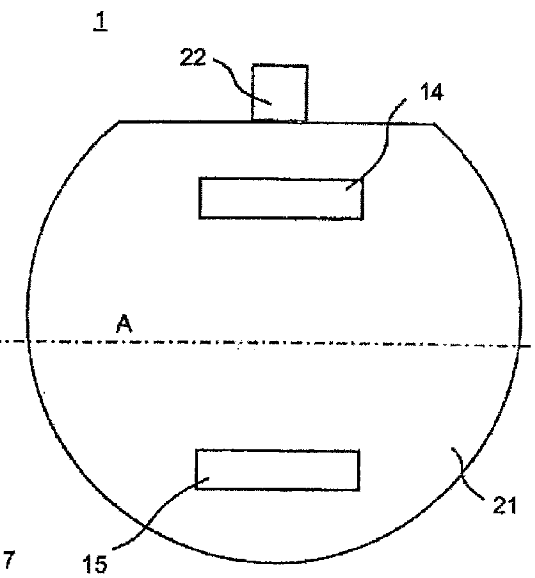


Fig. 4a

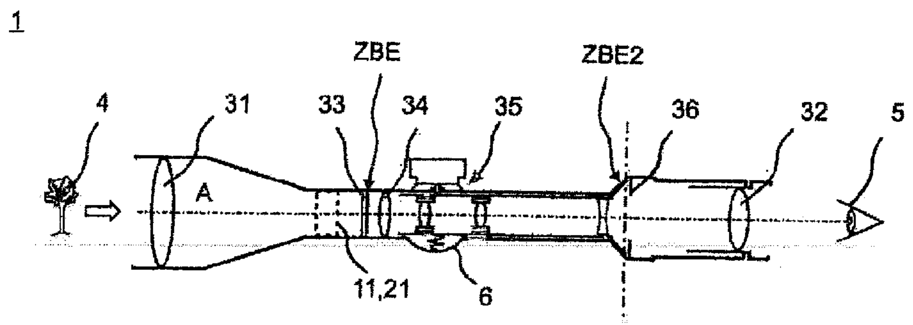

1
ZBE
ZBE2
4
31
33
34
35
36
32
5
A
11,21
6

Fig. 5

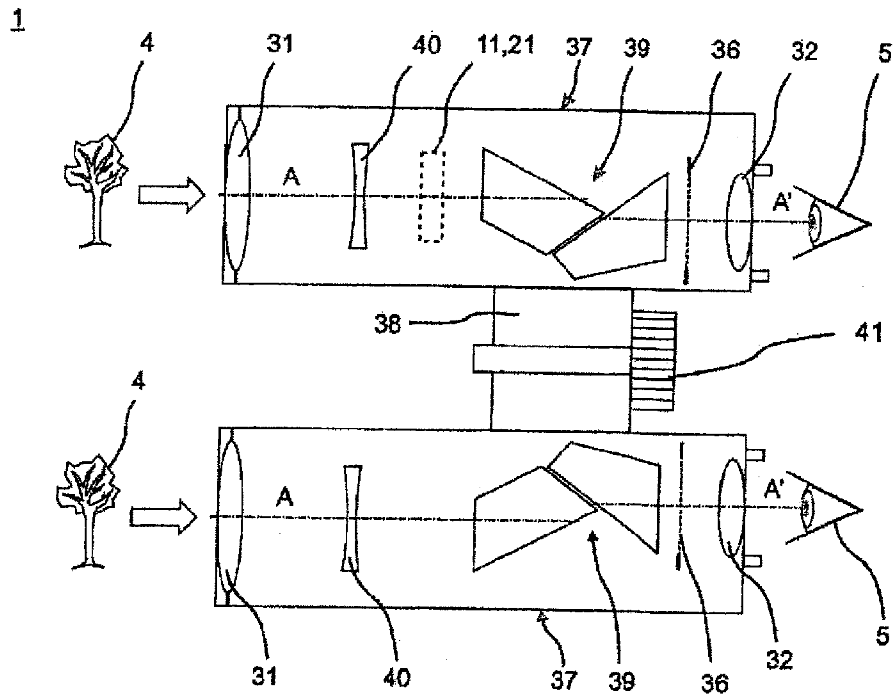

1
4
31
40
11,21
37
39
36
32
5
A
A'
38
41
4
A
A'
31
40
37
39
36
32
5

Fig. 6

UNKNOWN

[0001] The invention relates to a long-range optical instrument comprising at least one observation beam path and comprising an apparatus for laser ranging, in accordance with the preamble of claim **1**.

[0002] Known optical observation instruments with separate laser ranging optical units already have compact housings in order to accommodate the corresponding additional beam paths. The optical systems are adapted to the instrument geometry by using diffractive optical elements which require little installation space, for example diffraction gratings.

[0003] Document DE 10 2007 007 380 B4 describes binocular field glasses with a folding bridge, two observation beam paths and means for laser ranging. For the purposes of laser ranging, there is a transmission apparatus with a transmission beam path and a reception apparatus with a reception beam path, which are both arranged outside of the two observation beam paths. Here, the transmission apparatus and the reception apparatus are each housed in separate housing parts of the field glasses, separately from the two observation beam paths. The transmission apparatus and reception apparatus are arranged in the region of a central axis of the folding bridge and, as a result thereof, are movable relative to one another. There is at least one diffractive optical element for beam shaping purposes.

[0004] Furthermore, document DE 10 2008 059 892 A1 has disclosed a device for superimposing an image into the beam path of a sighting optical unit. To this end, an optical support element, at least partly transmissive to light, comprising a diffractive optical coupling-in element and decoupling element, is arranged in the beam path of the sighting optical unit.

[0005] It is an object of the invention to develop a long-range optical instrument in terms of the compactness and performance thereof.

[0006] According to the invention, this object is achieved by the features specified in claim **1**. The further dependent claims relate to advantageous embodiments and developments of the invention.

[0007] The invention includes a long-range optical instrument, comprising at least one observation beam path and comprising an apparatus for laser ranging comprising at least one transmission apparatus with a transmission beam path and at least one reception apparatus with a reception beam path, moreover comprising an image rendering unit. The transmission beam path of the transmission apparatus and/or the reception beam path of the reception apparatus are combined by means of at least one optical support element for superposition with the at least one observation beam path. The image rendering unit generates the light of an image to be superposed and likewise guides said light by means of the at least one optical support element for superposition with the at least one observation beam path. Moreover, in particular for beam shaping and/or beam guidance, at least one diffractive optical coupling element is arranged at the optical support element in the transmission beam path and/or in the reception beam path.

[0008] Here, the invention is based on the consideration that, as means of the apparatus for laser ranging, suitable diffractive optical coupling elements are used in conjunction with the transmitting objective, both for decoupling and beam shaping of the strongly astigmatic emission of a semiconductor laser, which may have a laser facet as luminous surface. Moreover, such coupling elements can serve for wavelength selection or beam splitting. The coupling elements are likewise employed to collect the IR laser light, scattered back from a scene, by means of the receiving objective and also to reproduce the display for indicating a distance of an object in the field of vision of a user.

[0009] The light transport in the support element is brought about by total internal reflection. In order to excite these light paths by the display or the IR laser, it may be necessary to provide transmission or reflection gratings, which can additionally be used for imaging or beam shaping. In principle, coupling-in and decoupling are functionally independent from one another.

[0010] A particular advantage of the invention lies in the solution that can be implemented in a cost-effective way and is based on imaging diffractive structures. This substantially develops a long-range optical instrument in terms of the compactness and performance thereof.

[0011] In a preferred configuration of the invention, the at least one diffractive optical coupling element can be embodied as transmission grating or as reflection grating. The light to be coupled-in enters the optical support element by diffraction, in which optical support element it is, in the further course, subjected to total internal reflection up to the decoupling point. In the case of more complex designs, both types of grating may be combined with one another, depending on usage purpose.

[0012] Advantageously, the optical support element can be a plane plate preferably formed from glass. The light can be carried forward by total internal reflection between the side faces of the plane plate. The additional diffractive optical coupling elements can, as a matter of routine, be attached well to the glass plate.

[0013] In a preferred configuration, the at least one diffractive optical coupling element can be embodied as holographically produced optical element (HOE), for example as sinusoidal grating or hologram. Such coupling elements have a particularly good performance in terms of the coupling efficiency thereof and can be produced more cost-effectively than binary diffraction structures.

[0014] Moreover, in a preferred configuration, the optical support element can be arranged 0.5 to 3 mm, particularly preferably 1 to 2 mm, outside of an intermediate image plane. The support element need not be situated in an intermediate image plane because the then additionally required optical power, which increases with distance from the intermediate image plane, can then be caused by the respective imaging diffractive element.

[0015] Moreover, the at least one diffractive optical coupling element can advantageously be employed for imaging and beam shaping; by way of example, a cylindrical laser beam can be converted into a circular cross-section. In this case, diffractive optical elements enable solutions which cannot be realized, or can only be realized with great difficulty, using refractive processes, e.g. line-shaped or circular illuminations.

[0016] Preferably, at least one diffractive optical coupling element for the transmission beam path can be embodied as circular ring-shaped or open square reflection grating, which is arranged at the optical support element in the region of the optical axis in the observation beam path.

[0017] Moreover, the circular ring-shaped optical coupling element can preferably serve as target mark. This structuring would be attractive, in particular because the adjustment of the target mark on the light path of the IR transmission laser in the transmission beam path parallel to the optical axis is dispensed with due to the mutually coupled functionality.

[0018] In a preferred configuration of the invention, the optical support element can be embodied as beam splitter with two prisms, between which a diffractive optical coupling element is arranged for coupling-in purposes. Here, a volume hologram, which is introduced in an extended polymer layer, typically with a thickness between 0.1 and 1 mm, between the two prisms, is particularly preferred. The above-described coupling-in renders a balance between the diffraction efficiencies for the light paths in the reception beam path and in the observation beam path necessary, the latter in the zeroth order of diffraction. The balancing is necessary since, firstly, each IR photon, emitted by the semiconductor laser, is required for the laser ranging or each lacking photon reduces the range of the ranging. Secondly, it should be noted that there is the smallest possible impairment of the observation beam path. This balancing is simplified by using a volume hologram. In this case, it is also possible to use two prisms made of the same material.

[0019] Alternatively, the diffractive optical coupling element can advantageously be structured in one of the prisms and cemented to the other prism. However, in this case, the optical design of the diffractive optical coupling element is, due to the smaller refractive index difference, under greater strain, for example as a result of more strongly refractive structures, which makes the aforementioned balancing more difficult.

[0020] In a preferred embodiment, the optical coupling element can have a whole-area embodiment in the beam splitter. Whole-area coupling-in supports the required balance between the diffraction efficiencies for the light paths in the reception beam path and in the observation beam path, since a possible reduction in the transmission is not noticed by the user due to a lack of pronounced contrast differences.

[0021] Moreover, in a preferred configuration of the invention, the at least one reception apparatus can have an avalanche photodiode. Such photodiodes are particularly suitable for detecting very small light intensities, down to individual photons.

[0022] Advantageously, the optical coupling element in the beam splitter can contain an imaging function, which brings about focusing of the deflected laser light onto the avalanche photodiode.

[0023] In a preferred configuration, the long-range optical instrument can be embodied as binocular field glasses with two observation beam paths. The entire measurement apparatus for laser ranging, comprising transmitter, receiver and display, or else only a part thereof, may be installed in each of the observation beam paths.

[0024] Alternatively, the long-range optical instrument can be embodied as telescopic sight with one observation beam path. In this case, the entire measurement apparatus for laser ranging is housed in conjunction with the only available observation beam path.

[0025] Further advantageous developments and configurations of the invention emerge from the exemplary embodiments, described in principle in the following text on the basis of the drawings.

[0026] In detail:

[0027] FIG. **1** shows a schematic beam path in one channel of the long-range optical instrument;

[0028] FIG. **2** schematically shows the light decoupling;

[0029] FIG. **2***a* shows a front view of the associated optical support element for FIG. **2**;

[0030] FIG. **3** schematically shows the coupling-in of laser light;

[0031] FIG. **3***a* shows a front view of the associated optical support element for FIG. **3**;

[0032] FIG. **4** schematically shows the coupling-in of laser light in combination with an image rendering unit;

[0033] FIG. **4***a* shows a front view of the associated optical support element for FIG. **4**;

[0034] FIG. **5** schematically shows a telescopic sight as long-range optical instrument; and

[0035] FIG. **6** schematically shows binocular field glasses as long-range optical instrument.

[0036] FIG. **1** schematically shows the path of all relevant beams in one channel of the long-range optical instrument **1**. A double telescope has two such channels; a telescopic sight merely has one channel. The means for laser ranging **2** are arranged outside of an intermediate image plane. The coupling elements (not depicted in any more detail in FIG. **1**) for the transmission beam path **16** and the image rendering beam path **17** can be embodied as imaging diffractive optical coupling elements. On the optical support element **11**, there is, on one side, an IR laser as transmission apparatus **12** and an image rendering unit **14** and, on another side, an avalanche photodiode as reception apparatus **22**. The optical support element **11** is configured as a plane-parallel glass plate. The objective **31** images an object at infinity in the intermediate image plane ZBE, in which it is observed by the user by means of the eyepiece **32**. The objective **31** may contain a focusing device, which images, in focus, an object at a finite object distance in the intermediate image plane ZBE and, simultaneously, focuses the transmission beam path at the object distance. For reasons of clarity, respectively only one individual ray is depicted, as representative for the IR transmission beam path **16** and the image rendering beam path **17**, from those beams which are decoupled from the instrument. The rays that are coupled into the instrument and reach the avalanche photodiode **22** have not been depicted. The optical axis of the decoupled laser extends parallel to the optical axis A of the observation beam path **18**. In this figure, and in the subsequent figures, the beam paths are to be understood schematically and may be exemplary.

[0037] FIG. **2** shows the light decoupling in the case of long-distance optical instrument **1** and, in FIG. **2***a*, the front view of the associated optical support element **11** for FIG. **2**. Situated on the optical support element **11**, which is embodied as glass plate, there is the laser for ranging as transmission apparatus **12** and the display for indicating the distance as image rendering unit **14**. If the glass plate is not situated in the intermediate image plane ZBE, a transmission grating **14'**, as diffractive optical coupling element, can be arranged upstream of the image rendering unit **14**. This renders it possible to generate an image which, together with the eyepiece following to the right-hand side (not depicted in FIG. **2**), images the display of the image rendering unit **14** at infinity. The reflection grating as decoupling element **15** for the image rendering beam path can further support this imaging. All diffractive coupling elements, with the exception of the transmission grating **14'**, are drawn as reflection gratings here and in the following images. When adapting the beam profile, the same function can also be achieved by means of transmission gratings. The decision as to whether an opaque reflection grating or a transparent transmission grating is used is made by the application.

[0038] The light path in the transmission beam path **16** for the IR transmission laser **12** works completely analogously to the just described image rendering beam path, except for that the luminous laser facet is imaged at infinity by the objective **31**. The conventionally employed laser diodes have a pronounced elliptical beam profile with very different divergence angles in mutually perpendicular directions. This (double) astigmatism can also be reduced, or even removed, by a suitable design of the reflection grating as coupling element **12'** and of the reflection grating as decoupling element **13** for the transmission beam path **16** downstream of the IR transmission laser **12**. Moreover, this renders it possible to generate the required additional optical power in the case where the optical support element **11** is not situated in the intermediate image plane. For the mentioned astigmatism correction, a reflection grating, as depicted, is to be preferred over a transmission grating, since the greater distance from the light source simplifies the correction.

[0039] In order to achieve the reflection effect, the reflection gratings **12'** and **13**, as coupling elements, are preferably coated by chromium or another metal, which can then act as a mirror in two directions. The sketched reflection grating as decoupling element **13** for the transmission beam path **16** therefore has an additional advantageous property. Provided that, in the case of e.g. a telescopic sight, the laser is adjusted relative to the glass plate in such a way that the optical axis of the decoupled laser is situated parallel to the optical axis of the sighting optical unit, the reflection grating **13** constitutes a target marker, which can also be depicted in an illuminated manner by simple measures. This is intended to be indicated schematically by the illumination beam path **19**, which could be realized from the rear side by oblique illumination by a light-emitting diode (not depicted in FIG. **2**).

[0040] If the efficiency of the decoupling of the laser is of secondary importance, the target marker formed by the reflection grating **13** can also be structured, for example in the shape of a circular ring or an open square.

[0041] FIG. **3** schematically shows the coupling of laser light into a long-range optical instrument **1** and, in FIG. **3***a*, the front view of the associated optical support element **21** for FIG. **3**. The optical support element **21** is designed like a beam splitter, which consists of a first prism **21'** with a low refractive index and a second prism **21"** with a high refractive index. An optical coupling element **23** (imagined over the whole area here), which deflects the incident IR photons in the reception beam path **16'** at a suitable angle, is situated between the prisms **21'**, **21"** in the beam splitter. Moreover, this diffractive optical coupling element **23** contains an imaging function, which leads to the focusing of the deflected IR light on the avalanche photodiode **22**. This procedure increases the efficiency of the detection. It is furthermore advantageous in the case of this arrangement that the avalanche photodiode **22** preferably or only registers IR photons diffracted at the grating, without being impaired by interfering photons from the visible spectral range, since the latter are deflected according to the law of refraction and are not focused either and therefore miss the avalanche photodiode **22**.

[0042] The lack of an otherwise conventional dichroic beam splitter layer, which would be evaporated onto the side faces of one of the prisms **21'**, **21"**, is furthermore advantageous. This beam splitter would be polarization sensitive due to the angle of incidence thereof deviating from zero degrees, which would make the design thereof substantially more difficult and therefore would lead to a complicated and expensive coating. Additionally, the grating can be designed in such a way that there is no undesirable reduction in transmission or discoloring for the observation beam path **18**, which would only be possible to a restricted extent by means of a dichroic beam splitter.

[0043] The beam path in FIG. **3** schematically shows the particularly preferred case, mentioned above, in which the prisms **21'** and **21"** consist of the same material. In this case, the diffractive coupling element is to be imagined as volume hologram in an extended polymer layer (not depicted in any more detail in FIG. **3**), which polymer layer simultaneously acts as optical cement. As was already mentioned previously, this functionality can also be achieved with different prism materials, as long as certain disadvantages are accepted.

[0044] FIG. **4** schematically shows the coupling-in of laser light in combination with an image rendering unit in a long-distance optical instrument **1** and, in FIG. **4***a*, the front view of the associated optical support element **21** for FIG. **4**. Here, the optical support element **21** is once again designed like a beam splitter, which consists of a first prism **21'** with a low refractive index and a second prism **21"** with a high refractive index. Between the prisms **21'**, **21"** in the beam splitter, there once again is an optical coupling element **23**, which deflects the incident IR photons in the reception beam path **16'** at a suitable angle in the direction of the avalanche photodiode **22**. Consequently, analogously to the circumstances in FIG. **3**, the arrangement in FIG. **4** and FIG. **4***a* is now complemented by a display for indicating the distance as an image rendering unit **14**. If the optical support element **21** is not situated in the intermediate image plane, a transmission grating **14'** as diffractive optical coupling element is arranged upstream of the image rendering unit **14** for imaging purposes. The reflection grating as decoupling element **15** for the image rendering beam path **17** can in turn further support this imaging. FIG. **4** contains all options which were already discussed in FIGS. **2** and **3** and is conceived for explaining that the principles of decoupling (FIG. **2**) and coupling-in (FIG. **3**) can be combined by means of a more complex support plate.

[0045] FIG. **5** schematically shows a telescopic sight as long-range optical instrument **1**. It comprises a tube, which has piecewise different diameters, and contains an optical system. The optical system consists at least of the objective **31**, depicted in FIG. **5**, a lens-erecting system with zoom members **35**, a field lens **34**, a reticle **33** and an eyepiece **32**. The objective **31** is situated in a front, usually thickened, region. The objective **31** can also be built from a plurality of individual lenses or cemented members (not depicted in detail in FIG. **5**). The objective **31** generates a real image, which is upside down relative to the observance object **4**, in a first image plane, the intermediate image plane ZBE, conjugate to the object **4**. In the present exemplary embodiment, the reticle **33** is arranged in the region of the intermediate image plane ZBE. The lens-erecting system with zoom members **35** as adjustable optical elements is situated in a central region, which is often referred to as center tube. At least one external adjustment tower **6**, by means of which the optical properties of the optical system, or a target line defined by the reticle **33**, can be adjusted, can also be situated there. The lens-erecting system erects the upside-down image and images the latter in a new image plane, the second image plane, with a certain linear magnification. In a further exemplary embodiment (not depicted here), the reticle **33** can also be arranged in the region of a second image plane or intermediate image plane ZBE**2**. If the lens-erecting system contains at least two axially displaceable zoom members **35**, these also satisfy the object of making the overall magnification of the image, perceived by the user, continuously selectable in a mechanically restricted region. The eyepiece **32** is arranged in a rear, usually thickened, region. For the purposes of focusing an object **4** observed through the telescopic sight, or for an adaptation to the defective vision of the user, the eyepiece **32** can be displaced axially.

[0046] In the region of the first image plane ZBE, the optical support element **11**, **21**, indicated by a dashed line, can be arranged with further apparatuses for laser ranging with the transmission apparatuses and the reception/rendering apparatuses (not depicted in detail in FIG. **5** for reasons of clarity).

[0047] The eyepiece **32** images the image of the second image plane at any distance or serves to focus on the reticle **33**. Depending on the magnification setting, a visual field stop **36**, near the second image plane ZBE**2**, restricts the subjectively perceived visual field. A telescopic sight can moreover contain further optical components, (not depicted in FIG. **5**) such as e.g. a reticle illumination, a beam coupling-in or decoupling means for ranging or apparatuses for photographic recordings. There can likewise be electronic components, sensors, operating elements or energy storage units, which are required for the aforementioned purposes.

[0048] In FIGS. **5** and **6**, functionally equivalent elements have been provided with the same reference signs.

[0049] FIG. **6** schematically shows binocular field glasses as long-distance optical instrument **1**, which have two tubes **37** arranged parallel to one another, which each contain an optical system. In the present case, the tubes **37** are connected to one another by means of at least one two-part bridge **38** with a central axis. Alternatively, they can be fixedly arranged with respect to one another in a common housing (not shown). The eye spacing of a user can be taken into account by an appropriate fold in the case where the at least one two-part bridge **38** is present. In the case of a common housing, the eye spacing of the user can be set by means of e.g. rhombic prisms. The optical system consists of at least one objective **31**, a prism system **39**, a visual field stop **36** and an eyepiece **32**. The objective **31** and the eyepiece each set one optical axis A, A' (see FIG. **5**). The objective **31** can consist of a plurality of individual lenses or cemented members. In order to focus an object **4** observed through the binocular field glasses, it is possible to axially displace either the eyepiece **32** or the whole objective **31**. It is likewise possible to displace a lens group, which is generally arranged between the objective **31** and the prism system **39** and which is referred to as focusing lens **40**. For focusing purposes, a rotary knob **41** can be arranged on the central axis, by means of which rotary knob the focusing lenses **40** can together be displaced axially. In the region between the focusing lens **40** and the prism system **39**, the optical support element **11**, **21** is arranged at least in one of the two tubes **37** with the further apparatuses for laser ranging with the transmission apparatuses and the reception/rendering apparatuses (likewise not depicted in detail in FIG. **6** for reasons of clarity).

[0050] The objective **31** generates a real image, upside down relative to the observed object **4**, in an image plane assigned to the objective **31**. For image-erecting purposes, the prism system **39** can be built according to an Abbe-König, Schmidt-Pechan, Uppendahl, Porro prism system, or another prism system variant. The prism system **39** re-erects the upside-down image and images it in an intermediate image plane. A visual field stop **36**, which abruptly delimits the visual field, is situated in the intermediate image plane.

[0051] The eyepiece **32** serves to image the image of the intermediate image plane at any distance, for example at infinity or at an apparent distance of one meter. A beam direction indicated by the arrow in FIG. **6** is defined by the sequence: object **4**-objective **31**-prism system **39**-eyepiece **32**-eye **5**. The visual field stop **36** can either be formed by a holder of an optical element or else be defined by a separate stop. It can be imaged in a plane by means of the remaining optical system downstream thereof in the beam direction, which plane lies downstream of the eyepiece **32** in the beam direction and typically has a distance therefrom of between 5 and 25 mm.

[0052] Moreover, binocular field glasses can contain further optical components, which, for example, serve for image stabilization, beam coupling-in or decoupling or photographic purposes. There can likewise be electronic components, operating elements or energy storage units, which are required for the aforementioned purposes. Holding devices, on which e.g. a belt for wearing may be fastened, can be situated, usually laterally, on binocular field glasses.

LIST OF REFERENCE SIGNS

[0053] **1** Long-range optical instrument
[0054] **2** Apparatus for laser ranging
[0055] **4** Object
[0056] **5** Eye
[0057] **6** Adjustment tower
[0058] **11** Optical support element, glass plate
[0059] **12** Transmission apparatus, IR transmission laser
[0060] **12'** Reflection grating as coupling element
[0061] **13** Decoupling element for the transmission beam path, reflection grating
[0062] **14** Image rendering unit
[0063] **14'** Transmission grating as coupling element
[0064] **15** Decoupling element for the image rendering beam path, reflection grating
[0065] **16** Transmission beam path
[0066] **16'** Reception beam path
[0067] **17** Image rendering beam path
[0068] **18** Observation beam path
[0069] **19** Light path in the illumination beam path
[0070] **21** Optical support element made of two prisms
[0071] **21'** First prism
[0072] **21"** Second prism
[0073] **22** Reception apparatus, avalanche photodiode
[0074] **23** Optical coupling element in the beam splitter
[0075] **31** Objective
[0076] **32** Eyepiece
[0077] **33** Reticle
[0078] **34** Field lens
[0079] **35** Zoom members
[0080] **36** Visual field stop
[0081] **37** Tube
[0082] **38** Bridge
[0083] **39** Prism system

[0084] **40** Focusing lens

[0085] **41** Rotary knob

[0086] A, A' Optical axes

[0087] ZBE Intermediate image plane, first image plane

[0088] ZBE**2** Second image plane

1-16. (canceled)

17. A long-range optical instrument, comprising:

at least one observation beam path;

a laser apparatus for laser ranging including at least one transmission apparatus with a transmission beam path and at least one reception apparatus with a reception beam path;

at least one optical support element, wherein at least one of: the transmission beam path of the transmission apparatus or the reception beam path of the reception apparatus are combined using the at least one optical support element for superposition with the at least one observation beam path,

an image rendering unit, wherein the image rendering unit generates light of an image to be superposed and guides said light using the at least one optical support element for superposition with the at least one observation beam path; and

at least one diffractive optical coupling element arranged at the at least one optical support element in at least one of: the transmission beam path or the reception beam path.

18. The long-range optical instrument according to claim **17**, wherein the at least one diffractive optical coupling element is embodied as transmission grating or as reflection grating.

19. The long-range optical instrument according to claim **17**, wherein the at least one optical support element is a plane plate.

20. The long-range optical instrument according to claim **19**, wherein the plane plate is made of glass.

21. The long-range optical instrument according to claim **17**, wherein the at least one diffractive optical coupling element is embodied as a holographically produced optical element.

22. The long-range optical instrument according to claim **17**, wherein the at least one optical support element is arranged 0.5 to 3 mm outside of an intermediate image plane.

23. The long-range optical instrument according to claim **17**, wherein the at least one diffractive optical coupling element is employed for at least one of: imaging, beam shaping or beam guidance.

24. The long-range optical instrument according to claim **17**, wherein the at least one diffractive optical coupling element for the transmission beam path is embodied as circular ring-shaped, which is arranged at the at least one optical support element in the region of an optical axis in the beam path.

25. The long-range optical instrument according to claim **24**, wherein the circular ring-shaped optical coupling element serves as a target mark.

26. The long-range optical instrument according to claim **17**, wherein the at least one diffractive optical coupling element for the transmission beam path is embodied as an open square reflection grating, which is arranged at the at least one optical support element in the region of an optical axis in the beam path.

27. The long-range optical instrument according to claim **17**, wherein the at least one optical support element is embodied as beam splitter with two prisms, between which the at least one diffractive optical coupling element is arranged for coupling-in purposes.

28. The long-range optical instrument according to claim **27**, wherein the at least one diffractive optical coupling element is a volume hologram, which is introduced in an extended polymer layer between the two prisms.

29. The long-range optical instrument according to claim **27**, wherein the at least one diffractive optical coupling element is structured in one of the two prisms and cemented to the other of the two prisms.

30. The long-range optical instrument according to claim **27**, wherein the at least one diffractive optical coupling element has a whole-area embodiment in the beam splitter.

31. The long-range optical instrument according to claim **17**, wherein the at least one reception apparatus has an avalanche photodiode.

32. The long-range optical instrument according to claim **31**, wherein the at least one diffractive optical coupling element in the beam splitter contains an imaging function, which brings about focusing of deflected laser light onto the avalanche photodiode.

33. The long-range optical instrument according to claim **17**, wherein the long-range optical instrument is embodied as binocular field glasses with two observation beam paths.

34. The long-range optical instrument according to claim **17**, wherein the long-range optical instrument is embodied as telescopic sight with one observation beam path.

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