

Device for illumination with polarized light

The present invention relates to a device according to the precharacterizing clause of Claim 1 and according to the precharacterizing clause of the independent Claim 2.

It is known that linearly polarized light is required for certain applications. An electrical incandescent lamp, for example, which normally emits unpolarized light can be used to produce linearly polarized light. The light element in the desired polarization direction can be selected with the aid of polarization means, such as a polarizer or a polarization beam splitter (PBS) for example.

Polarized light is used in many fields, such as examining glass bodies for mechanical stresses, for example. In addition to other applications, polarized light can be used for illumination of liquid-crystal displays (LCD), which can also be used as part of a projection system.

Although the present invention will be described with the aid of such an LCD projection system in the following text, it should be mentioned that the lighting system according to the invention is not limited to such applications.

Irradiation with polarized light and a high light yield is required, for example, in the case of projection systems which have so-called liquid-crystal modulators, also called light valves.

Projection systems for displaying colour video signals are known, which projection systems split the light radiation emerging from a light source by means of colour filters, such as dichromatic mirrors, into three spectral bands, for red, green and blue light, and modulate each of them by means of suitable light modulators. The radiation modulated in such a manner is projected by means of a lens system onto a reflection or transmission medium, such as a screen for example, so that the red, green and blue light elements are well



adjusted with respect to one another.

An article by J. Kobayashi et al. in SID 89 Digest, pages 114 to 117 discloses a back-projection television which uses high-definition a-Si TFT-LCD panels as light modulators. A suitable optical system comprising a plurality of mirrors, a panel and projection lenses is likewise specified there.

Furthermore, a display system which is suitable for projection in television and video systems is proposed in European Laid-Open Specification EP 258 927 A2.

This contains at least two light valves. These have the property that individual pixels can be modulated by applying voltages or currents to appropriate connections. If these light valves are irradiated with light from one side and are projected by projection lenses onto a front-projection or back-projection screen, the image which is produced by driving the individual pixels can be made visible.

The said Laid-Open Specification likewise specifies how the efficiency when using polarized light, which is obtained from a lamp by means of a so-called polarization beam splitter, can be improved.

An article by M. Schadt et al. in SID 90 Digest, pages 324 to 326 further discloses a light source for polarized light, which light [sic] uses a so-called cholesteric liquid-crystal filter.

Furthermore, a lighting system which uses two lamps arranged side by side is proposed in EP 258 927 A2.

As a result of the geometry of the emitted light beam, which is normally circular-symmetrical, and the geometry of the rectangular light valves which are to be illuminated and normally have an aspect ratio of 4:3 or 16:9, the lighting systems which are known from the prior art lead to high losses, depending on the aspect ratio.

If it is intended to use polarized light for illumination of the light valves, then the polarization means, for example polarization beam splitters, can advantageously be designed in such a manner that they result in the splitting and deflection of two partial



beams. In the case of a refinement of the invention, in which at least two lamps are used, on the one hand the advantage is achieved that the individual lamps are less severely loaded for the same illumination level of the light valve and, on the other hand, the function of the lighting system is maintained by the other lamp in the event of failure of one lamp.

If lamps having a relatively low rated power are used, the advantage is furthermore achieved that they have a greater degree of light focusing. This leads to a smaller illuminated area and thus to lower losses.

Furthermore the focusing means which focus the light from a lamp can be designed in such a manner that they are used as deflection means for a partial beam from at least one further lamp. In consequence, additional means can be saved and the light yield can be increased.

The light yield of the device according to the invention can be further increased by additional focusing means, such as lens systems for example.

The service life of the system and its long-term efficiency can be increased by means which prevent overheating of the system.

Reproduction of colour pictures is made possible if a number of light valves are illuminated simultaneously.

The lighting systems which are known from the prior art do not have the reliability required for long-term operation.

It is the object of the present invention to propose a device for illumination with polarized light, which device has increased reliability.

This object is achieved, in the case of a device of the generic type, by the features of Claim 1 and the features of Claim 2 which is next to it.

It is proposed according to the invention, on the one hand, that the light from a light source, such as a halogen metal-vapour (metal halide) lamp for example, is focused with the aid of focusing means and is split with the aid of polarization means into wanted radiation,



which has a first polarization direction, and into complementary radiation, which has a second polarization direction.

5 In this context, both the direction of field vectors of linearly polarized light and the rotation direction of circularly (elliptically) polarized light are called the polarization direction.

10 In this case, the wanted radiation is deflected onto means to be illuminated, such as a light valve for example, and the complementary radiation is deflected in such a manner that reflection and transmission processes occurring in this case lead to a change in the polarization direction. The new polarization direction of the complementary radiation runs at least partially in the
15 same manner as the polarization direction of the wanted radiation.

In this context, changing the polarization direction shall be understood to mean that, in the case of linearly polarized wanted radiation, the new polarization direction of the complementary radiation has components which run in the direction of the first polarization direction. This is normally achieved by depolarizing.
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In this case, it is essential in the case of a first version according to the invention that changing the polarization direction of the complementary radiation is achieved in that it is reflected on a rough surface or is radiated through this surface.
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In this context, a rough surface shall be understood to mean a surface which has irregularities with dimensions whose orders of magnitude are above the wavelength of the light used.
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As a result of the fact that the rotation of the polarization direction is carried out on a rough surface, in the case of this solution it is possible to dispense with means which convert linearly polarized radiation into circularly polarized radiation, such as quarter-lambda platelets for example, which are normally heavily dependent on the wavelength.
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The reliability of lighting devices of the said type can thus be increased by the reduction in the number of means which have to be adjusted exactly.

5 In the case of a second version according to the invention, the reliability of the lighting system according to the invention is improved in that a second light source is provided, having its own focusing means. These focusing means are additionally used for the purpose of deflecting the complementary radiation from the first
10 light source. Furthermore, the complementary radiation from the second light source is deflected by the focusing means of the first light source.

If two light sources having their own focusing means are used, the use of means which convert linearly
15 polarized radiation into circularly polarized radiation can be provided. Since circularly polarized radiation changes its polarization rotation direction on reflection, the linear polarization direction can likewise be changed by the radiation subsequently passing through
20 means which convert the circularly polarized radiation into linearly polarized radiation.

A quarter-lambda platelet can in each case be used both for changing from linearly polarized radiation into circularly polarized radiation, and vice versa. If
25 the beams are routed in a suitable manner, both conversions can be produced by a single quarter-lambda platelet.

The use of two light sources furthermore has the advantage that, in order to achieve a predetermined light
30 intensity, the light sources can be operated with a power which is less than that which would be necessary if only one light source were used.

A further advantage of the use of two light sources, the focusing means for one lamp being used as
35 deflection means for the radiation from the other light source as well (or vice versa), is that the light source is heated to a greater extent than that resulting from its own power loss. If necessary, this makes it possible to operate the light sources used at lower drive powers,

but not below their operating temperature.

Light sources having a roughened or milky (frosted) lamp bulb, which is also called a glass bulb if it is made of glass, are advantageously used in order to
5 increase the radiation uniformity. Such a rough surface can be used for depolarization of the complementary radiation.

Conventional light sources, such as the said halogen metal-vapour lamps for example, are severely
10 loaded in particular when they are switched on again after having been switched off briefly. The use of two light sources furthermore raises the possibility of these light sources being driven alternately. This solution has the particular advantage that the switched-off period of
15 the individual light source can be lengthened, and its service life can thus be increased.

A further advantage is that a cooled-down halogen metal-vapour lamp requires a lower starting voltage when switching on than a "hot" lamp. Normally, less than 10
20 kilovolts are required for a lamp which is cooled down and more than 20 kilovolts for a "hot" lamp. Thus, if the normal switching-on temperature is reduced, a power supply having a lower power can be used, as a result of which production and operating costs can be saved.

25 If two light sources are used whose wanted radiation have [sic] different polarization planes, a normal or an inverse image of an LCD display can be produced when one light source or the other is switched on.

30 If mirror elements are used as the polarization means, which mirror elements are in each case transparent for light elements in a predetermined wanted wavelength band and reflect light elements in other complementary wavelength bands (dichroic mirrors), then this has, in
35 particular, the advantage that excessive heating of the system is reduced.

If mirror elements of the said type and having small lateral dimensions are arranged in the beam path of a wanted beam for various wanted wavelength bands, then



the desired wanted wavelength bands (red, green, blue) can be obtained without special deflection means.

Further features, advantages and details of the invention are explained in the following exemplary

- 5 Fig. 1 shows a first exemplary embodiment having a single light source;
- 10 Fig. 2 shows a second exemplary embodiment which has two electronically driven light sources with their own focusing means;
- 15 Fig. 3 shows the flow chart of a method for driving two light sources alternately;
- 20 Fig. 4 shows the flow chart of a method for monitoring the serviceability of light sources;
- 25 Fig. 5 shows a third exemplary embodiment having two light sources and a broadened wanted beam;
- 30 Fig. 6 shows a fourth exemplary embodiment having dichroic mirror elements;
- 35 Fig. 7 shows a fifth exemplary embodiment having angled polarization beam splitters.

In the following text, means, signal paths and beam paths which have the same meanings are in each case provided with the same reference symbols in the figures and, once they have been described, are explained in the

25 further description only to the extent that is necessary for understanding of the present invention.

Figure 1 shows a first exemplary embodiment having a single light source 10. The light emitted by it is focused to produce a parallel light beam by a focusing

30 means 11, which in this exemplary embodiment comprises a spherical hollow mirror 11a whose focus point coincides with the position of the light source 10, and a lens 11b whose focus point likewise coincides with the position of the light source 10. This parallel light beam passes to

35 a polarization means 13 which is designed, in this exemplary embodiment, as a so-called polarization beam splitter and splits the light beam 12

- into a wanted beam 12a (wanted radiation) having a first polarization direction, which beam passes with



a first polarization direction to a means 14 to be illuminated, such as an LCD light valve for example, and

- 5 - into a complementary beam 12b (complementary radiation) having a second polarization beam, which passes to a mirror 15 having a second polarization direction.

10 The complementary beam 12b is reflected back by the mirror 15 onto the polarization beam splitter 13 and is subsequently deflected by said polarization beam splitter 13 to the lens 11b. This focuses the deflected complementary beam 12b onto the light source 10 which, in this exemplary embodiment, has a glass body with a rough surface. As a result of the radiation passing through
15 this rough or else milky surface, the deflected complementary beam 12b is depolarized and thus has components in the first polarization direction. The light beam produced in this way once again passes to the hollow mirror 11a and subsequently to the lens 11b, and leaves
20 the focusing means 11 once again as a parallel light beam, as part of the light beam 12. Since components in the first polarization direction are present, the polarization beam splitter 13 once again produces splitting into the desired polarization direction of the wanted
25 beam 12a and into the polarization direction of the complementary beam 12b.

If one considers that the light source 10 has emitted light radiation only for a short period of time, then this light radiation is deflected by the polarization beam splitter 13 either directly onto the LCD light
30 valve 14, as the wanted beam 12a, or else is deflected by means of the mirror 15, the polarization beam splitter 13, the lens 11b, the glass body of the light source 10 and the hollow mirror 11a, as the complementary beam 12b,
35 until virtually all the light produced by the light source has passed as the wanted light beam 12a to the LCD light valve 14.

In the case of the analysis carried out above, it should be noted that absorption processes have not been



considered. In the case of actual operation of the light source 10, the beam 12 and the deflected complementary beam 12b are superimposed without disturbance.

5 The essential feature in the case of this exemplary embodiment is that components in the first polarization direction are produced by reflection processes on, and radiation passing through, the rough glass body of the light source 10.

10 Figure 2 shows a second exemplary embodiment which has a first light source 10 and a second light source 20. The light from the first light source 10 is focused with the aid of the first focusing means 11. The light from the second light source 20 is focused with the aid of second focusing means 21, comprising a second
15 hollow mirror 21a and a second lens 21b. The first light beam 12 is split into the first wanted beam 12a having the first polarization direction, and into the first complementary beam 12b having the second polarization direction. The second light beam 22 is split with the aid
20 of a second polarization beam splitter 23 into a second wanted beam 22a and a second complementary beam 22b. The two wanted beams 12a, 22a pass to the LCD light valve 14.

For a second version of this exemplary embodiment, a first quarter-lambda platelet 17 is provided
25 between the first light source 10 and the first polarization beam splitter 13, and a second quarter-lambda platelet 27 is provided between the second light source 20 and the second polarization beam splitter 23. These are shown by dashed lines in Figure 2.

30 Furthermore, a light sensor 16 is provided which detects the intensity of the beams 12a, 22a. This sensor 16 emits signals INT, which are a measure of the light intensity at the input of the sensor 16, to an electronic controller (ECU) 17. The electronic controller 17 is
35 furthermore connected to an input/output unit 18, from which it receives signals ea.

The electronic controller 17 uses a signal L1 to drive first supply means 10a as a function of the signals INT and ea, which supply means 10a supply the first light



source 10 with the necessary electrical power. The electronic controller 17 furthermore uses a signal L2 to drive second supply means 20a, which supply the second light source 20 with the desired electrical power.

5 In the simplest case, the supply means 10a, 20a can be designed as lamp sockets for the light sources 10, 20. In this case, the signals L1, L2 correspond to the supply voltages for the light sources used. The values of the signals L1, L2 can be changed by changing their volt-
10 ages and/or their currents.

It is also conceivable for the supply means 10a, 20a to be connected to electrical supply devices, which are not illustrated, and for the light sources to be supplied with the desired amount of power as a function
15 of values of the drive signals L1, L2. The values of the drive signals L1, L2 can be set by analogue and/or digital modulation.

Normal operating conditions and alarm conditions can be signalled via a display device 19, which can be
20 designed as a simple lamp or as an alphanumeric display panel.

It is likewise conceivable for the display device to be integrated as part of the LCD light valve 14.

The path of the light emitted from the first
25 light source 10 will be explained first. This light is focused by means of the first focusing means 11 to form the first light beam 12, which is split by the first polarization beam splitter 13 into the first wanted beam 12a and the complementary beam 12b. This first complemen-
30 tary beam 12b passes through the second polarization beam splitter 23 unchanged, and passes to the second lens 21b, which deflects it to the second light source 20. The polarization direction of the first complementary beam 12b is changed there by reflection on the rough surface
35 of the glass body, in such a manner that, after deflection by means of the second hollow mirror 21a and the second lens 21b, this first complementary beam 12b passes as part of the second light beam 22 to the second polarization beam splitter 23 and is split by the latter in



such a manner that a first part runs as the wanted beam to the LCD light valve 14, and a second part runs as the complementary beam, in an analogous manner to the second complementary beam 22b.

5 If one once again considers that the first light source 10 was switched off for only a short period of time, then the light emitted from it runs either directly as the wanted beam 12a to the LCD light valve 14 or else it is reflected backwards and forwards between the first
10 and the second focusing means 11, 21 until only light having the desired polarization direction still remains. Absorption processes have been ignored in this case.

 An analogous situation applies to the light radiation which is emitted from the second light source
15 20.

 The first quarter-lambda platelet 17 and/or the second quarter-lambda platelet 27 are/is used in the case of a second version of this exemplary embodiment. In this case, it is possible to dispense with a rough glass
20 cylinder for the first or second light source 10, 20 respectively, and beam paths are obtained as described in more detail in the following text.

 Starting once again from the first light source 10, the light which is emitted from it and is deflected
25 by the first hollow mirror 12a passes through the first quarter-lambda platelet 17, which passes the light without hindrance.

 The linear polarization of the first complementary beam 12b is changed after passing through the second
30 quarter-lambda platelet 27 into circular polarization in a first rotation direction. This is rotated by the reflection on the second hollow mirror 21a, so that the deflected complementary radiation 21b has circular polarization in a second rotation direction. After
35 passing through the second quarter-lambda platelet 27 once again, this is converted into linear polarization, whose polarization direction corresponds to that of the second wanted beam 22a. Consequently, after passing through the second quarter-lambda platelet 27 twice and



Figure 4.

The start in step 300 is followed by a switch-on command in step 310, via the input/output unit 18. Both the first light source 10 and the second light source 20 are then driven by an appropriate signal L1 or L2 respectively. The value of these signals L1, L2 corresponds to a predetermined value for the electrical power which is intended to be emitted by the supply units 10a, 20a to the light sources 10 and 20 respectively (step 320). The overall light intensity of the two wanted light beams 12a, 22a is measured (step 330) by the light sensor 16, which can also be integrated as part of the LCD light valve 14. The value of the signal INT emitted from it is compared to a required intensity value I required in step 340. If the value of the measured intensity is greater than or equal to the required value, then the method leads back to step 330.

If, on the other hand, it is found in step 340 that the value of the measured light intensity is less than the required intensity value I required, then the method continues at step 350, in that the value of the drive signal for the electrical power is increased. If the value determined in step 350 has not yet reached a maximum value Pm, then the method leads back from step 360 to step 330, so that the sequence passes through the steps 330 to 360 once again.

If, on the other hand, it is found in step 360 that the value of the power drive signal P is already greater than the maximum value Pm, then an alarm condition is signalled via the display device 19 (step 370).

In the case of versions of the method illustrated in Figure 4, an analysis can be carried out, for example, by deliberately switching off the first or the second light source 10, 20 in order to determine which of the two areas of the light sources 10, 20 has a fault condition.

It is furthermore conceivable for two sensors to be provided instead of the one sensor 16, which sensors are not illustrated in the figures in this case but



individually check the light radiation from the first and second light sources respectively.

Further variants which carry out a check known to the person skilled in the art are likewise conceivable as part of this functional sequence.

Combinations of the said functional sequences are particularly advantageous.

A third exemplary embodiment of the lighting device according to the invention is illustrated in Figure 5. In this case, only the paths of those light beams are indicated which are emitted from the first light source and the second light source and are converted by the means shown. The electrical drive and corresponding monitoring methods can be carried out in a similar manner to that described in the abovementioned exemplary embodiment.

The major difference in the case of this exemplary embodiment is that the first light source 10 and the second light source 20 are provided with corresponding focusing means 11 and 21 respectively, but that the light beams emitted from these light sources are split by only one polarization beam splitter 13 into a first wanted beam 12a and a second wanted light beam 22a. Since these two light beams run at right angles to one another, a further deflection mirror 28 is provided, which converts the second wanted beam 22a into a deflected wanted beam 22a'. In this exemplary embodiment, said wanted beam 22a' runs virtually parallel to the first wanted beam 12a so that a larger area can be illuminated, overall, on the LCD light valve 14. However, it is also conceivable for the deflection mirror 28 to deflect the second wanted beam 22a' in such a manner that the light beams 12a and 22a' illuminate a common area.

A further exemplary embodiment is illustrated in Figure 6, which contains the Figures 6a and 6b. The essential feature in the case of this exemplary embodiment is that a mirror having dichroic mirror elements, as is illustrated in Figure 6b, is provided in the beam path of the wanted beam 12a. The principle of such mirror



elements is based on the fact that radiation at a specific wavelength is passed through, and the rest of the radiation is reflected. If, as is illustrated in Figure 6b, such mirror elements are arranged in the form of strips alongside one another, but for different wavelength bands (red, green, blue), and if, furthermore, the dimensions of the said strips are small enough, then a colour picture can be produced in this way.

Figure 6a illustrates symbolically how the wanted beam 12a arrives at the dichroic mirror 29. Thus, only the wavelength band for red light is passed through out of the upper area of the wanted beam, and the wavelength bands for green and blue light are reflected, as a result of which the light beam 12c is produced. The wavelength band for blue light is passed through in the lower area of the wanted beam 12a and the light element for red and green light is reflected, as a result of which the light beam 12d is produced.

The mirror elements for the various wavelength bands can likewise run in horizontally running strips, or in any other way. Such paths for producing colour pictures are known and it is not intended to describe them in more detail at this point.

A fifth exemplary embodiment having angled polarization beam splitters 13a, 13b is illustrated in Figure 7.

The essential feature is that the upper part of the parallel light beam 12 is split by the upper part 13a of the polarization beam splitter into the wanted beam 12a and into the complementary beam 12b, which subsequently passes, by reflection, to the lower part 13b of the polarization beam splitter. From there, it is reflected back to the focusing means 11 and, as a result of the radiation passing through the rough surface of the glass body of the light source 10, it receives components in the first polarization direction. The deflected complementary beam is reflected back by the hollow mirror 11a in such a manner that, subsequently, its path is the same as the original beam 12.



The lower part of the beam 12 is split by the lower part 13b of the polarization beam splitter into the wanted beam 12a and into the complementary beam 12b which, in this case, is deflected to the upper part 13a of the polarization beam splitter and, subsequently, onto the focusing means 11.

The angled arrangement of the polarization beam splitter allows an additional deflection mirror to be saved, and the required amount of glass can be reduced by half.

The use of quarter-lambda platelets is likewise conceivable in the case of the exemplary embodiments according to Figures 5 to 7.

In order to avoid light losses when illuminating non-circular surfaces, such as LCD light valves for example which are normally designed to be rectangular with an aspect ratio of 4:3 or 16:9, at least one of the following variants of the said exemplary embodiments is advantageous:

- mirrors can be provided in the path of the beams 12 and/or 12a, which mirrors form a frame through which light having the desired geometric dimensions can be radiated. The beam elements which strike the mirrors are reflected in the direction of the relevant focusing means. The mirrors which form the frame can be designed to be planar, spherical, elliptical or the like, depending on the type of focusing means used;
- parts of the focusing means 11, 21 can be designed in such a manner that the light beams produced have a non-circular cross-section;
- two or more of the beams produced can be deflected onto the means to be illuminated in such a manner that the illuminated area corresponds at least approximately to the desired geometry.

Further combinations of features of the individual exemplary embodiments are likewise conceivable.



Versions of the said exemplary embodiments may have at least individual variants of the following variants

- 5 - instead of the specified focusing means, other means known to the person skilled in the art can be used. The use of elliptically shaped hollow mirrors is conceivable, for example. A light source can be arranged at one of its focus points, and the other focus point corresponds with the focus point of a downstream lens. Parallel beams 12 and 22 can in consequence likewise be produced. However, it is still necessary to consider the fact that circularly polarized light must carry out an odd number of such reflections for rotation of polarization planes with the aid of reflections on planar surfaces;
- 10 - cholesteric liquid-crystal filters can be used instead of polarization beam splitters (PBS);
- 15 - if it is intended to illuminate means with elliptically (circularly) polarized light, then additional appropriate means, such as quarter-lambda platelets for example, can be provided in the beam path of the wanted beams;
- 20 - the rough surface by means of which a cause [sic] of components in the first polarization direction is produced can be provided instead of by the lamp body or bodies on other means for deflection. For this purpose, this should be understood to be means which reflect or refract the light, or otherwise give it a diffuse path;
- 25 - more than two light sources may be provided. These can be driven by control means in such a manner that the load on the individual light source is reduced;
- 30 - the angles between incident beams and polarization means can be determined in such a manner that the degree of reflection or the degree of polarization of the beam splitters is optimized for example taking account of the Brewster angle,
- 35 - more than two partial beams may be formed and each light valve is illuminated by at least three partial



beams,

- cold mirrors can be used which deflect visible wavelengths differently from infrared radiation and thus prevent overheating of the system.

5 Thus, according to the invention, a device for illumination with linearly or elliptically polarized light is proposed which allows the reliability to be improved in comparison with known systems.

10 This is achieved on the one hand in that costly and highly wavelength-dependent means for conversion of linearly polarized light into circularly polarized light are dispensed with, these means being regarded as being sensitive and subject to defects.

15 Instead of this, deflection such as by reflection and refraction on a rough surface which is not subject to defects is provided. Such a surface is available in the case of some lamps which are used as light source, so that even the means can be saved.

20 Use of two light sources having their own focusing means furthermore ensures the operation of the device according to the invention in the event of failure of one illumination path.

25 To this end, in a development, control means can additionally be used which indicate, as required, operating conditions such as the total operating time of individual light sources etc., as well as fault conditions.

30 If illumination is produced using non-circular beams, which can be produced, for example, by suitable focusing systems or by parallel paths of intrinsically circular beams, then, in particular, light valves having rectangular dimensions (4:3, 16:9) can be illuminated with relatively low losses.

35 Further variants, such as the use of dichroic mirror elements and angled polarization means for example, lead to further savings of deflection means.

 An illumination device is thus proposed which can be assigned, for example, to a projection system which contains at least one light valve. The illumination



device according to the invention is characterized in that a plurality of partial beams are formed from the light from at least one lamp, of which partial beams one, two or more can be supplied to one light valve.

5 The light which is emitted from the illumination device can be polarized or unpolarized.

 This results initially in the advantage of reduced light losses and more uniform illumination of the light valves.

10 If at least two lamps are used whose light beams are deformed in such a manner that the two partial beams contain light elements from each lamp, then this furthermore results in the advantage that the function of the illumination system continues to be ensured in the event
15 of failure of one lamp.

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Annex

NEW Patent Claims

1. Device for illumination with polarized light having at least one first light source (10) whose light is focused with the aid of first focusing means (11) and is split with the aid of one or more polarization beam splitters (13, 23) into wanted radiation (12a), which has a first polarization direction, and into complementary radiation (12b), which has a second polarization direction, the wanted radiation (12a) being deflected onto means (14) to be illuminated, characterized in that deflection means (15, 21a) are provided which deflect the complementary radiation (12) via means (10, 20) having a rough surface, which surface has irregularities with dimensions whose order of magnitude are [sic] above the wavelength of the light used, and in that the light which is scattered by the rough surface is deflected by deflection means (11a, 21a) and polarization beam splitters (13, 23) at least partially onto the means (14) to be illuminated.
2. Device for illumination according to Claim 1, characterized in that a second light source (20) is additionally provided having its own second focusing means (21), and in that the complementary radiation (12b) from the first light source (10) is deflected by means of the second focusing means (21), and the complementary radiation (22b) from the second light source (20) is deflected by means of the first focusing means (11).
3. Device for illumination according to Claim 1 or 2, characterized in that the means having a rough surface are formed by lamp bulbs of the at least one light source (10, 20).
4. Device for illumination according to one of Claims 1 to 3, characterized in that the polarization beam splitter (13, 23) contains
- a cholesteric element and
 - a further means which converts the elliptically polarized radiation into linearly polarized radi-





ation.

5. Device for illumination according to one of Claims 2 to 4, characterized in that at least one first light source (10) and one second light source (20) are provided which are driven by switching means (10a, 20a, 17, 18) in such a manner that the first light source (10) or the second light source (20) are [sic] switched on alternately.

6. Device for illumination according to one of Claims 2 to 5, characterized in that at least one first light source (10) and one second light source (20) are provided, the wanted radiation (12a and 22a respectively) from which light sources has different polarization directions, and in that control means (17) drive the light sources (10, 20) in such a manner that either the wanted radiation (12a or 22a respectively) in the one polarization direction or the wanted radiation (22a or 12a respectively) in the other polarization direction is deflected onto the means (14) to be illuminated.

7. Device for illumination according to one of Claims 1 to 6, characterized in that the polarization beam splitters (13, 23) have mirror elements (29) which are in each case transparent for light elements in a predetermined wanted wavelength band and reflect light elements in other, complementary wavelength bands.

8. Device for illumination according to Claim 7, characterized in that mirror elements (29) are provided for various wanted wavelength bands.

9. Device for illumination according to one of Claims 1 to 8, characterized in that a light sensor (16) is provided whose output signal is a measure of the intensity of the light emitted by the at least one light source (10), and in that a controller (17) is provided to which the signal from the light sensor (16) is supplied and which emits an alarm signal if the light intensity is below a predetermined level when the at least one light source (10) is being driven at maximum power.

10. Device for illumination with polarized light according to one of Claims 1 to 9, characterized in that



means (28) are provided which form at least two partial beams (12a, 22a) from the light which is focused by the focusing means (11, 21), and deflect these partial beams (12a, 22a) onto the means (14) to be illuminated.

- 5 11. Device for illumination with polarized light according to one of Claims 1 to 10, characterized in that the polarization beam splitters (13, 23) are designed as angled polarization beam splitters (13a, 13b).
- 10 12. Device for illumination according to one of Claims 1 to 11, characterized in that means are provided which prevent overheating of the device and/or of the means (14) to be illuminated.
- 15 13. Device for illumination according to one of Claims 1 to 12, characterized in that the means (14) to be illuminated have two or more light valves.
- 20 14. Device for illumination according to one of Claims 1 to 13, characterized in that mirror means are provided in the beam path of the wanted beams (12a, 22a), which mirror means form a frame whose opening corresponds essentially to the geometry of the means (14) to be illuminated.

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