(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 786 799 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
10.04.2002 Bulletin 2002/15

(51) Int Cl.7: **H01K 1/26**, F21V 9/02

(21) Application number: **97300451.8**

(22) Date of filing: **24.01.1997**

(54) Incandescent reflector lamp with sun-like spectral output

Glühlampe mit Reflektor mit sonnenähnlichem Emissionsspektrum

Lampe à incandescence avec réflecteur à spectre d'émission semblable à celui du soleil

(84) Designated Contracting States:
BE DE FR GB NL

(30) Priority: **24.01.1996 GB 9601402**

(43) Date of publication of application:
30.07.1997 Bulletin 1997/31

(73) Proprietor: **FLOWIL INTERNATIONAL LIGHTING (HOLDING) B.V.**
NL-2031 CC Haarlem (NL)

(72) Inventors:
- **de Bosscher,Wilmert Cyriel Stefaan**
  9000 Gent (BE)
- **Gielen,Joseph Guido Marie**
  3350 Linter (BE)

(74) Representative: **Butler, Michael John et al**
Frank B. Dehn & Co.,
European Patent Attorneys,
179 Queen Victoria Street
London EC4V 4EL (GB)

(56) References cited:
DE-A- 3 931 950 **US-A- 2 831 966**
US-A- 4 125 775

- **PATENT ABSTRACTS OF JAPAN vol. 096, no. 005, 31 May 1996 & JP 08 021785 A (MITSUBISHI HEAVY IND LTD;OTHERS: 01), 23 January 1996,**
- **DATABASE WPI Section Ch, Week 8406 Derwent Publications Ltd., London, GB; Class L01, AN 84-035659 XP002029718 & SU 1 008 170 A (GLASS RES INST) , 30 March 1983**

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 0 786 799 B1

Description

[0001] The present invention relates to an incandescent reflector lamp which emits light with a spectral output that substantially simulates sunlight, at least over the visible range of the electromagnetic spectrum.

[0002] For many years, it has been sought to produce light by artificial means. In the film and TV industry, for example, where daylight hours are precious and a standard amount of light having a particular colour is desirable, there is a need to produce artificial daylight. In response to this need a company by the name of Balzers has developed a "TL60" daylight filter, which when put in front of a halogen lamp, can convert the light output of the lamp to roughly that of daylight.

[0003] Artificial daylight is nowadays also sought after for the home and the office to offer a more soothing environment. A number of different approaches are known where particular lamps have been adapted in some way to shift their colour coordinates to values closer to those of the sun.

[0004] For example, it is known to provide an incandescent lamp containing the rare earth element Neodymium in or on the glass envelope. This addition has a filtering effect which results in a quite severe absorption in the yellow/ orange region of the visual spectrum. Unfortunately, this results in a spectrum which is not particularly smooth and which tends to highlight and enhance other colours of the visual spectrum.

[0005] Incandescent daylight lamps having a blue coating are also known. The blue coating results in a partial filtering of the red portion of the spectrum from the light source. Generally, this may cause the colour coordinates in the CIE chromaticity diagram to exhibit a shift towards perfect white, ie. $x = 0.33$ and $y = 0.33$, though it still remains in the yellowish region. However, the spectral output has no real correlation with the spectrum of sunlight.

[0006] Another attempt to produce artificial daylight is known from the field of fluorescent lamps. This is achieved by selecting a precise mix of different phosphors in order to match a desired set of colour coordinates, such as those of sunlight. However, a problem with these lamps is that their spectral output comprises a series of discrete sharp spectral peaks, which bears no real correlation to that of sunlight. In addition, the flickering effect of a fluorescent lamp, due to the AC power supply, often has a negative effect on people and may defeat any soothing effect created by the simulated daylight.

[0007] Another lamp is known from DE-A-3931950 (over which claim 1 has been characterised). This lamp uses an incandescent halogen burner as the light source and incorporates a cold light reflector on its parabolic surface behind the light source. The lamp further includes a separate filter, which is preferably a daylight filter made from a dichroic material, which provides a colour temperature of approximately 5600K. Although this lamp is said to produce an agreeable cool light, the filter is just a standard dichroic filter.

[0008] A problem with such standard dichroic daylight filters is that they do not take into account secondary or multiple reflections which occur within reflector lamps.

[0009] Reflector lamps are lamps which have an integral coating on the generally parabolic surface located behind the light source, usually a dichroic coating, in order to reflect light back past the light source and through the front glass.

[0010] The known daylight filters generally reduce the proportion of the yellow and red light being transmitted. When these filters are formed as dichroic coatings, they do not absorb but reflect the unwanted radiation back to the parabolic reflector, whereupon the light is reflected back again towards the front glass. These secondary and multiple reflections will increase the relative amount of yellow and red light hitting the dichroic coating of the filter, which also increases the amount of yellow and red light being transmitted. To correct this, the transmission of yellow and red light must be significantly lower than the theoretical value.

[0011] According to the present invention, there is provided a reflector lamp for simulating daylight comprising a front glass, a reflector, a halogen light source and a dichroic filter to filter light from the light source, characterised in that the transmission of light through the dichroic filter over the range 400 to 480 nm is not less than 90% and the value of the average transmittance in the 580 to 760 nm region subtracted from the average transmittance in the 400 to 480 nm region is greater than 70%, wherein the lamp has colour coordinates and an emission spectrum substantially the same as sunlight, the emission spectrum of the lamp having a single peaked curve with the peak laying between 450 and 580 nm and a coefficient of correlation with the spectrum of sunlight over the visible region of between 0.7 and 1.0.

[0012] Thus, the transmission of light through the filter of the front glass between the range of 400 and 480nm is higher, and between 580 and 700nm is lower, than the predicted values for a lamp not having a reflector. This therefore reduces the relative amount of yellow and red light being emitted and produces light from a reflector lamp whose spectral emission is closer to that of sunlight.

[0013] In one preferred embodiment, the filter produces a transmission curve that has a single broad peak with no minima between 400 and 580 nm, most preferably between 400 and 480nm. Preferably the transmission of light over the range 580 to 760nm is below 25%.

[0014] With the known standard daylight filters, which do not take account of secondary and multiple reflections, the transmission curve exhibits a minimum between 400 and 480nm, usually at around 430nm.

[0015] A further difference between the known filters and that of the present invention can be seen when the average transmittance in the 580-760 nm region is subtracted from the average transmittance in the 400-480 nm region. In existing daylight filters such as those supplied by Balzers and Schott the difference is about 60%, whereas in the present invention the difference between the two regions is greater than 70%.

[0016] In contrast to the known daylight filters, the transmission properties of the dichroic filter can be seen therefore to be tuned to take account of secondary and multiple reflections from the reflector so that the lamp has a spectral emission substantially the same as sunlight, at least over the visible range.

[0017] Thus the lamp allows a reflector to be used whilst producing a light that more closely resembles sunlight. The spectral emission has a coefficient of correlation with the spectrum of sunlight over the visible region of between 0.7 and 1.0, preferably between 0.8 and 1.0, and most preferably between 0.85 and 1.0. In existing products, generally no correlation exists and in many cases the opposite tendency is found producing negative values for the correlation coefficient.

[0018] In addition to resembling the sunlight spectrum, the lamp also has colour coordinates which substantially match those of the sun. In a preferred embodiment, the colour coordinates were measured as approximately $x = 0.32$ and $y = 0.33$. Preferably the colour coordinates are between $0.310 < x < 0.350$ and $0.320 < y < 0.360$.

[0019] Although the spectral emission curve of the lamp closely resembles that of sunlight over the visible region having a single peak in the region between 450 and 580nm, preferably the width of the peak is narrower than that of the sunlight spectrum. Medical tests have shown that the human eye can focus more easily on single peaked spectral light distributions, resulting in better vision for contrast and detail. By decreasing the width of the single peak, this effect can be increased whilst maintaining a good colour rendering index (CRI).

[0020] Preferably the lamp has a CRI of greater than 90%. Preferably the CRI is greater than 93% and in a most preferred embodiment the CRI is equal to or greater than 95%. A preferred range for the CRI is between 93 and 97%.

[0021] Preferably the peak of the lamp's emission spectrum is at 480 nm as this correlates well with the peak of the sunlight spectrum. However, just having a single peaked spectrum provides advantages in its own right, because of the increase in ease with which the eye can focus.

[0022] In a preferred embodiment, the dichroic filter comprises alternating layers of ZnS and SiO_2. Preferably the filter consists of the following 8 layers:

layer 1 - ZnS of 76.73nm thickness;
layer 2 - SiO_2 of 110.74nm thickness;
layer 3 - ZnS of 65.04nm thickness;
layer 4 - SiO_2 of 103.86nm thickness;
layer 5 - ZnS of 71.59nm thickness;
layer 6 - SiO_2 of 118.81nm thickness;
layer 7 - ZnS of 102.94nm thickness; and
layer 8 - SiO_2 of 80.38nm thickness.

[0023] Preferably the dichroic filter is a coating which is integral with the front glass of the lamp, preferably coated on the inside of the front glass. Preferably the reflector lamp has a halogen light source and the dichroic filter is a coating applied to the inside surface of the front glass which consists of alternating layers of ZnS and SiO_2.

[0024] This coating is preferably applied by the molybdenum boat thermal evaporation process using ZnS and SiO as evaporation materials. The SiO is evaporated in a partial oxygen atmosphere to form SiO_2 layers. This method is advantageous because it is considerably cheaper to use than other evaporation processes, such as the electron beam gun evaporation process, with SiO_2 and TiO_2 as evaporation materials, used by Balzers in the production of their above mentioned "TL60" filter.

[0025] In order to produce the correct spectral emission for the lamp, it is important to tune the lamp's filter to the particular burner or light source being used and also to the reflector.

[0026] The reflector may be a standard reflector material which reflects substantially all of the visible light incident on it back into the lamp, or it may be designed to reflect only selected wavelengths, for example, a cold light reflector which may allow infrared light to pass through.

[0027] The preferred light source is an incandescent halogen capsule or burner with a colour temperature of between 2700 and 3200K, for example, a 100W high volt halogen lamp or at least a 50W low volt lamp. The higher the colour temperature of the light source, the better the result will be because less filtering has to be applied.

[0028] It is preferred for the emission from the lamp itself to have a colour temperature higher than 5000K, while maintaining the smallest possible deviation from the black body locus of a chromaticity diagram. In the most preferred embodiments, the lamp has an emission with a colour temperature of greater than 6000K, preferably as high as 6500K, since this provides a person using the light with better conditions for reading due to improved contrast and vision.

[0029] However, to an extent many of the advantages provided by the invention, for example, the soothing properties and the improved contrast and vision can be achieved by the single peaked distribution without having such a high colour temperature, for example, 4000K. Such a colour temperature may be produced by a high volt 50W lamp, which may be more appropriate for existing desk top fixtures which usually only allow up to a maximum of 60W. In a lamp of this type, the single peak of the emission curve would be at approximately 580 nm, rather than 480 nm for the 6500K version.

[0030] The preferred illuminance level for the lamp is between 1100 and 1700 lx, preferably between 1200 and 1650 lx, and most preferably at 1350 lx. A homogeneous illumination of the work space by the lamp is important, especially if the lamp is to maximise its soothing and its improved contrast and vision properties. The reflector should therefore have a large beam angle, for example, 50° or more, preferably 60° or greater for desk top applications, in order to spread the beam of desired illuminance over a reasonable area, rather than just a small spot.

[0031] Some preferred embodiments of the present invention will now be described by way of example only and with reference to the accompanying drawings, in which:

FIG. 1 is a side sectional elevation through the central axis of a preferred reflector lamp;
FIG. 2 is a graph showing the spectral outputs of various lamps from the prior art compared to that of the sun;
FIG. 3 is a graph showing the spectral outputs of a preferred embodiment of the lamp of the present invention in comparison with spectral outputs from the sun and a standard incandescent halogen lamp;
FIG. 4 is a graph showing the transmission properties of the Balzers' "TL60" daylight filter;
FIG. 5 is a graph showing the transmission properties of the Schott No. 512 filter used in DE-A-3931950; and
FIG. 6 is a graph showing the transmission properties of a preferred dichroic front glass coating, in accordance with the present invention.

[0032] In Figure 1, there is shown an embodiment of a preferred reflector lamp. The lamp comprises a front glass 1, a reflector 2, an incandescent light source 3, often referred to as a "burner", and a socket 4.

[0033] In the most preferred embodiment, the lamp has a dichroic filter 5 coated on the inside of the front glass 1.

[0034] The coating may be applied by any suitable technique, the preferred technique being a standard molybdenum boat thermal evaporation process using ZnS and SiO as evaporation materials. In the process, the SiO is evaporated in an oxygen enriched atmosphere to form SiO_2 layers. Other techniques, such as electron beam gun evaporation, may also be used although tend to be more expensive. As discussed above, in accordance with the invention, the transmission properties of the dichroic filter are tuned so that the spectral emission of the lamp is substantially the same as sunlight.

[0035] As an example of a preferred lamp, the lamp consists of a high voltage hard glass incandescent halogen burner 3, focused inside a parabolic reflector 2 with a rim diameter of 95mm. The reflector consists of a moulded parabolic glass portion of the lamp envelope inside which a standard semi durable cold light mirror material is coated. The coating reflects visible light but is transparent to infrared. A front glass 1 is glued to the reflector 2 to prevent dust and other pollutants from entering the lamp, as well as providing protection in the event of the burner 3 exploding and a UV-stop filter. The front glass 1 has a coating 5 applied to its inside surface which converts the light emitted from the high voltage burner into a single peaked spectrum with a colour temperature of at least 6000K. The coating 5 consists of 8 layers of alternating ZnS and SiO_2 with the following thicknesses:

Layer Nr.	Material	Thickness (nm)
1	ZnS	76.73
2	SiO_2	110.74
3	ZnS	65.04
4	SiO_2	103.86
5	ZnS	71.59
6	SiO_2	118.81
7	ZnS	102.94
8	SiO_2	80.38

[0036] The transmission properties of this coating 5 are shown in Figure 6. The coating 5 in this example achieves a colour temperature conversion of 2800K to between 6000 to 6500K when used with a 100W, high volt light source or at least a 50W low volt light source.

[0037] The spectral outputs of the sun, various prior art lamps and a preferred embodiment of the present invention are compared in Figures 2 and 3. In the figures, the spectral outputs are normalised to 100% in order to allow for comparison.

[0038] The spectral outputs of the different curves when compared to that of the sun correlate as follows:

light source	correlation coefficient
sun	1.00
preferred embodiment of the present invention	0.86
halogen lamp	-0.51
neodymium containing lamp	-0.42
blue coated incandescent daylight lamp	-0.53
fluorescent daylight lamp	0.40

[0039] Figure 3, in addition to clearly showing that the single peaked spectral emission of the preferred lamp closely matches that of sunlight, also shows that there is improved kurtosis, ie. sharpness of the peak. This allows for easier focusing of the human eye whilst maintaining the high colour rendering index.

[0040] As can be seen from the transmission curves of Figure 4 and 5 of the prior art, the filters exhibit transmission minima between approximately 420 to 430nm. In contrast to this, the preferred filter has a transmission curve that exhibits a single broad peak in the blue region that spans between about 400 and 500nm. The preferred filter also shows lower transmission in the yellow and red region of the spectrum compared to the Balzer's "TL60" daylight filter shown in Figure 4.

[0041] The reflector 2 may be of any type, eg. smooth, faceted etc, and its transmission properties may be dictated by the heat resisting properties of the socket 4 and/or the light fitting (not shown). The lamp may, for example, be a 75W lamp with a 25° spread angle for ceiling mount applications, or perhaps a 50W lamp with a 50° spread angle or a 50mm diameter, 50W lamp with a 60° spread angle for desk lamp applications. In all these cases, it may be necessary to adjust the coating or filter in order to compensate for the different colour temperatures of the burners and for the different secondary and multiple reflections of the various reflector types.

[0042] Thus there has been described a lamp which does not require a complex construction or extra parts to hold a filter; which in its most preferred embodiment has improved daylight reproducing abilities; and which can provide a soothing light that enables optimal contrast and homogeneous illumination of a reading surface.

Claims

1. A reflector lamp for simulating daylight comprising a front glass (1), a reflector (2), a halogen light source (3) and a dichroic filter (5) to filter light from the light source, **characterised in that** the transmission of light through the dichroic filter (5) over the range 400 to 480 nm is not less than 90% and the value of the average transmittance in the 580 to 760 nm region subtracted from the average transmittance in the 400 to 480 nm region is greater than 70%, wherein the lamp has colour coordinates and an emission spectrum substantially the same as sunlight, the emission spectrum of the lamp having a single peaked curve with the peak laying between 450 and 580 nm and a coefficient of correlation with the spectrum of sunlight over the visible region of beween 0.7 and 1.0.

2. A lamp as claimed in claim 1, wherein the dichroic filter (5) is applied to the front glass (1) of the lamp.

3. A lamp as claimed in claim 1 or 2, wherein the lamp has a colour temperature of greater than 5000K.

4. A lamp as claimed in claim 3, wherein the lamp has a colour temperature of greater than 6000K.

5. A lamp as claimed in any preceding claim, wherein the peak of the emission spectrum is at 480 nm.

6. A lamp as claimed in claim 1 or 2, wherein the lamp has a colour temperature of 4000K and the peak of the emission spectrum is at 580 nm.

7. A lamp as claimed in any preceding claim, wherein the transmission of light through the dichroic filter (5) over the range 580 to 760 nm is not more than 25%.

8. A lamp as claimed in any preceding claim, wherein the dichroic filter (5) produces a transmission curve that has a single broad peak, with no minima present between the range of 400 to 580 nm.

9. A lamp as claimed in claim 8, wherein the peak of the transmission curve extends between 400 and 480 nm.

10. A lamp as claimed in any preceding claim, wherein the colour coordinates of the lamp are between 0.310 < x < 0.350 and 0.320 < y < 0.360.

11. A lamp as claimed in any preceding claim, wherein the lamp has a Colour Rendering Index of greater than 90%.

12. A lamp as claimed in claim 11, wherein the Colour Rendering Index is not less than 95%.

13. A lamp as claimed in any preceding claim wherein the dichroic filter (5) comprises alternating layers of ZnS and SiO_2.

14. A lamp as claimed in claim 13, wherein the dichroic filter (5) comprises 8 or more layers.

15. A lamp as claimed in claim 14, wherein the dichroic filter (5) consists of the following 8 layers:

    layer 1 - ZnS of 76.73nm thickness;
    layer 2 - SiO_2 of 110.74nm thickness;
    layer 3 - ZnS of 65.04nm thickness;
    layer 4 - SiO_2 of 103.86nm thickness;
    layer 5 - ZnS of 71.59nm thickness;
    layer 6 - SiO_2 of 118.81nm thickness;
    layer 7 - ZnS of 102.94nm thickness; and
    layer 8 - SiO_2 of 80.38nm thickness.

Patentansprüche

1. Reflektorlampe zur Simulation von Tageslicht mit einer Frontscheibe (1), einem Reflektor (2), einer Halogenlichtquelle (3) und einem dichroischen Filter (5) zum Filtern von Licht der Lichtquelle, **dadurch gekennzeichnet, dass** der Lichtdurchlaß durch den dichroischen Filter (5) über den Bereich von 400 bis 480 nm nicht kleiner ist als 90% und der Wert der durchschnittlichen Durchlässigkeit im Bereich von 580 bis 760 nm, abgezogen von der durchschnittlichen Durchlässigkeit im Bereich vom 400 bis 480 nm, größer ist als 70%, wobei die Lampe Farbkoordinaten und ein Emissionsspektrum aufweist, die substantiell die gleichen sind wie Sonnenlicht, und wobei das Emissionsspektrum der Lampe eine Kurve mit einem einzelnen Spitzenwert, der zwischen 450 und 580 nm liegt, und einem Koeffizienten der Korrelation mit dem Sonnenlichtspektrum über den sichtbaren Bereich von zwischen 0,7 und 1,0 besitzt.

2. Lampe nach Anspruch 1, bei welcher der dichroische Filter (5) an der Frontscheibe (1) angebracht ist.

3. Lampe nach Anspruch 1 oder 2, bei welcher die Lampe eine Farbtemperatur größer als 5000K aufweist.

4. Lampe nach Anspruch 3, bei welcher die Lampe eine Farbtemperatur größer als 6000K aufweist.

5. Lampe nach einem der vorhergehenden Ansprüche, bei welcher der Spitzenwert des Emissionsspektrums bei 480 nm liegt.

6. Lampe nach Anspruch 1 oder 2, bei welcher die Lampe eine Farbtemperatur von 4000K aufweist und der Spitzenwert des Emissionsspektrums bei 580 nm liegt.

7. Lampe nach einem der vorhergehenden Ansprüche, bei welcher der Durchlässigkeit von Licht durch den dichroischen Filter (5) über den Bereich von 580 bis 760 nm nicht mehr als 25% beträgt.

8. Lampe nach einem der vorhergehenden Ansprüche, bei welcher der dichroische Filter (5) eine Durchlasskurve produziert, die einen einzelnen breiten Spitzenwert aufweist, mit keinerlei vorhandenen Minima innerhalb des Bereichs von 480 bis 580 nm.

9. Lampe nach Anspruch 8, bei welcher der Spitzenwert der Durchlasskurve sich zwischen 400 und 480 nm erstreckt.

10. Lampe nach einem der vorhergehenden Ansprüche, bei welcher die Farbkoordinaten der Lampe sich zwischen

0,310 < x < 0,350 und 0,320 < y < 0,360 befinden.

11. Lampe nach einem der vorhergehenden Ansprüche, bei welcher die Lampe einen Farbwiedergabeindex von mehr als 90% aufweist.

12. Lampe nach Anspruch 11, bei welcher der Farbwiedergabeindex nicht kleiner ist als 95%.

13. Lampe nach einem der vorhergehenden Ansprüche, bei welcher der dichroische Filter (5) aus abwechselnden Schichten von ZnS und SiO_2 besteht.

14. Lampe nach Anspruch 13, bei welcher der dichroische Filter (5) acht oder mehr Schichten umfasst.

15. Lampe nach Anspruch 14, bei welcher der dichroische Filter (5) aus den folgenden acht Schichten besteht:

Schicht 1 - ZnS von 76,73 nm Dicke;
Schicht 2 - SiO_2 von 110,74 nm Dicke;
Schicht 3 - ZnS von 65,04 nm Dicke;
Schicht 4 - SiO_2 von 103,86 nm Dicke;
Schicht 5 - ZnS von 71,59 nm Dicke;
Schicht 6 - SiO_2 von 118,81 nm Dicke;
Schicht 7 - ZnS von 102,94 nm Dicke; und
Schicht 8 - SiO_2 von 80,38 nm Dicke.

Revendications

1. Lampe à réflecteur simulant la lumière du jour comprenant une dalle frontale (1), un réflecteur (2), une source de lumière à halogène (3) et un filtre dichroïque (5) pour filtrer la source de lumière,
caractérisée en ce que
la transmission de la lumière à travers le filtre dichroïque (5) sur la plage des 400 à 480 nm n'est pas inférieure à 90 % et que la valeur de la transmittance moyenne sur la plage des 580 à 760 nm, soustraite de la transmittance moyenne dans la région des 400 à 480 nm est supérieure à 70 %, et dans laquelle la lampe a des coordonnées de couleur et un spectre d'émission substantiellement identiques à la lumière du soleil, le spectre d'émission de la lampe présentant une courbe à crête unique se situant entre 450 et 580 nm et un coefficient de corrélation avec le spectre de la lumière du soleil sur la région visible comprise entre 0,7 et 1,0.

2. Lampe selon la revendication 1, dans laquelle le filtre dichroïque (5) est appliqué sur la dalle frontale (1) de la lampe.

3. Lampe selon la revendication 1 ou 2, dans laquelle la lampe présente une température de couleur supérieure à 5000 ° K.

4. Lampe selon la revendication 3, dans laquelle la lampe présente une température de couleur supérieure à 6000 ° K.

5. Lampe selon l'une quelconque des revendications précédentes, dans laquelle la crête du spectre d'émission est à 480 nm.

6. Lampe selon la revendication 1 ou 2, dans laquelle la lampe présente une température de couleur de 4000 ° K et la crête du spectre d'émission est à 580 nm.

7. Lampe selon l'une quelconque des revendications précédentes, dans laquelle la transmission de la lumière à travers le filtre dichroïque (5) sur la plage des 580 à 760 nm est inférieure à 25 %.

8. Lampe selon l'une quelconque des revendications précédentes, dans laquelle le filtre dichroïque (5) détermine une courbe de transmission n'ayant qu'une crête unique large, sans minimum présent sur la plage des 400 à 580 nm.

9. Lampe selon la revendication 8, dans laquelle la crête de la courbe de transmission s'étend entre 400 et 480 nm.

10. Lampe selon l'une quelconque des revendications précédentes, dans laquelle les coordonnées de couleur de la lampe répondent à :

$$0,310 < x < 0,350$$

$$0,320 < y < 0,360$$

11. Lampe selon l'une quelconque des revendications précédentes, dans laquelle la lampe a un indice de rendu des couleurs supérieur à 90 %.

12. Lampe selon la revendication 11, dans laquelle l'indice de rendu des couleurs n'est pas inférieur à 95 %.

13. Lampe selon l'une quelconque des revendications précédentes, dans laquelle le filtre dichroïque (5) comporte des couches alternées de ZnS et de SiO_2.

14. Lampe selon la revendication 13, dans laquelle le filtre dichroïque (5) comporte au moins 8 couches.

15. Lampe selon la revendication 14, dans laquelle le filtre dichroïque (5) comprend les huit couches suivantes :

couche 1 ZnS 76,73 nm d'épaisseur
couche 2 SiO_2 110,74 nm d'épaisseur
couche 3 ZnS 65,04 nm d'épaisseur
couche 4 SiO_2 103,86 nm d'épaisseur
couche 5 ZnS 71,59 nm d'épaisseur
couche 6 SiO_2 118,81 nm d'épaisseur
couche 7 ZnS 102,94 nm d'épaisseur
couche 8 SiO_2 80,38 nm d'épaisseur

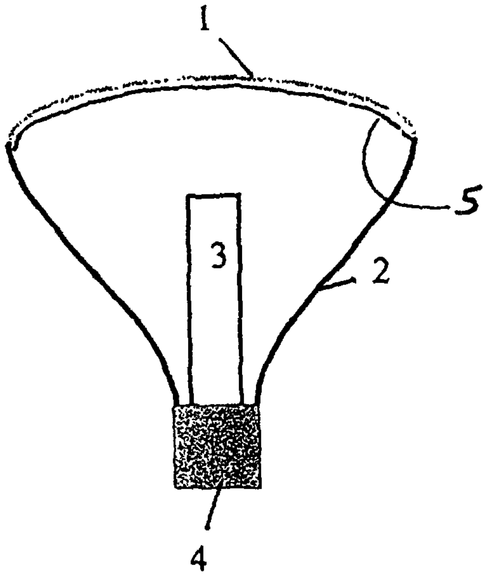
1
5
3
2
4

FIG. 1

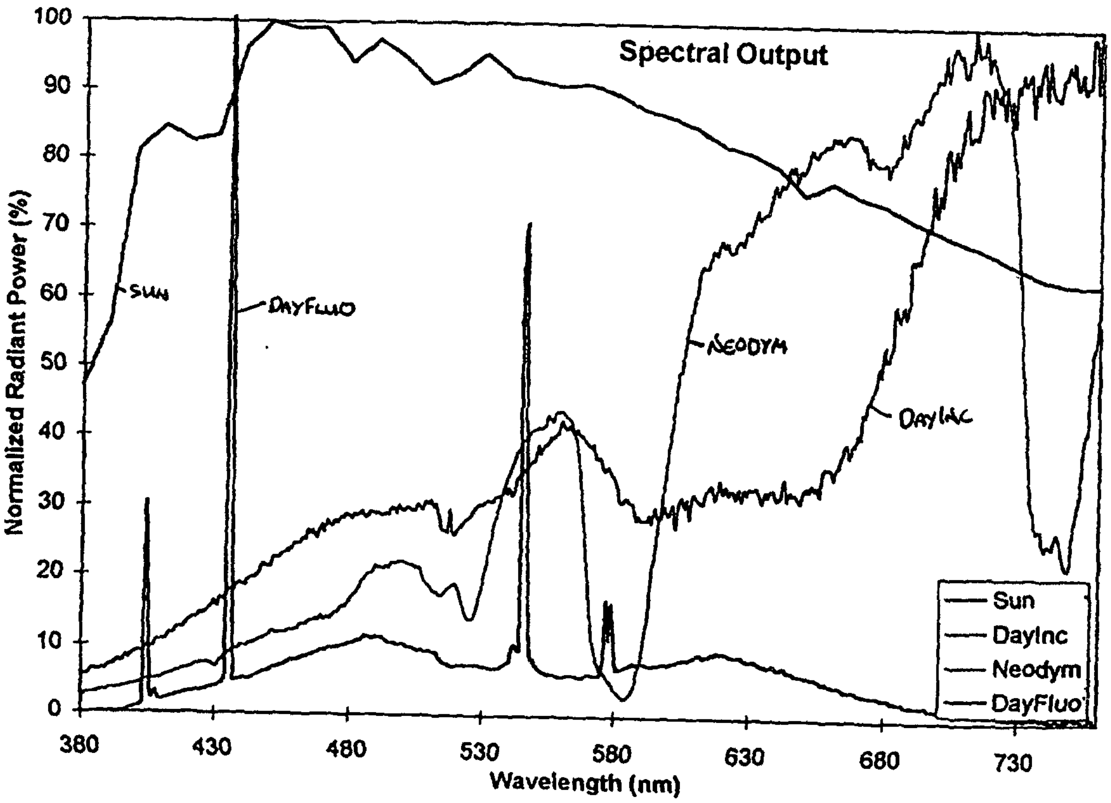
Spectral Output
Normalized Radiant Power (%)
100
90
80
70
60
50
40
30
20
10
0
380
430
480
530
580
630
680
730
Wavelength (nm)
SUN
DAYFLUO
NEODYM
DAYINC
Sun
DayInc
Neodym
DayFluo

FIG. 2

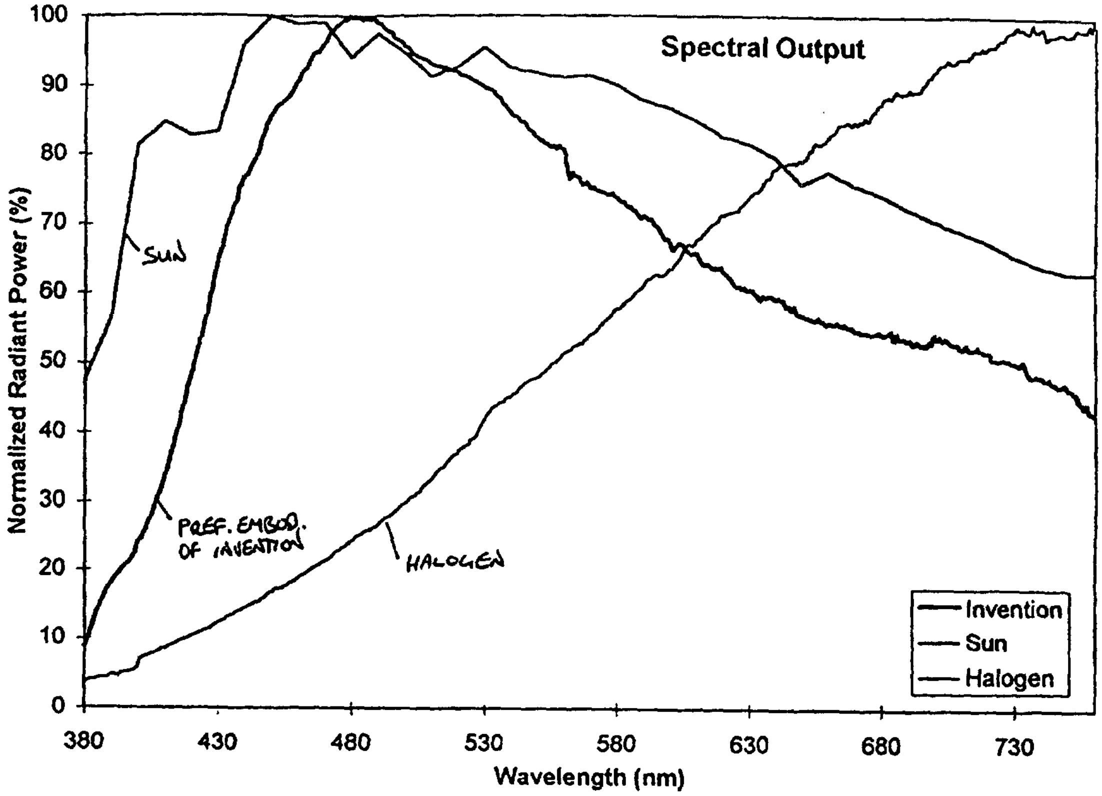
Spectral Output
Normalized Radiant Power (%)
100
90
80
70
60
50
40
30
20
10
0
380
430
480
530
580
630
680
730
Wavelength (nm)
SUN
PREF. EMBOD. OF INVENTION
HALOGEN
Invention
Sun
Halogen

FIG. 3

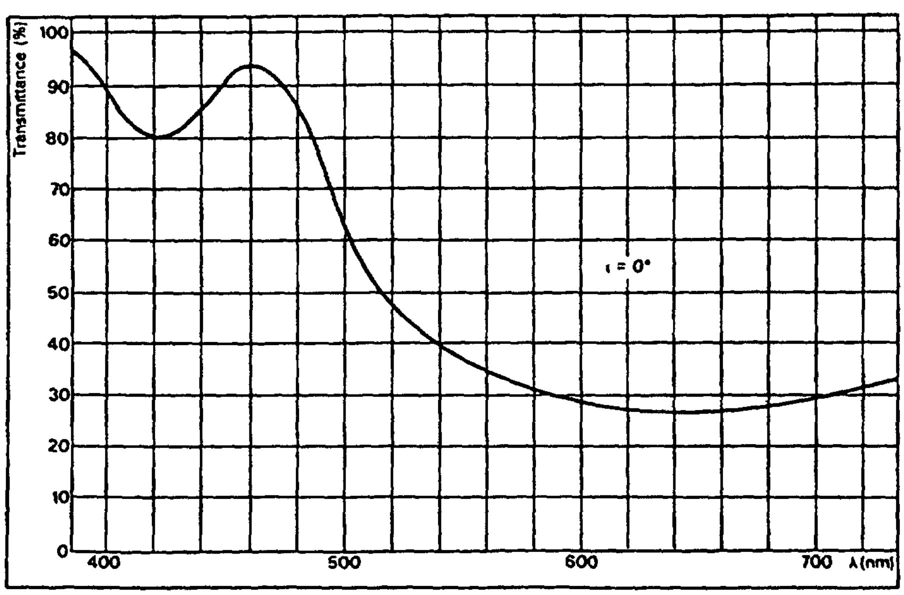
Transmittance (%)
100
90
80
70
60
50
40
30
20
10
0
400
500
600
700
λ(nm)
ι = 0°

FIG. 4

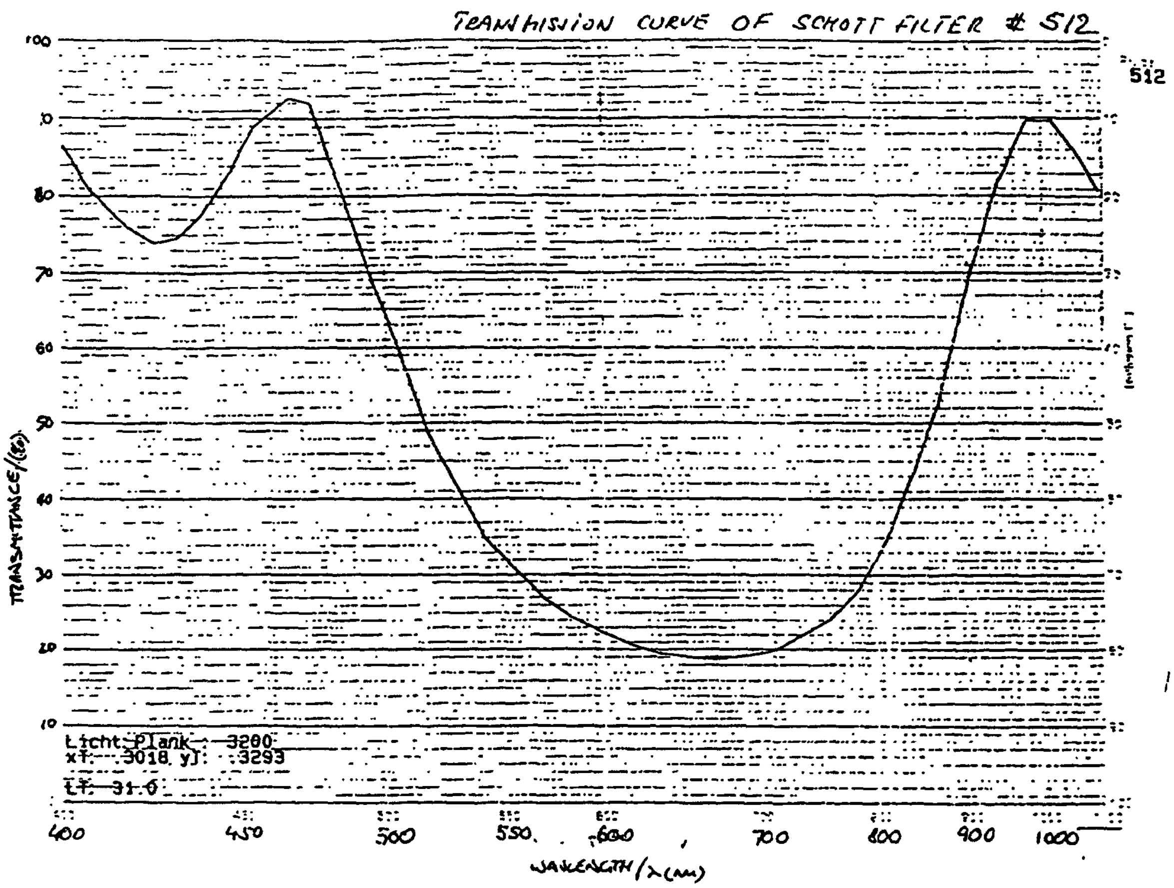
TRANSMISSION CURVE OF SCHOTT FILTER # 512
512
TRANSMITTANCE/(%)
Licht Plank 3200
xT 3018 yT 3293
LT 31.0
400
450
500
550
600
700
800
900
1000
WAVELENGTH/λ(nm)

FIG. 5

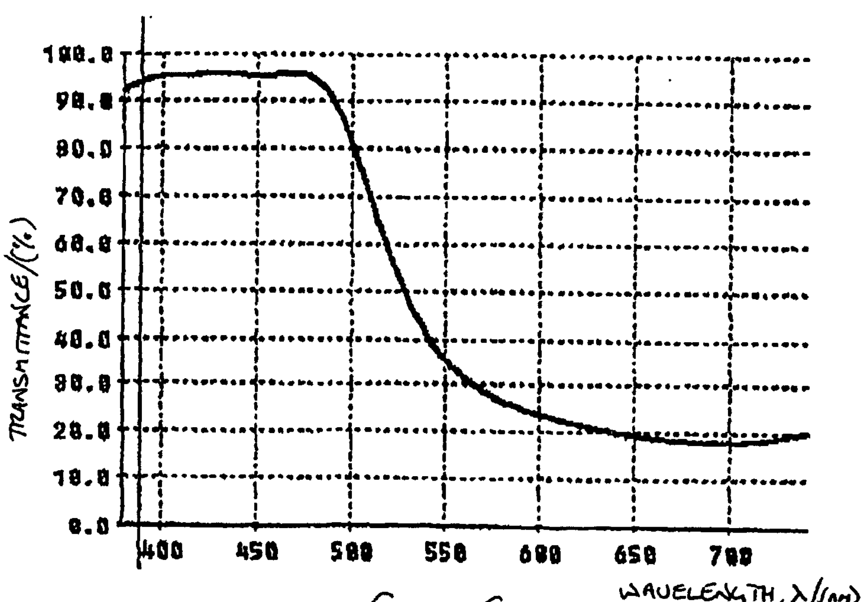
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
TRANSMITTANCE/(%)
400
450
500
550
600
650
700
WAVELENGTH, λ/(nm)

FIG. 6