(54) Title: DECORATIVE ILLUMINATION, DIFFRACTION PLATE AND SIGNBOARD USING DIFFRACTION PHENOMENON

(57) Abstract: The present invention discloses decorative illumination, diffraction plate and signboard using diffraction phenomenon. The present invention makes multiple light-source from unique light-source by repeating reflection and incidence of light radiated from light-source such as illumination, diffracts and makes interference light transmitted and radiated from multiple light-source. So, the effect of decoration and display for decorative illumination, diffraction plate and signboard using diffraction phenomenon of the present invention is increased.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
TITLE OF INVENTION

DECORATIVE ILLUMINATION, DIFFRACTION PLATE AND
SIGNBOARD USING DIFFRACTION PHENOMENON

TECHNICAL FIELD

The present invention generally relates to a decorative illumination, a
diffraction plate, and a signboard using diffraction phenomenon, and more
specifically to a decorative illumination, a diffraction plate, and a signboard using
diffraction phenomenon for forming multiple light sources from a unique light
source by repeatedly reflecting and transmitting light radiated from light source like
illumination and for increasing decorative beauty and display effects by causing
diffraction and interference as light radiated from the light sources is transmitted.

BACKGROUND ART

In prior art, as for a decorative illumination combined with decoration and
illumination effects or signboard using light sources, light radiated from unique or
multiple light sources comprised inside is radiated outside as it is.

As for a prior decorative illumination, it is common to increase an aesthetic
sense by combining light radiated from an internal light source with external shape, colors, and forms of the decorative illumination. Also, a technology of obtaining a more solid decorative effect has become influential by lighting with double numbers of the number of illumination substantially installed in prior decorative illumination. For instance, it is introduced in the Korean Patent Utility Model No. 1983-0003510.

However, the above device cannot obtain more vivid light owing to diffraction and interference, since light emitted from illumination is radiated to an opening as it is without being diffracted.

In addition, a signboard using a prior light source is mainly attached to outer walls of buildings as an advertisement, and divided into many kinds in terms of its types and functions. However, the most common type is as follows: it has a hexahedral housing, and a fluorescent lamp is installed in the housing; the housing is covered with acryl or polyvinyl materials where light of the fluorescent lamp is transmitted to some extent; and characters or images to be advertised are displayed on top of the acryl or polyvinyl materials by using paint or acryl. Besides, a method of using gas pipes and a method of illuminating outer walls after protrusively attaching characters or images to the outer walls are widely used.

But, since the prior signboard sheds light on the characters or images to be
advertised by simply using illumination, it does not use sufficient illumination, causing displaying advertisements in a simple way.

**DISCLOSURE OF INVENTION**

5

It is therefore an object of the present invention to provide a decorative illumination using diffraction phenomenon for obtaining the same effect as light is radiated from a unique light source to infinite light sources by infinitely reflecting light radiated from light sources, and for varying radiated shapes of the light according to viewing angles by diffracting and interfering in the radiated light.

10

In addition, it is another object of the present invention to provide a diffraction plate using diffraction phenomenon for increasing illumination and decorative effects of light sources by using diffraction phenomenon of light.

15

And, it is another object of the present invention to provide a signboard using diffraction phenomenon for increasing advertising and display effects by diffracting light radiated from light sources, as displaying different advertising words or firm names in the daytime and the nighttime.

20

To accomplish the above objects, in a decorative illumination having a
power line supplied with power and a illumination radiating light by receiving the power from the power line and converting electric energy into light energy, the decorative illumination using diffraction phenomenon in accordance with the present invention comprises: a plural incident plates composed of a transmissive material, a reflective coating layer formed on one side of the transmissive material, and a diffraction layer formed on the other side of the transmissive material, the reflective coating layer reflecting a portion of light radiated from the illumination and transmitting the rest of the light, and the diffraction layer diffracting the light, and the plural incident plates forming a predetermined combined body in solid type by reciprocally combining the incident plates surrounding the illumination.

In addition, the decorative illumination further comprises a reflecting plate totally reflecting the light radiated from the illumination, and combined on a lower side of the combined body of the incident plates; and plural brackets comprised in bar type, and forming predetermined solid shapes together by being arranged on an upper side of the reflecting plate, and the illumination is hanging on the brackets.

The decorative illumination further comprises a reflecting plate totally reflecting the light radiated from the illumination and combined on a lower side of the combined bodies of the incident plates. It is possible to arrange the illumination on an upper side of the reflecting plate.
In this case, a joining parts for joining the combined body of the incident plates to the reflecting plate is further comprised.

It is desirable that reflectivity of the reflective coating layer is between 30% and 90%, and able to configure it with an aluminum coating layer.

The diffractive layer can be configured with diffraction gratings or hologram films. When configured with the diffraction gratings, it is possible to configure the diffraction gratings by drawing lines in a mechanical way. At this moment, it is desirable to form the diffraction gratings at 2μm to 40μm intervals.

Also, to accomplish another object above, the diffraction plate using diffraction phenomenon in accordance with the present invention comprises: a transparent substrate; diffraction gratings comprised on one side of the transparent substrate; and a semi-transmissive layer comprised on the other side of the transparent substrate, and having 10% to 90% transmissivity.

In addition, to accomplish another object above, another embodiment of the diffraction plate using diffraction phenomenon in accordance with the present invention comprises: a transparent substrate; diffraction gratings comprised on one
side of the transparent substrate; and a semi-transmissive layer shaped as covering the diffraction gratings on the one side of the transparent substrate, and having 10% to 90% transmissivity. At this point, it is desirable to form the diffraction gratings in embossing type.

And, to accomplish another object above, the signboard using diffraction phenomenon in accordance with the present invention comprises: a housing having at least more than one light source inside; an image plate separated from an upper part of the light source at a predetermined interval, coated with a reflective material on an opposite side of a side opposite to the light source in plate type having predetermined thickness, and having many pierced grooves formed in predetermined diameter to transmit light irradiated from the light source; and a diffraction plate separated from an upper part of the image plate at a predetermined interval, coated with a semi-transmissive material on a side opposite to the image plate in a transmissive material having predetermined thickness, and formed with diffraction gratings on the opposite side thereof.

In addition, the signboard can further comprise an advertising plate separated from an upper part of the diffraction plate at a predetermined interval. And, images and/or characters to be advertised are formed on the transparent substrate with materials having transmissivity.
It is desirable that the image plate coats the side opposite to the light source with the reflective material, and the semi-transmissive material has 10% to 90% transmissivity. Also, the diffraction gratings should be comprised in embossing type.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a format diagram of a decorative illumination in accordance with the present invention.

Fig. 2 is a diagram illustrating that light is reflected and transmitted from the inside of a decorative illumination in accordance with the present invention.

Fig. 3 is a detailed format diagram of a section of incident plates in accordance with the present invention.

Fig. 4 is a first formation diagram of diffraction gratings on hologram films in accordance with the present invention.

Fig. 5 is a second formation diagram of diffraction gratings on hologram films in accordance with the present invention.

Fig. 6 is an unfolding perspective view of a signboard in accordance with the present invention.

Fig. 7 is a sectional view of a signboard in accordance with the present
invention.

Fig. 8 is a diagram illustrating a detailed configuration of an image plate used on a signboard in accordance with the present invention.

Fig. 9 is a diagram illustrating a detailed configuration of a diffraction plate in accordance with the present invention.

Fig. 10 illustrates variously transformed examples of a diffraction plate in accordance with the present invention.

Fig. 11 is a diagram illustrating a detailed configuration of an advertising plate used on a signboard in accordance with the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

The advantages, features and desirable embodiments of the present invention will now be described more fully hereinafter with reference to the accompanying drawings.

Fig. 1 is a format diagram of a decorative illumination in accordance with the present invention. Fig. 1a is an external perspective view of the decorative illumination, Fig. 1b is a diagram illustrating the inside of the decorative illumination whose incident plates are removed, and Fig. 1c is a diagram illustrating a combined shape of incident plates. Like shown in Fig. 1a through Fig. 1c, the decorative illumination in accordance with the present invention has a pyramid
shape, comprising a reflecting plate(10), incident plates(20), a power line(44), brackets(30), an electric wire(42), and illuminations(40).

The reflecting plate(10) is a base of the decorative illumination having a pyramid structure, and totally reflects light incident from the illuminations(40), making the light incident on the incident plates(20). Thus, supposing that an illumination where light is directly incident is a first light source, the reflecting plate where the reflected light is incident becomes a second light source. On the other hand, it is possible to manufacture a decorative illumination composed of incident plates only by replacing the reflecting plate(10) with the incident plates(20).

The incident plates(20) are installed to surround the illuminations with transmissive materials comprising many incident plate-combined bodies on the reflecting plate(10). Reflective coating layers are formed on inner sides of each incident plate(20), and diffraction gratings are formed on outer sides. Here, the inner sides of the incident plates(20) mean sides toward a space surrounded by the incident plate-combined bodies and the reflecting plate(10), and the outer sides mean opposite sides thereof.

Plastics or glass having transmissivity can be used as the transmissive materials.
The reflective coating layers are formed by vacuum-depositing aluminum on the transmissive materials processed with fixed density, and reflectivity inside should be between 30% ~ 90%, approximately, and more desirably, between 50% ~ 90%, approximately. When light radiated from the illuminations(40) is incident on the incident plates(20), a portion of the light is reflected on a reflective coated inner side, and the rest are emitted outside by being transmitted. The light partially reflected in the incident plates(20) is re-lected from the reflecting plate(10), and re-incident on the incident plates(20). And the re-incident light is partially reflected from the incident plates(20), and incident on the reflecting plate and other incident plates.

Through the above countless process, infinite reflections and transmissions occur within the pyramid structure of the decorative illumination.

In the meantime, the diffraction gratings can be formed by drawing lines on the transmissive materials in a mechanical way with the use of diamonds, and it is desirable to form the diffraction gratings by attaching hologram films having interference patterns(diffraction gratings) generated in a holographic way to the surface of the incident plates.

Forming the diffraction gratings in the mechanical way takes too much time.
Also when drawing the lines, the lines are apt to be curved, thereby causing noises due to irregular line intervals.

In case the hologram films having the interference patterns generated in the holographic way are attached to the surface of the incident plates, it is easy to manufacture at regular grating intervals. And, it is possible to remarkably narrow the grating intervals, thereby obtaining resolving power up to 10,000 lines/mm(line interval 0.1μm) according to the illuminations(40). Hereinafter, a method of forming the diffraction gratings will be more fully described.

The incident plates(20) are combined together on the edge as combined bodies in regular shapes, installed on the reflecting plate, and are attached to the reflecting plate(10) by connection parts(12). It is desirable that the combined bodies of the incident plates form a regular triangular pyramid.

The connection parts(12) are formed to connect the reflecting plate(10) with the incident plates. Since it is not easy to couple the reflecting plate(10) comprising the base with the incident plates(20) connected in regular triangular pyramid type, the connection parts(12) easily connect the reflecting plate with the incident plate-combined bodies. The connection parts can be united with the combined bodies, or comprised separately. The connection parts(12) and the reflecting plate(10) are
reciprocally adhered or coupled by another adhesive unit or coupling screw (not shown).

The power line (44) supplies power to the inner illuminations (40) from outside of the decorative illumination.

Meanwhile, the brackets (30) are pluraly comprised on the reflecting plate (10). By hanging the illuminations (40) and the electric wire (42) connected with the illuminations, the illuminations and the electric wire are arranged in a solid way like an incident plate (20)-combined shape (pyramid shape). The brackets (30) are formed in a part of the reflecting plate (10), except a region for being connected with the connection parts (12). If first light sources, the illuminations (40) are arranged by the brackets (30) in a solid way, it gives a more vivid effect than the decorative illumination by 2-dimensional light sources, therefore its value as the decorative illumination is more increased. Since the electric wire (42) is hanging on the brackets (30), there is a risk of short circuit if an electric conductor is used. Thus, it is desirable to use a non-conductor and, better to increase reflectivity by coating the surface. Of course, transmissive materials may be used.

However, it is possible to vary shapes, structure, and materials of the electric wire (42) and the brackets (30) without restrictions like described above.
Also, in some cases, the decorative illumination in accordance with the present invention does not have the brackets(30). In this case, the illuminations and the electric wire are arranged on an upper side of the reflecting plate.

The illuminations(40) convert electric energy into light energy by using power supplied from the electric wire(42) connected with the power line(44). Fluorescent lamps, LED lamps, or general light bulbs radiating white light can be used as the illuminations. It is possible to have one illumination, but when many illuminations are arranged by the brackets(30) in a solid way, it gives more vivid effect with an aesthetic sense. Thus, it is better to have the plural illuminations(40). A plurality of illumination give various colors.

Fig. 2 is a diagram illustrating that light is reflected and transmitted from the inside of a decorative illumination in accordance with the present invention. When reflectivity of reflective coating layers is 2/3, it illustrates that light radiated from a unique illumination appears radiated from many light sources by being reflected and transmitted from the inside of the incident plates(20). Referring to Fig. 2, reflecting and transmitting processes of the light from the inside of the decorative illumination will be described as follows.
Among light radiated from illuminations, supposing entire light(A) toward an opposite side of a reflecting plate(10) is ‘1’, 2/3 of the light(A) is reflected and 1/3 is transmitted at point “a”. 4/9 of the reflected light(A) is reflected and 2/9 thereof is transmitted at the point “a’” again. In this case, the light(A) recognizable by the eyes is recognized that light corresponding to the 2/9 of the light radiated from the illumination is radiated from the point “a” . Accordingly, supposing the illumination(40) is a first light source, the point “a” becomes a second light source. Among light radiated from the illumination(40), supposing entire light(B) toward the reflecting plate(10) is ‘1’, the light(B) is totally reflected at point “b”, 2/3 thereof is reflected and 1/3 thereof is transmitted at the point “b’ ” again. In this case, the light(B) recognizable by the eyes is recognized that light corresponding to the 1/3 of the light radiated from the illumination(40) is radiated from the point “b” . Thus, supposing the illumination(40) is a first light source, the point “b” becomes another second light source. In the meantime, among the light radiated from the illumination(40), supposing entire light(C) toward the incident plates(20) directly focused by the eyes is ‘1’, 2/3 of the light(C) is reflected and 1/3 thereof is transmitted at point “c’ ”. For descriptive convenience, three kinds of light have been described above, but the above reflective phenomenon countlessly occurs inside the decorative illumination.

Therefore, as for light sources recognizable by the eyes, infinite light sources from a unique light source are generated by a unique illumination. Strength of light
radiated from each light source can be different according to reflectivity and reflecting paths of the light. When a point light source, the illumination(40) is a monochromatic light LED, many light sources having the same wavelength are generated within the decorative illumination. On the other hand, since diffraction gratings are formed on an external side of the incident plates(20) in accordance with the present invention, the light(A, B, and C outside of the decorative illumination) passing through the incident plates is diffracted, and interference occurs again between the diffracted light(A, B, and C inside of the decorative illumination).

Fig. 3 is a detailed format diagram of a section of incident plates in accordance with the present invention. Referring to Fig. 3a, a reflective coating layer(24) like aluminum is deposited on one side of a transparent material(22), and diffraction gratings in embossing type are formed on the opposite side thereof in a mechanical way. On the other hand, referring to Fig. 3b, a reflective coating layer(24) like aluminum is deposited on one side of a transparent material(22), and hologram films(26) having diffraction gratings made in a hologram way are attached to the opposite side thereof.

Fig. 4 is a first formation diagram of diffraction gratings on hologram films in accordance with the present invention. Referring to Fig. 4, a first formation process of diffraction gratings on hologram films(26) in accordance with the present
invention are as follows.

First, suppose both first light waves\(26a\) and second light waves\(26b\) incident on the hologram films\(26\), where the diffraction gratings are not generated, are monochromatic light and plane waves. Interference patterns are generated by two waves on the hologram films\(26\). Fig. 4a shows an aspect of interference patterns being generated on the hologram film\(26\) by the two waves. Since light passes through a place where constructive interference occurs, the hologram film\(26\) gets dark after development, and it remains transparent in a place where disappearance interference occurs even after the development.

Therefore, diffraction gratings having grating-type patterns at the same intervals are formed on the hologram film\(26\) developed like above, and when the diffraction gratings are attached to an external side of incident plates, light does not pass through the part where the hologram film gets dark by the constructive interference, and the light passes through the transparent part by the disappearance interference.

In this case, given that wavelength of incident light is \(\lambda\) and an inclined angle is \(\Theta\) (inclined angle between the first light wave\(26a\) and the second light wave\(26b\)), an interval \('d'\) of the diffraction gratings can be calculated by getting
wavelength and an angle under constructive interference conditions of 
\[ d \sin \Theta = n \lambda \] (n is a constant). Desirably, the diffraction interval \( 'd' \) should be 
between 2\( \mu \)m to 40\( \mu \)m by using wavelength of a visible ray region (0.4 \( \mu \)m to 
0.6\( \mu \)m) and controlling an angle between 1° to 10°.

In the meantime, like shown in Fig. 4b, a direction of light passing through 
the diffraction gratings is \( n = -2, -1, 0, 1, 2, \ldots \). Among them, a case the \( n = 0 \), the 
light becomes the first light wave(26a) rightly passing through the diffraction 
gratings. An \( n = 1 \) wave is the same as the second light wave(26b). On the other 
hand, a wave of the \( n = -1 \) is called a conjugate wave.

Fig. 5 is a second formation diagram of diffraction gratings on hologram 
films in accordance with the present invention. Referring to Fig. 5, it shows that 
plane waves(first light waves(26c)) and a spherical wave(a second light wave(26d)) 
form diffraction gratings by being incident on hologram films(26), though they are 
all monochromatic light. In this case, it is considered that each part of the second 
light wave(26d), the spherical wave, is incident on the hologram films(26) at 
different angles as plane waves, thus intervals of interference patterns constantly 
change. When the first light waves(26c), the plane waves are lighted up on the 
hologram films(26), diffraction angles are differentiated according to each part of 
the hologram films. Therefore, an \( n = 1 \) diffraction wave becomes a spherical wave
radically emitted as if it starts from a point light source. And, an $n=1$ wave forms a real image of a point light source by gathering on one point. At this time, observing a wave radiating as a spherical wave only over a back side of the hologram films, it feels like light is radiated from the point light source. If there are many point light sources, interference effects appear complexly duplicated, thus diffracting the light as if there are many point light sources. If the first light waves(26c) are lighted up on the hologram films(26) where the interference patterns are generated, it feels like a light source exists beyond the hologram films. In addition, shapes observed according to the line of sight are differentiated.

Fig. 6 is an unfolding perspective view of a signboard in accordance with the present invention. Like shown in Fig. 6, the signboard in accordance with the present invention comprises a housing(50), an illumination(60), an image plate(70), a diffraction plate(80), and an advertising plate(90).

The housing(50) has at least more than one illumination(60) on one side. A fluorescent lamp, an LED lamp, or a general bulb can be used as the illumination. Also, light radiated from the illumination should be upward by coating certain regions of each side inside of the housing with reflective materials.

The image plate(70) for displaying characters or images is installed in an
upper part of the illumination(60) with a plurality of small-sized holes(78). Accordingly, light radiated by the illumination(60) is radiated to an upper part of the image plate through the small holes(78) formed on the image plate(70). By coating a lower side of the image plate(70) with a total reflection material, it prevents the light radiated from the illumination(60) from being absorbed by the image plate, thereby radiating all light upward through the holes(78) as possible. And an upper side of the image plate(70) is coated with the total reflection material.

The diffraction plate(80) is installed in the upper part of the image plate(70) at predetermined interval. A lower side of the diffraction plate(80), that is, a side opposite to the upper side of the image plate(70) is coated with a semi-transmissive material having 10% to 90% transmissivity, and it is desirable to maintain 40% to 60% transmissivity. Light radiated through the holes(78) formed on the image plate(70) should be diffracted by comprising diffraction films on an upper side of the diffraction plate(80). By diffracting the light, the light radiated from the small-sized holes appears diffused in many wavelengths, thereby avoiding simplicity of characters and images to be displayed.

The housing(50) has hooking ends(54) on inner sides in order to install the image plate(70) and the diffraction plate(80). When installing the image plate and the diffraction plate in the housing, they should be hooked over the hooking ends or
fixed with another adhesives or coupling screws. Of the inner sides of the housing, the hooking ends are comprised on at least more than two sides.

The advertising plate(90) reflecting a specific wavelength of natural light radiated from the sun is installed on the upper side of the diffraction plate(80). Thus, the advertising plate is arranged on an upper end of the housing(50).

An operation of the signboard by the present invention will be described as follows.

First, the illumination(60) keeps turned off in the daytime. Accordingly, advertising words or advertising images formed on top of the advertising plate(90) are displayed in the daytime. On the other hand, the illumination(60) turns on at night, radiating light from the illumination. And, the light radiated from the illumination is emitted through the small holes(78) formed on the image plate(70).

The light emitted through the holes of the image plate is reflected many times between the image plate(70) and the diffraction plate(80), and incident on the advertising plate(90) by transmitting the diffraction plate. Since the advertising plate(90) is formed with semi-transmissive advertising contents formed in an upper part of a transmissive substrate, the light incident on the advertising plate(90) lights up outside. At this moment, the light is emitted through the small holes formed on the image plate(70), thus it is possible to display the advertising contents formed on
the image plate(70).

Fig. 7 is a sectional view of a signboard in accordance with the present invention, showing arranged relations of each component described in Fig. 6. Like shown in Fig. 7, an illumination(60) is arranged on one side of a housing(50), and an image plate(70), a diffraction plate(80), and an advertising plate(90) are sequentially arranged at regular intervals in an upper part thereof.

The signboard in accordance with the present invention displays images or character advertisements comprised on the advertising plate(90) by using natural light while turning off the illumination(60) in the daytime, and displays “2002” in a case of Fig. 6. Also, it turns on the illumination(60) at night, thereby displaying advertising contents displayed by small holes(78) formed on the image plate(70). In the case of Fig. 6, “seoul” is displayed. At this time, since light passing through the holes of the image plate is diffracted through the diffraction plate(80) and radiated, the advertising contents of the image plate are displayed in diffracted state. Thus, the signboard in accordance with the present invention can display different contents of advertisements in the daytime and the nighttime.

In addition, each side of the housing(50) having the illumination(60) is coated with a reflective layer(52), thereby increasing efficiency of the illumination(60) and it is desirable to coat the reflective layer(52) with a total
reflection material.

Fig. 8 illustrates a detailed configuration of an image plate(70) used on a signboard in accordance with the present invention. Like shown in Fig. 8, the image plate(70) is fabricated, coating an upper side and a lower side of a transparent or an opaque substrate(72) with total reflection layers(74, 76).

The total reflection layer(76) formed on the lower side of the image plate(70) with a total reflection layer(52) formed on an inner side of a housing(50) radiates light radiated from an illumination(60) outside through holes(78) only of the image plate, thereby increasing efficiency of the illumination(60). In addition, the small holes(78) are formed on the image plate(70) to display images or characters to be advertised. In Fig. 6, a character string "seoul" is displayed by using each hole(78).

Fig. 9 illustrates a detailed configuration of a diffraction plate in accordance with the present invention. Like shown in Fig. 9, the diffraction plate(80) forms emboss diffraction gratings(84) on an upper side of a substrate having good transparency or a film(82), and coats a lower side with a semi-transmissive material(86).
PVC(Polyvinyl chloride), PET(Polyester), cellophane, PE(Polyethylene), PP(Polypropylene), EVA(Ethylene vinyl acetate), Ionomer, PVDC(Polyvinylidene chloride), PS(Polystyrene), PSP(Polystyrene Popir), BOPS(bishially oriented PS Sheet), PC(Polycarbonate), PVAC(Polyvinyl alcohol), acrylic resin, and glass having good transparency are used as the substrate or the film(82).

Light radiated through many small holes(78) formed on an image plate(70) is irregularly reflected between the semi-transmissive material(86) formed on the diffraction plate(80) and a total reflection layer(74) formed on an upper side of the image plate(70), and incident on the semi-transmissive material(86) formed on the diffraction plate(80). On this occasion, an inner side of the housing(50) between the semi-transmissive material(86) formed on the diffraction plate(80) and the total reflection layer(74) formed on the upper side of the image plate(70) has an increased light reflectivity by coating a total reflection layer(52). Also, owing to irregular reflection between the semi-transmissive material(86) formed on the diffraction plate(80) and the total reflection layer(74) formed on the upper side of the image plate(70), it looks there are more holes than the actual holes(78). Light radiated from the semi-transmissive material(86) is emitted outside after being diffracted by the diffraction gratings(84) formed on the upper side of the diffraction plate(80).

A method of making an emboss hologram will be simply described as
follows, since it has been already announced.

Rainbow embossing holograms in credit cards, commonly used among users, can be mass-produced by forming the rainbow holograms as masters and performing a print process. Generally, when manufacturing the embossing holograms, holograms whose surface is concave are made by using photo resister as a photosensitive material. At this time, depth of the concave surface should be less than 0.4μm. Since the surface of the photo resister is not strong, mass-printing is impossible. Thus, a metal mold is formed with unevenness. Commonly, nickel is used as the metal mold. To make a nickel mold, gold or silver is deposited on a developed photo resister, adding conductivity, and a nickel plate is removed by nickel-plating between 200μm and 300μm, approximately. By printing as heating thermoplastics with the nickel mold, the emboss holograms are formed. If a resin series of substrate is used, the emboss holograms are easily formed by using the nickel mold, but if the substrate is made of glass, the emboss holograms are formed by a UV deposition method.

There are methods of forming diffraction gratings by a laser beam and by manufacturing a mask through lithography.

In the method of using the laser beam, when dividing the laser beam into
two by a beam splitter and interfering in them at optional angle, grating patterns are made.

**[Formula 1]**

\[ d \sin \theta = \lambda \]

Here, 'd' is a grating pattern period, \( \theta \) is an interference angle, and \( \lambda \) is wavelength of recorded light.

As an \( \theta \) value is small, the formula 1 can be used as a formula 2.

**[Formula 2]**

\[ d \theta = \lambda \]

Wanted grating patterns can be created by using the formula 2.

In addition, when forming the diffraction gratings by manufacturing a mask through lithography, draw the gratings by using autocad and manufacture the created gratings through lithography.
Fig. 10 illustrates variously transformed examples of a diffraction plate in accordance with the present invention. Fig. 10a illustrates a configuration of forming diffraction gratings(84) in an upper part of a transparent substrate(82) and depositing a semi-transmissive layer(86) in an upper part of the diffraction gratings(84), and Fig. 10b illustrates a reversed state of the substrate of Fig. 10a, having diffraction gratings(84) in a lower part of a transparent substrate(82) and depositing a semi-transmissive layer(86) in a lower part of the diffraction gratings(84). Also, in case of Fig. 10c, a semi-transmissive layer(86) is deposited on a transparent substrate(82), and diffraction gratings(84) are formed in a lower part of the transparent substrate(82). As the commonest method of forming a reflective layer and a transmissive layer applied to a signboard in accordance with the present invention, there is an aluminum deposition method.

Fig. 11 illustrates a detailed configuration of an advertising plate used on a signboard in accordance with the present invention. Like shown in Fig. 11, an advertising plate(90) is formed by attaching a semi-transmissive layer(94) presenting advertising contents with emboss diffraction gratings or semi-transmissive colored paper on a substrate having good transparency or an upper side of a film(92).

PVC(Polyvinyl chloride), PET(Polyestor), cellophane, PE(Polyethylene),
PP(Polypropylene), EVA(Ethylene vinyl acetate), Ionomer, PVDC(Polyvinylidene chloride), PS(Polystyrene), PSP(Polystyren Popir), BOPS(bisxially oriented PS Sheet), PC(Polycarbonate), PVAC(Polyvinyl alcohol), acrylic resin, and glass having good transparency are used as the transmissive substrate(92).

Forming the emboss diffraction gratings with the semi-transmissive layer(94) is the same as forming the diffraction gratings(84) on the above diffraction plate(80). However, diffraction gratings formed on the advertising plate(90) make grating intervals in order to selectively reflect visible rays, and advertisement is displayed in the daytime with the use of the diffraction gratings when an illumination(60) is turned off.

The semi-transmissive layer(94) can be manufactured by forming characters or images to be advertised with the use of semi-transmissive colored paper such as cellophane or semi-transmissive ink, except a method of forming diffraction gratings. In Fig. 6, a character string “2002” is displayed on the advertising plate(90).

**INDUSTRIAL APPLICABILITY**

Like described so far, the present invention can remarkably improve
decorative effects and advertising/display effects with the use of illumination by repeatedly reflecting and transmitting light radiated from illuminations.

Concretely, in case of a decorative illumination in accordance with the present invention, it can obtain an effect of installing multiple illuminations rather than the actual number of installed illuminations, by repeatedly reflecting and transmitting light radiated from illuminations with a reflecting plate and a semi-transparent incident plate while lighting up. Thus, it can magnify aesthetic efficiency from a unique light source as well as magnify decorative beauty by more solid appearance.

In addition, the present invention interferes in and diffracts light radiated from many light sources on the surface of incident plates, thereby obtaining more vivid decorative effects by only light radiated from illumination in harmony with various colors and a cubic effect, without giving another beauty factors to external shape, forms, or colors of the decorative illumination.

And, for the signboard in accordance with the present invention, since light radiated from illumination is sufficiently used, diffraction of the light can be easily used without any decoration such as crystal. In the daytime, advertisement is displayed through an advertising plate manufactured to display advertising contents
by reflecting a specific wavelength, and also through light radiated by holes formed on an image plate by turning off the illumination at night, thereby differently advertising in the daytime and the nighttime.

5 It is to be understood that changes and modifications to the embodiments described above will be apparent to those skilled in the art, and are contemplated. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, that are intended to define the spirit and scope of this invention.
CLAIMS

What is claimed is:

5  1. In a decorative illumination, said decorative illumination having a power line, said power line supplied with power and a illumination, said illumination radiating light by receiving power from said power line and said illumination converting electric energy into light energy, said decorative illumination using diffraction phenomenon, comprising:

10 a plural incident plates, said incident plates composed of a transmissive material, a reflective coating layer, said reflective coating layer formed on one side of said transmissive material, and a diffraction layer, said diffraction layer formed on the other side of said transmissive material, said reflective coating layer reflecting a portion of light, said light radiated from said illumination and said reflective coating layer transmitting the rest of said light, and said diffraction layer diffracting said light,

and said plural incident plates forming a predetermined combined body in solid type by reciprocally combining said incident plates, said combined body of said incident plates surrounding said illumination.

20 2. Said decorative illumination using diffraction phenomenon of claim 1, where in
said decorative illumination further comprises:

a reflecting plate, said reflecting plate totally reflecting said light radiated from said illumination, and said reflecting plate combined on a lower side of said combined body of said incident plates; and

a plural brackets, said brackets comprised in bar type, and said brackets forming predetermined solid shapes together by being arranged on an upper side of said reflecting plate,

and said illumination is hanging on said brackets.

3. Said decorative illumination using diffraction phenomenon of claim 2, wherein said decorative illumination further comprises a joining parts, said joining parts joining said combined body of said incident plates to said reflecting plate.

4. Said decorative illumination using diffraction phenomenon of claim 1, wherein said decorative illumination further comprises a reflecting plate, said reflecting plate totally reflecting said light radiated from said illumination, and said reflecting plate combined on the lower side of said combined body of said incident plates,

and said illumination is arranged on the upper side of said reflecting plate.

5. Said decorative illumination using diffraction phenomenon of claim 4, wherein said decorative illumination further comprising a joining parts, said joining parts
joining said combined body of said incident plates to said reflecting plate.

6. Said decorative illumination using diffraction phenomenon of claim 1, wherein reflectivity of said reflective coating layer is between 30% and 90%.

7. Said decorative illumination using diffraction phenomenon of claim 1, wherein said reflective coating layer is aluminum coated layer.

8. Said decorative illumination using diffraction phenomenon of claim 7, wherein reflectivity of said reflective coating layer is between 30% and 90%.

9. Said decorative illumination using diffraction phenomenon of claim 1, wherein said diffraction layer is diffraction gratings.

10. Said decorative illumination using diffraction phenomenon of claim 9, wherein said diffraction gratings are formed from drawing lines in a mechanical way.

11. Said decorative illumination using diffraction phenomenon of claim 9, wherein said diffraction gratings are formed at 2 \( \mu \text{m} \) to 40 \( \mu \text{m} \) intervals.

12. Said decorative illumination using diffraction phenomenon of claim 1, wherein
said diffraction layer is hologram film.

13. A diffraction plate, said diffraction plate comprising:

a transparent substrate;

diffraction gratings, said diffraction gratings comprised on one side of said transparent substrate; and

a semi-transmissive layer, said semi-transmissive layer comprised on the other side of said transparent substrate, and said semi-transmissive layer having 10% to 90% transmissivity.

14. Said diffraction plate of claim 13, wherein said diffraction gratings are comprised in embossing type.

15. A diffraction plate, said diffraction plate comprising:

a transparent substrate;

diffraction gratings, said diffraction gratings comprised on one side of said transparent substrate; and

a semi-transmissive layer; said semi-transmissive layer covering said diffraction gratings on said one side of said transparent substrate, and said semi-transmissive layer having 10% to 90% transmissivity.
16. Said diffraction plate of claim 15, wherein said diffraction gratings are comprised in embossing type.

17. A signboard using diffraction phenomenon, said signboard comprising:

a housing, said housing having at least more than one light source inside;
an image plate, said image plate separated from an upper part of said light source at predetermined interval, said image plate coated with a reflective material on an opposite side of a side facing to said light source in plate type having predetermined thickness, and said image plate having many pierced grooves formed in predetermined diameter to transmit light irradiated from said light source; and
a diffraction plate, said diffraction plate separated from an upper part of said image plate at a predetermined interval, said diffraction plate coated with a semi-transmissive material on a side facing to said image plate in a transmissive material having predetermined thickness, and said diffraction plate formed with diffraction gratings on the opposite side thereof.

18. Said signboard using diffraction phenomenon of claim 17, wherein said signboard further comprises an advertising plate, said advertising plate separated from an upper part of said diffraction plate at predetermined interval, and said advertising plate having images and/or characters to be advertised being formed on a transparent substrate with materials having transmissivity.
19. Said signboard using diffraction phenomenon of claim 17, wherein said image plate is coated with said reflective material on a side facing to said light source.

20. Said signboard using diffraction phenomenon of claim 17, wherein transmissivity of said semi-transmissive material is between 10% and 90%.

21. Said signboard using diffraction phenomenon of claim 17, wherein said diffraction gratings are comprised in embossing type.
FIG. 2
FIG. 3

Diagram showing two sections labeled 'a' and 'b', with labeled elements 22, 24, and 26.
A. CLASSIFICATION OF SUBJECT MATTER

IPC7 F21V 7/22

According to International Patent Classification (IPC) or to both national classification and IPC.

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 F21V 7/22; G02B 5/18; F21V 7/22; G02B 5/18

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KR classes as above.

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>KR 2001-0074425 A (LUCKOFF DISPLAY CORPORATION) 4 AUGUST 2001 Fig. 3,4,5,7,9</td>
<td>1,2,10,17,18,19,21</td>
</tr>
<tr>
<td>A</td>
<td>KR 1984-0007559 U (KWANG NAM LEE) 22 DECEMBER 1984 Fig. 2</td>
<td>2,17,18,19</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "E" earlier application or patent but published on or after the international filing date
  "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
  "O" document referring to an oral disclosure, use, exhibition or other means
  "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art document member of the same patent family

Date of the actual completion of the international search
17 MARCH 2003 (17.03.2003)

Date of mailing of the international search report
19 MARCH 2003 (19.03.2003)

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea

Authorized officer
Yoon, Se Won

Facsimile No. 82-42-472-7140
Telephone No. 82-42-481-5640

Form PCT/ISA/210 (second sheet) (July 1998)
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>KR 1985-0007559 U</td>
<td>22-12-1984</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>