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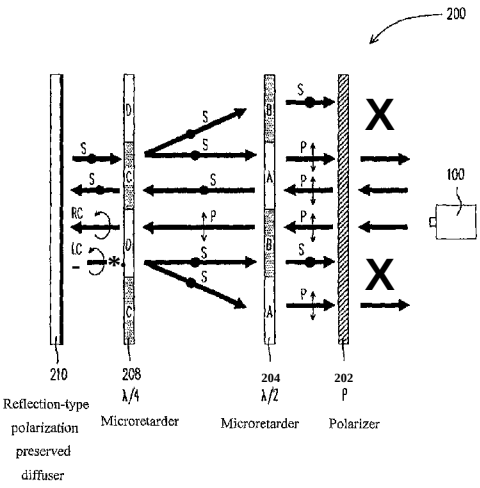


FIG. 4

(57) Abstract: A projection auto-stereoscopic display includes an image projector (100) and a stereo screen (200). The image projector (100) projects image. The image includes multiple viewing-zone pictures. The stereo screen (200) receives the image and reflects the image. The stereo screen (200) includes a linear polarizer (202), for receiving the image projected thereon and filtering the image in polarization. A first micro-retarder layer (204) is attached behind over the linear polarizer. A second micro-retarder layer (208) is disposed behind over the first micro-retarder layer (204). A reflection-type polarization preserved diffuser is disposed behind the second micro-retarder layer, for reflecting and diffusing an incident light into various directions.

WO 2012/000164 A1

PROJECTION AUTO-STEREOSCOPIC DISPLAY AND STEREO SCREEN

TECHNICAL FIELD

The disclosure relates to projection autostereoscopic display using a stereo screen to display a 3D image.

BACKGROUND

The 3D display will be one of the trends in next generation in display industry. The 3D display is also known as stereoscopic display. The mechanism to display image in 3D effect is based on the property of eyes. When the two eyes separately observe the images for the same object but with parallax, the images seen by the human eyes are fused in the brain and the viewer perceives a single 3D image. In the earlier 3D display, in order to let the two eyes separately observe the images with parallax, an observer needs to wear eyeglasses to see the 3D images.

As the fast development in technology, the digital TV or digital display has been rather popular and then the new generation for 3D display has been also developed. Now, it is possible to observe the 3D image by naked eyes, i.e. without wearing extra eyeglasses. A naked-eye 3D display produces 2 or more viewing zones in front of the display screen. Each of the viewing-zone images has a parallax relative to each other. When the two eyes located in different viewing zones separately observe two images with parallax, an image with depth effect is produced in human brain.

In a 3D display system, the size of screen is usually an important factor for depth sensation, larger screen provide the ability of producing large depth range. The projection display, especially front projection type which is popularly used in 3D theaters, has advantage of producing larger image than flat panel displays. However, the audiences have to wear extra glasses to watch the 3D movies. Front projection type autostereoscopic displays are still under development.

SUMMARY

The disclosure provides a projection autostereoscopic display to display the 3D image, using a stereo screen. The naked eyes can still directly observe the 3D image based on the effect of parallax barrier.

The disclosure provides a projection autostereoscopic display, comprising an image projector and a stereo screen. The image projector is used to project an image, wherein the image includes multiple viewing-zone images. The stereo screen is receiving the image and reflecting the image back to an observing direction. The stereo screen has multiple optical stack layers. In a relative sequence from the projector, the stereo screen comprises a linear polarizer, a first microretarder layer, a second microretarder layer, and a reflection-type polarization preserved diffuser. The linear polarizer is for receiving the image incident thereon and filtering the image in polarization. The first microretarder layer is attached behind over the linear polarizer, wherein the first microretarder layer has a plurality of first-retarding column regions and a plurality of second-retarding column regions, being alternatively configured. The second microretarder layer is disposed behind over the first microretarder layer by a distance, wherein the second microretarder layer has a plurality of third-retarding column regions and a plurality of fourth-retarding column regions, being alternatively configured. The reflection-type polarization preserved diffuser is disposed behind over the second microretarder layer for reflecting and diffusing an incident light into various directions, wherein a polarization still preserved.

The disclosure provides stereo screen, used to receive an image and reflect the image back to an observing direction. The stereo screen having multiple optical stack layers comprises a linear polarizer, a first microretarder layer, a second microretarder layer, and a reflection-type polarization preserved diffuser. The linear polarizer is for receiving the image incident thereon and filtering the image in polarization. The first microretarder layer is attached behind over the linear polarizer, wherein the first microretarder layer has a plurality of first-retarding column regions and a plurality of second-retarding column regions, being alternatively configured. The second microretarder layer is disposed behind over the first microretarder layer by a distance, wherein the second

microretarder layer has a plurality of third-retarding column regions and a plurality of fourth-retarding column regions, being alternatively configured. The reflection-type polarization preserved diffuser is disposed behind over the second microretarder layer for reflecting and diffusing an incident light into various directions, wherein a polarization still preserved.

It is to be understood that both the foregoing general description and the following detailed description are exemplary, and are intended to provide further explanation of the disclosure as claimed.

DESCRIPTION OF DRAWINGS

The accompanying drawings are included to provide a further understanding of the disclosure, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the disclosure and, together with the description, serve to explain the principles of the disclosure.

FIG. 1 is a drawing, schematically illustrating a system of a projection autostereoscopic display, according to an embodiment of the disclosure.

FIG. 2 is a drawing, schematically illustrating a structure of first microretarder layer, according to an embodiment of the disclosure.

FIG. 3 is a drawing, schematically illustrating a structure of second microretarder layer, according to an embodiment of the disclosure.

FIG. 4 is a drawing, schematically illustrating a mechanism of barrier function for the parallax barrier in 3D display of a projection autostereoscopic display, according to an embodiment of the disclosure using an example.

FIG. 5 is a drawing, schematically illustrating a general mechanism of barrier function for the parallax barrier in 3D display of a projection autostereoscopic display, according to an embodiment of the disclosure.

FIG. 6 is a drawing, schematically illustrating a mechanism of 3D display of a projection autostereoscopic display by two viewing zones, according to an embodiment of the disclosure.

FIG. 7 is a drawing, schematically illustrating a mechanism of 3D display of a projection autostereoscopic display by four viewing zones, according to an

embodiment of the disclosure.

FIG. 8 is a drawing, schematically illustrating another structure of first microretarder layer in slant type, according to an embodiment of the disclosure.

FIG. 9 is a drawing, schematically illustrating another structure of second microretarder layer in slant type, according to an embodiment of the disclosure.

FIG. 10 is a drawing, schematically illustrating the arrangement of microretarder layer in slant type with respect to the image pixel pattern, according to an embodiment of the disclosure.

FIG. 11 is a drawing, schematically illustrating a system of a projection autostereoscopic display with multiple projectors, according to an embodiment of the disclosure.

FIG. 12 is a drawing, schematically illustrating a system of a projection autostereoscopic display with phase compensator, according to an embodiment of the disclosure.

DETAILED DESCRIPTION

In the disclosure, a projection autostereoscopic display is proposed. The projection autostereoscopic display can display the 3D image observed by naked eyes. Due to the properties of projection display, a large display screen with 3D effect can be achieved. In addition, multiple viewing-zone images can be produced. The observer can have more moving space to observe the 3D image. The projector is projecting the image from the front side of the screen. The backside space occupied by the screen can be reduced.

Several embodiments are provided to describe the disclosure. However, the disclosure is not limited to the embodiments. In addition, the embodiments can be properly combined to each other into another embodiment without restriction to individual embodiment.

FIG. 1 is a drawing, schematically illustrating a system of a projection autostereoscopic display, according to an embodiment of the disclosure. In FIG. 1, a projection autostereoscopic display is provided for description. The projection autostereoscopic display takes one projector 100 as an example.

However, multiple image projectors can be used to compose a more large size 3D image, as to be described later. The image projector projects an image onto a stereo screen 200. The image includes multiple viewing-zone images. Each of the viewing-zone images has a relative parallax to each other. As a result, when two eyes separately observe different two viewing-zone images, a stereo effect for the image can be created in the brain.

The stereo screen 200 is designed to have the parallax barrier function. The image can be projected in front of the stereo screen and the observer can watch the 3D images from the same side of the screen, without wearing any extra glasses. The stereo screen 200 is an optical stack layer. In structure point of view, the stereo screen 200 includes a linear polarizer 202, a first microretarder layer 204, a second microretarder layer 208, and a reflection-type polarization preserved diffuser 210. Usually, the linear polarizer 202 and the first microretarder layer 204 are directly attached together, for example. Likewise, the second microretarder layer 208 and the reflection-type polarization preserved diffuser 210 are directly attached together, for example. The first microretarder layer 204 is separate from the second microretarder layer 208 by a space 206 with a distance. The distance is for allowing the image light reflected from the reflection-type polarization preserved diffuser 210 and through different column of the second microretarder layer 208 to be viewed through different column of the first microretarder 204 layer from different angle by the observer. The thickness of the space 206 is just a design parameter under adjustment. The space 206 can be formed by a transparent material layer or just a separation by transparent spacers without being limited to a specific structure.

Generally, the linear polarizer 202 receives the image and filtering the passing image in polarization. The first microretarder layer 204 attached behind over the linear polarizer 202. The second microretarder layer 208 is disposed behind over the first microretarder layer 204. The second microretarder layer 208 and the first microretarder layer 204 can be separated by a distance, in which the space 206 is formed for separation. The reflection-type polarization preserved diffuser 210 is disposed behind over the second microretarder layer 208

for reflecting and diffusing an incident light into various directions, wherein a polarization still preserved.

FIG. 2 is a drawing, schematically illustrating a structure of first microretarder layer, according to an embodiment of the disclosure. In FIG. 2, the first microretarder layer 204 in front view has a plurality of retarding column regions B in first retarding effect shown in shading regions and a plurality of retarding column regions A in second retarding effect shown in white regions. The regions A and B are alternatively disposed. An example for the A region is with half-wavelength retarding effect, having optical axis in ±45 degrees with the polarization axis of linear polarizer 202. The B region has no retarding effect and can also be referred as zero retarding effect, alternatively. Furthermore examples in general are to be described later.

FIG. 3 is a drawing, schematically illustrating a structure of second microretarder layer, according to an embodiment of the disclosure. The second microretarder layer 208 has a plurality of retarding column regions C in third retarding effect shown in shading regions and a plurality of retarding column regions D in fourth retarding effect shown in white regions. The regions C and D are alternatively disposed. An example for the C region is no retarding effect and D region with quarter-wavelength retarding effect, having optical axis in ±45 degrees with the polarization axis of linear polarizer 202. Furthermore examples in general are to be described later. It is noted that the C, D regions of the second microretarder layer 208 locate right after the A, B regions of the first microretarder layer 204. The light from the projector and passing through regions A, B go to C, D regions respectively only.

FIG. 4 is a drawing, schematically illustrating a mechanism of barrier function for the parallax barrier in 3D display of a projection autostereoscopic display, according to an embodiment of the disclosure using the above-mentioned example. In FIG. 4, the image light is projected by the image projector 100 onto the stereo screen 200 at the polarizer 202, which is linear polarizer 202, such as the P polarizer. Usually, the linear polarizer 202 and the first microretarder layer 204 are directly attached. The P-polarization light directly enters the first

microretarder layer 204 at the A retarding column region and the B retarding column region. Here, only a portion of the light is shown to describe the mechanism. However, the light behaviors remain the same in other portion.

For the portion of the P-polarization light entering the A region with half-wavelength retardation of the first microretarder layer 204, it becomes a S polarization. Then, the S polarization light enters the C column region with 0 retardation of the second microretarder layer 208. The C column region with 0 retardation does not change the polarization state of the passing light. As a result, the S polarization light enters the reflection-type polarization preserved diffuser 210, which reflects the incident light with diffusing effect into a range of viewing angle. The polarization state after reflection from the reflection-type polarization preserved diffuser 210 is preserved. The reflected S polarization light directly enters the second microretarder layer 208 at the C column region with 0 retardation and keeps the S polarization state. Due to the diffusing function, the reflected S polarization light may enter the first microretarder layer 204 at the A column region with half-wavelength retardation or the B column region with 0 retardation. If the S polarization light enters the first microretarder layer 204 at A column region with half-wavelength retardation, the S polarization state is changed into P polarization state. If the S polarization light enters the first microretarder layer 204 at the B column region with 0 retardation, the S polarization state remains. In this example, the linear polarizer 202 is the P-state polarizer 202, the S-state light incident to the linear polarizer 202 is filtered without passing but the P state light passes the P-state polarizer 202. The barrier property is like the function of the parallax barrier.

In another part about the P-state light from the linear polarizer 202 to enter the B column region with 0 retardation of the first microretarder layer 204, it keeps the same P-state and enters the D column region with quarter-wavelength retardation of the second microretarder layer 208. Due to the retarding effect of the second microretarder layer, the P-state light becomes right-hand circular polarization (RC). The light with the RC-state is reflected by the reflection-type polarization preserved diffuser 210 and changed to left-hand circular polarization

(LC). The reflected LC-state light enters the D column region with quarter-wave retardation of the second microretarder layer 208 again, and becomes the S polarization state. The backward S polarization light may enter either the A column region with half-wavelength retardation or the B column region with 0 retardation of the first microretarder layer 204. If the backward S polarization light enters the first microretarder layer 204 at A column region with half-wavelength retardation, the S polarization state is changed into P polarization state and pass through the polarizer 202. If the S polarization light enters the first microretarder layer 204 at the B column region with 0 retardation, the S polarization state remains. and is filtered away by the liner polarizer 202.

As a result, the stereo screen 200 also has the function of parallax barrier. The stereo screen 200 can directly project the viewmg-zone images separately to two eyes to produce the 3D image. The stereo screen 200 can receive the projected imaged from the front side. The image from the image projector 100 can always reach the reflection-type polarization preserved diffuser 210 without being blocked but just the change of polarization state and some minor brightness decay due to the absorption of the material. In other words, the stereo screen 200 can receive the image light without losing pixels of the image content. However, for the reflected light, the parallax forms according to the design of the first microretarder 204. The result is just like putting a parallax barrier in front of a display panel, except that the image pixel is projected from the front side.

The foregoing example is not the only possible arrangement. In other words, the regions A, B, C and D shown in FIGs. 2-3 may have different retarding effects. The operation mechanism still remains the same but the actual detailed effects in FIG. 4 are different. The more general descriptions are shown in FIG. 5. FIG. 5 is a drawing, schematically illustrating a more general mechanism of barrier function for the parallax barrier in 3D display of a projection autostereoscopic display, according to an embodiment of the disclosure. In FIG. 5, the stereo screen 200' is also shown in four regions A, B, C, and D for the first microretarder layer 204' and the second microretarder layer 208' . When the light enters the polarizer 202' and then reflected by the screen 210', there are four light

path patterns as follows:

Light path 1 : p polarized light -→ A -→ C -→ C -→ A;

Light path 2 : p polarized light -→ A → C → C → B;

Light path 3 : p polarized light -→ B -→ D -→ D -→ B; and

Light path 4 : p polarized light -→ B → D → D → A.

In order to get the parallax barrier effect from the first microretarder layer 204' and the second microretarder 208', it needs to get the light passing light paths 1 and 4 in P polarization state and the light passing light paths 2 and 3 in S polarization state. To meet this condition, the retarding regions between the four regions A, B, C, and D basically needs to satisfy the conditions:

1. A+C = $\pm m\pi$, m =0, 1, 2, 3, …;
2. B+D = $\pm(n+1/2)\pi$, n=0, 1, 2, …; and
3. A-B = $\pm(2k+1)\pi$, k = 0, 1, 2, 3, … .

More examples with the parallax barrier effect for 3D display are shown in Table 1. However, Table 1 is also just for some more examples but not for all situations.

Table 1

A	B	C	D	Light path	Result
π	0	0	π/2	#1 P→A→C→C→A	P
				#2 P→A→C→C→B	S
				#3 P→B→D→D→B	S
				#4 P→B→D→D→A	P
π	0	π	π/2	#1 P→A→C→C→A	P
				#2 P→A→C→C→B	S
				#3 P→B→D→D→B	S
				#4 P→B→D→D→A	P
π/2	-π/2	π/2	0	#1 P→A→C→C→A	P
				#2 P→A→C→C→B	S
				#3 P→B→D→D→B	S
				#4 P→B→D→D→A	P

Alternatively, the parallax barrier effect can also be achieved by getting the

light paths 1 and 4 in S polarization state and the light paths 2 and 3 in P polarization state. In this case, the retarding regions between the four regions A, B, C, and D basically needs to satisfy the conditions:

1. B+D = $\pm m\pi$, m =0, 1, 2, 3, …;
2. A+C = $\pm (n + 1/2)\pi$, n=0, 1, 2, …; and
3. A-B = $\pm (2k + 1)\pi$, k = 0, 1, 2, 3, … .

There will be other examples of the retardation values for A,B,C, and D regions that can form the parallax barrier.

In the examples of Table 1, the light paths 1 and 4 are in P polarization state and can finally pass the P-type polarizer 202' while the light paths 2 and 3 in S polarization state are blocked by the polarizer 202'. In the same principle, the polarizer 202' can be S polarization state as well.

In actual applications, the embodiments of the case with two viewing-zone images and the case with four viewing-zone images are provided as the examples for description. FIG. 6 is a drawing, schematically illustrating a mechanism of 3D display of a projection autostereoscopic display by two viewing zones, according to an embodiment of the disclosure. In FIG. 6, the number of viewing zones is two in this example. The projected image on the reflection-type polarization preserved diffuser 210 has two viewing-zone images. In other words, each of the pixels 216 has two sub-pixels 212 and 214, respectively belonging to the two viewing-zone images. The two viewing-zone images are respectively observed by the two eyes. The function of parallax barrier is complete at the first microretarder layer 204 with the linear polarizer 202 upon the reflected image light, as shown in FIG. 4. By the function of parallax barrier, one eye just see the pixels 212, belonging to one of the two viewing-zone images, and the other eye just see the pixels 214, belonging to another one of the two viewing-zone images. The 3D effect can be created in the physiological visual system of human.

FIG. 7 is a drawing, schematically illustrating a mechanism of 3D display of a projection autostereoscopic display by four viewing zones, according to an embodiment of the disclosure. In FIG. 7, like FIG. 6 in mechanism, one pixel

226 includes four sub-pixels 218, 220, 222, 224, respectively belonging to the four viewing-zone images. With the same function of parallax barrier, two eyes can respectively see any two pixels of the four pixels. In this example, the two eyes see the two pixels 222 and 224. However, if the observer moves to other locations, the two eyes may see the other two pixels of the four pixels. This design allows the observer to move or more observers to see the 3D image. If the number of the viewing-zone images increases, the freedom of movement for the observer accordingly increases. However, the image resolution may be reduced in the horizontal direction.

In order to reserve more resolution at the horizontal direction, the vertical resolution can take some loading. In other words, the resolution loading of the viewing-zone images can be shared by both the horizontal direction and the vertical direction. FIGs. 8-9 are drawings, schematically illustrating another structure of first and second microretarder layers in slant type, according to an embodiment of the disclosure. In this consideration, the half-wavelength retarding column regions E and the no-retarding column regions F in the first microretarder layer 204 can be arranged by a slant pattern. Likewise, the retarding column regions H and the no-retarding column regions G in the second microretarder layer 208 is also arranged by a slant pattern. The function of the parallax barrier remains the same as previously described. However, the pixel pattern for the viewing-zone should be accordingly arranged.

FIG. 10 is a drawing, schematically illustrating the arrangement of microretarder layer in slant type with respect to the image pixel pattern, according to an embodiment of the disclosure. In FIG. 10, the slant parallax barrier is shown in shading pattern. In this situation, the pixels of four viewing-zone images are also slant. The numerals of 1, 2, 3, and 4 represent the four viewing-zone images and the characters of R, G and B represent the three primary-color pixels of a full-color pixel. As can be seen, for example, the pixels of each the viewing zone is slant by the same angle as the slant angle of the parallax barrier instead of the vertical distribution.

In order to get a large displaying area, the image projector 100 in FIG. 1 can

be formed by multiple section projectors 102, 104, 106, as shown in Fig. 11. Each of the section projectors 102, 104, 106 projects a section of the full image. As a result, the full image is formed by several section images from the section projectors 102, 104, 106. In this arrangement, the stereo screen 200 can be, for example, performing the same function without change.

Even further, since the polarization state of the image light is changed in several stages, a phase compensator may be included to improve the performance. FIG. 12 is a drawing, schematically illustrating a system of a projection autostereoscopic display with phase compensator, according to an embodiment of the disclosure. In FIG. 12, for example, a phase compensator 250 can be, for example, added between the reflection-type polarization preserved diffuser 210 and the first microretarder layer 204. In further one example, the phase compensator 250 is between the reflection-type polarization preserved diffuser 210 and the second microretarder layer 208. The phase compensator 250 may be, for example, a reversed retardation plate by a certain degree of retardation, so as to adjust the polarization state into more precise level.

It's also possible to choose that, with polarizer 202', as shown in FIG. 5, with P-polarization, either the light passing light paths 1 and 4 or the light passing light path 2 and 3 are in S polarization state and the light passing the other two light paths are in polarization state other than P or S. Another possible choose is that, with polarizer 202' in S-polarization, either the light passing light paths 1 and 4 or the light passing light path 2 and 3 are in P polarization state and the light passing the other two light paths are in polarization state other than P or S. In these two cases, the brightness of the image will be lower than the above-mentioned cases but the stereoscopic effect is maintained. Generally, the linear polarizer can be P polarization or S polarization to block a portion of a reflected light in different polarization state as a parallax barrier.

In general applications, the image projector can be mounted on the ceiling to project image light onto the stereo screen on the vertical wall. The observer can be on the floor to observe the 3D image from the stereo screen. However, it is not the only way in application.

It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present disclosure without departing from the scope or spirit of the disclosure. In view of the foregoing descriptions, it is intended that the present disclosure covers modifications and variations of this disclosure if they fall within the scope of the following claims and their equivalents.

CLAIMS

1. A projection autostereoscopic display, comprising:

an image projector, to project an image out, wherein the image includes multiple viewing-zone images; and

a stereo screen, receiving the image and reflecting the image back to an observing direction, wherein the stereo screen being an optical stack layer in a relative sequence from the projector comprises:

a linear polarizer, for receiving the image incident thereon and filtering the image in polarization;

a first microretarder layer, attached behind over the linear polarizer, wherein the first microretarder layer has a plurality of column regions in a first retarding effect and a plurality of column regions in a second retarding effect, being alternatively configured;

a second microretarder layer, disposed behind over the first microretarder layer by a distance, wherein the second microretarder layer has a plurality of column regions in a third retarding effect and a plurality of column regions in a fourth retarding effect, being alternatively configured; and

a reflection-type polarization preserved diffuser, disposed behind over the second microretarder layer for reflecting and diffusing an incident light into various directions, wherein a polarization still preserved.

2. The projection autostereoscopic display of claim 1, wherein the first microretarder layer is directly attached on the linear polarizer and the second microretarder layer is directly attached on the reflection-type polarization preserved diffuser.

3. The projection autostereoscopic display of claim 1, wherein the column regions of the first microretarder layer are extending along a vertical direction of the stereo screen.

4. The projection autostereoscopic display of claim 3, wherein the column regions of the second microretarder layer are extending along the vertical direction of the stereo screen but have a relatively horizontal shift to the column regions of

the first microretarder layer.

5. The projection autostereoscopic display of claim 1, wherein the column regions of the first microretarder layer are extending along a slant direction relative to a vertical direction of the stereo screen by an angle.

6. The projection autostereoscopic display of claim 3, wherein the column regions of the second microretarder layer are extending along the slant direction but have a relatively horizontal shift to the column regions of the first microretarder layer.

7. The projection autostereoscopic display of claim 1, wherein the image projector comprises a plurality of subsection projectors, each of the subsection projectors projecting a section image onto the stereo screen to compose the image in a full content.

8. The projection autostereoscopic display of claim 1, wherein the reflection-type polarization preserved diffuser is directly disposed behind on the second microretarder layer.

9. The projection autostereoscopic display of claim 1, wherein the stereo screen further comprises a phase compensator between the reflection-type polarization preserved diffuser and the first microretarder layer.

10. The projection autostereoscopic display of claim 9, wherein the phase compensator comprises a reversed retardation plate.

11. The projection autostereoscopic display of claim 1, wherein relative locations between the first microretarder layer and the second microretarder layer are set to produce a parallax barrier function for the stereo screen.

12. The projection autostereoscopic display of claim 1, wherein the first to fourth retarding effects as respectively denoted by A-D satisfy conditions:

$A+C = \pm m\pi$, m =0, 1, 2, 3, …;

$B+D = \pm (n + 1/2)\pi$, n=0, 1, 2, …; and

$A-B = \pm (2k+1)\pi$, k = 0, 1, 2, 3, … ;

or

$B+D = \pm m\pi$, m =0, 1, 2, 3, …;

A+C = $\pm(n+1/2)\pi$, n=0, 1, 2, …; and

A-B = $\pm(2k+1)\pi$, k = 0, 1, 2, 3, … .

13. The projection autostereoscopic display of claim 1, wherein the linear polarizer is a P polarization state or a S polarization state to block a portion of a reflected light in different polarization state as a parallax barrier.

14. A stereo screen, used to receive an image and reflect the image back to an observing direction, the stereo screen being an optical stack layer comprising:

a linear polarizer, for receiving the image incident thereon and filtering the image in polarization;

a first microretarder layer, attached over the linear polarizer, wherein the first microretarder layer has a plurality of column regions in a first retarding effect and a plurality of column regions in a second retarding effect, being alternatively configured;

a second microretarder layer, disposed over the first microretarder layer by a distance, wherein the second microretarder layer has a plurality of column regions in a third retarding effect and a plurality of column regions in a fourth retarding effect, being alternatively configured; and

a reflection-type polarization preserved diffuser, disposed over the second microretarder layer for reflecting and diffusing an incident light into various directions, wherein a polarization still preserved.

15. The stereo screen of claim 14, wherein the first microretarder layer is directly attached on the linear polarizer and the second microretarder layer is directly attached on the reflection-type polarization preserved diffuser.

16. The stereo screen of claim 14, wherein the column regions of the first microretarder layer are extending along a vertical direction of the stereo screen.

17. The stereo screen of claim 16, wherein the column regions of the second microretarder layer are extending along the vertical direction of the stereo screen but have a relatively horizontal shift to the column regions of the first microretarder layer.

18. The stereo screen of claim 14, wherein the column regions of the first microretarder layer are extending along a slant direction relative to a vertical

direction of the stereo screen by an angle.

19. The stereo screen of claim 18, wherein the column regions of the second microretarder layer are extending along the slant direction but have a relatively horizontal shift to the column regions of the first microretarder layer.

20. The stereo screen of claim 14, wherein the reflection-type polarization preserved diffuser is directly disposed behind on the second microretarder layer.

21. The stereo screen of claim 14, wherein the stereo screen further comprises a phase compensator between the reflection-type polarization preserved diffuser and the first microretarder layer.

22. The stereo screen of claim 21, wherein the phase compensator comprises a reversed retardation plate.

23. The stereo screen of claim 14, wherein relative locations between the first microretarder layer and the second microretarder layer are set to produce a parallax barrier function for the stereo screen.

24. The stereo screen of claim 14, wherein depending on a projecting location of the image, widths of the column regions with the first retarding effect and the second retarding effect of the first microretarder layer are proportionally set in accordance with widths of the column regions with the third retarding effect and the fourth retarding effect of the second microretarder layer.

25. The stereo screen of claim 14, wherein the first to fourth retarding effects as respectively denoted by A-D satisfy conditions:

A+C = $\pm 2m\pi$, m =0, 1, 2, 3, …;

B+D = $\pm(n+1/2)\pi$, η = 0, 1, 2, … ; and

A-B = $\pm(2k+1)\pi$, k = 0, 1, 2, 3, … ;

or

B+D = $\pm 2m\pi$, m =0, 1, 2, 3, …;

A+C = $\pm(n+1/2)\pi$, n=0, 1, 2, …; and

A-B = $\pm(2k+1)\pi$, k = 0, 1, 2, 3, … .

26. The stereo screen of claim 14, wherein the linear polarizer is a P polarization state or a S polarization state to block a portion of a reflected light in different polarization state as a parallax barrier.

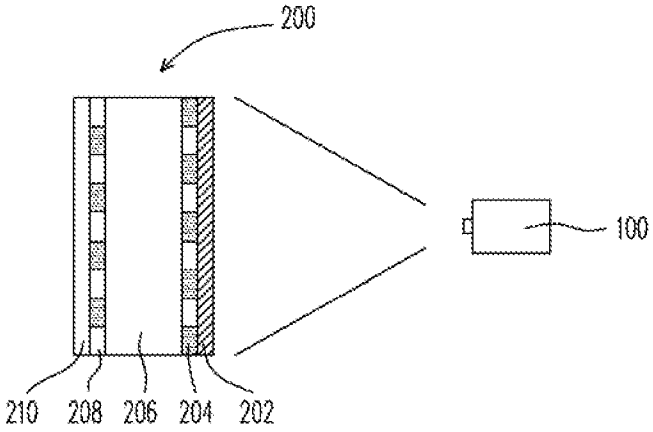


FIG. 1

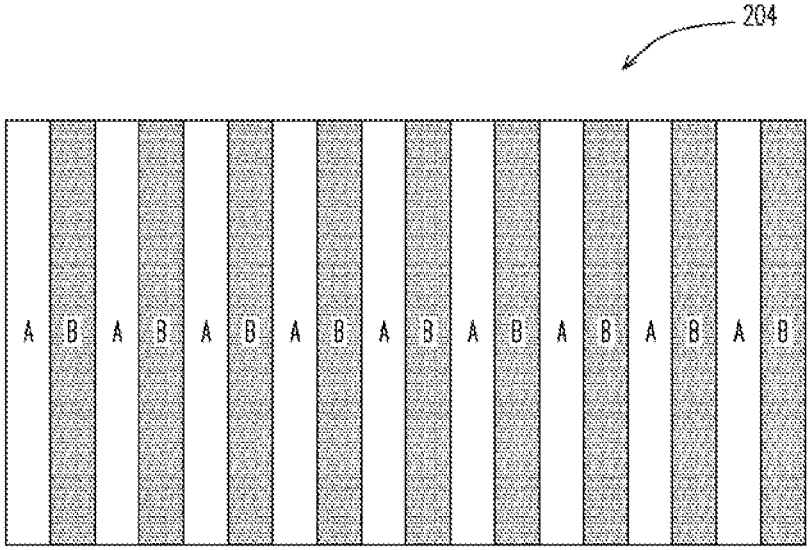


FIG. 2

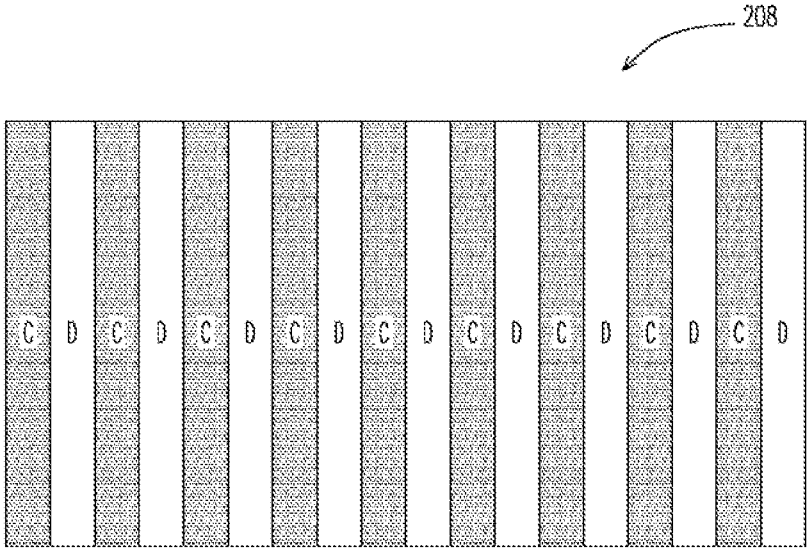


FIG. 3

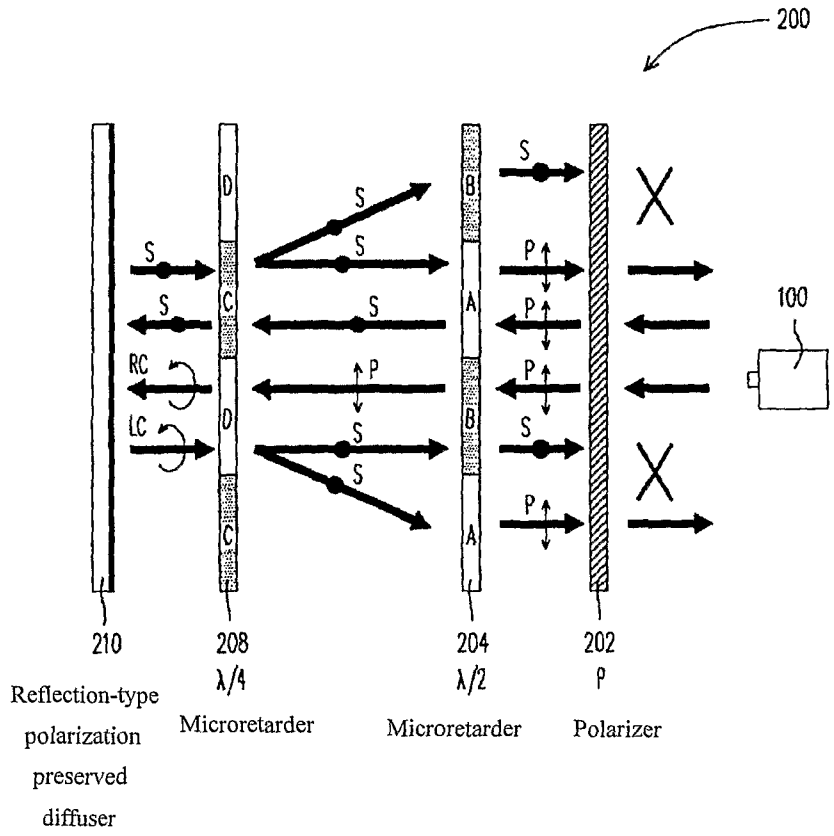

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100
210
208
λ/4
204
λ/2
202
P
Reflection-type polarization preserved diffuser
Microretarder
Microretarder
Polarizer

FIG. 4

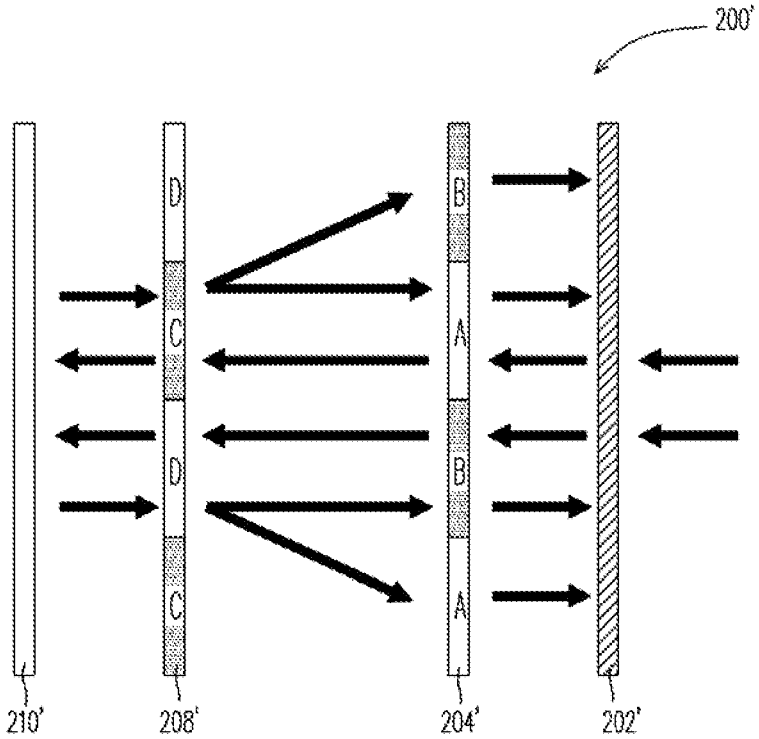


FIG. 5

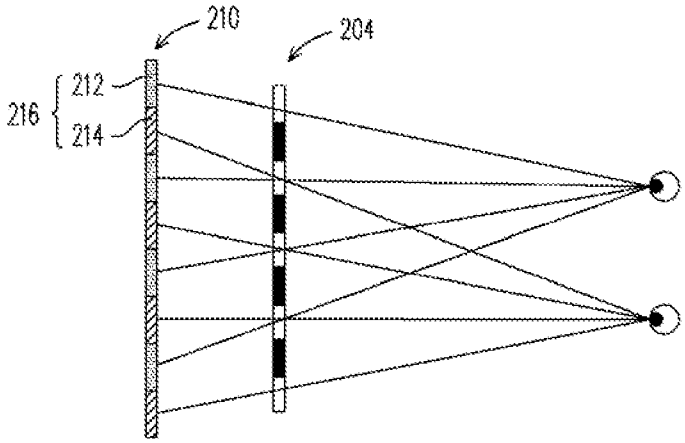


FIG. 6

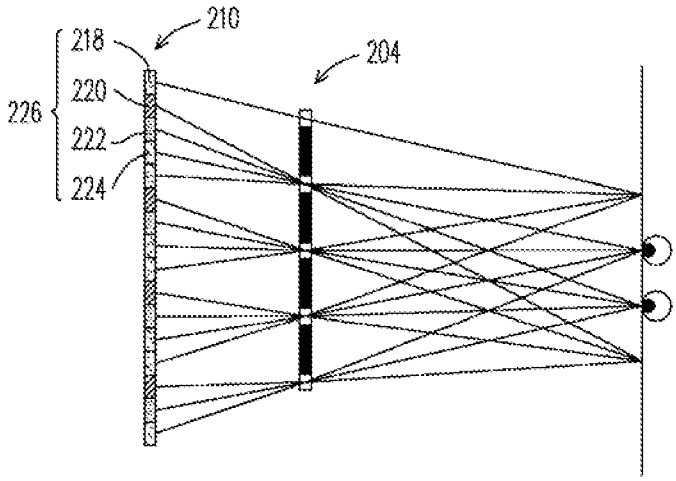


FIG. 7

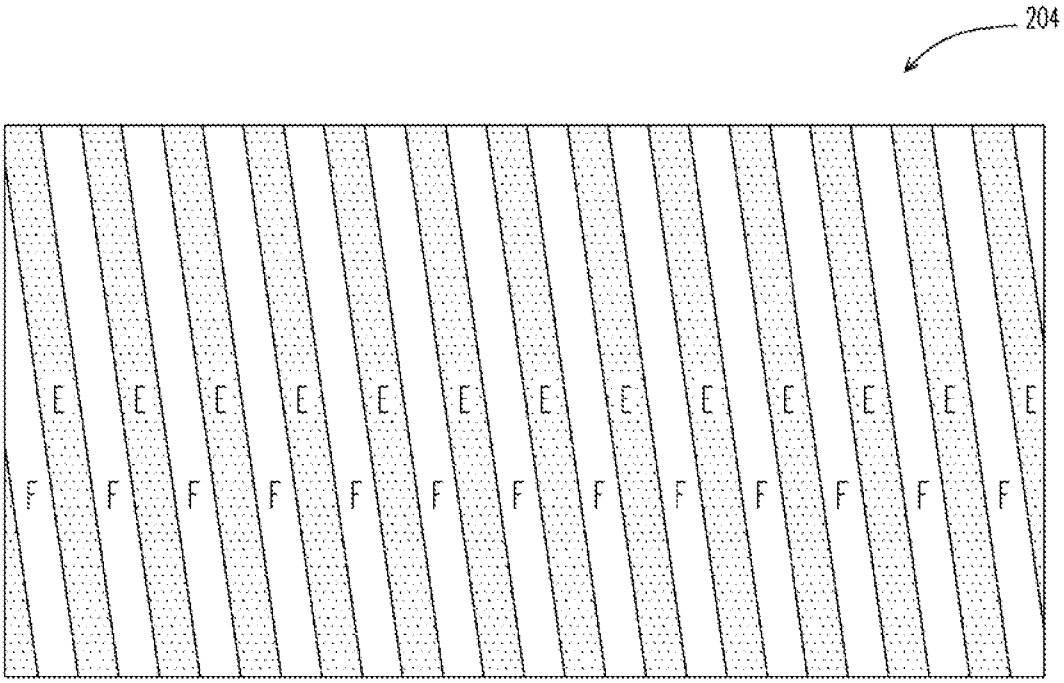


FIG. 8

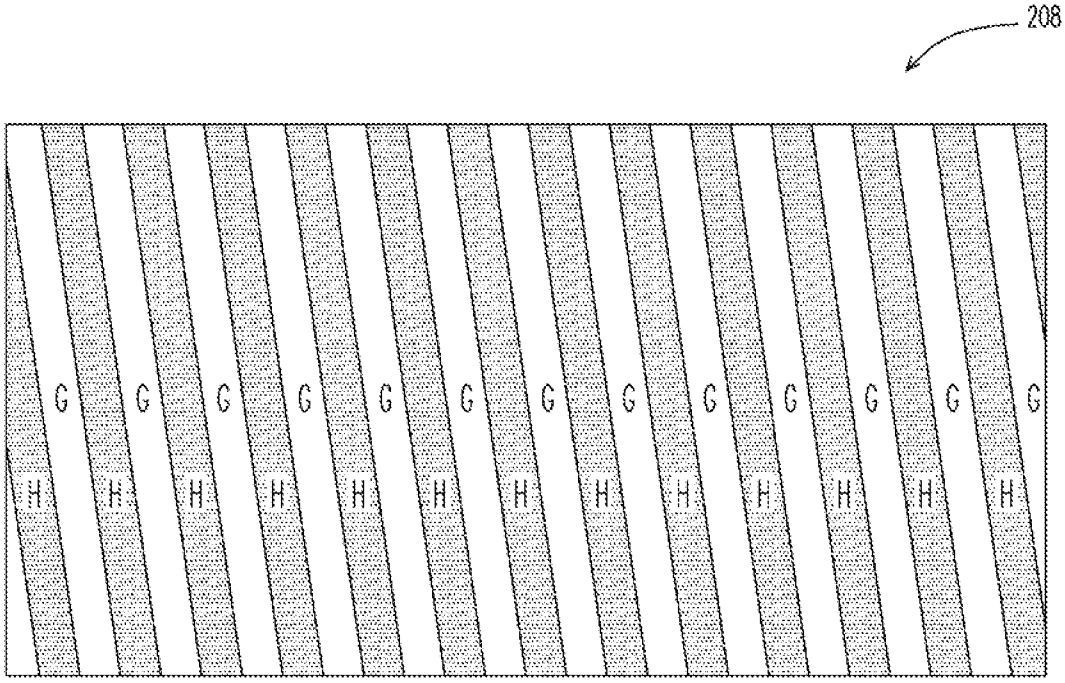


FIG. 9

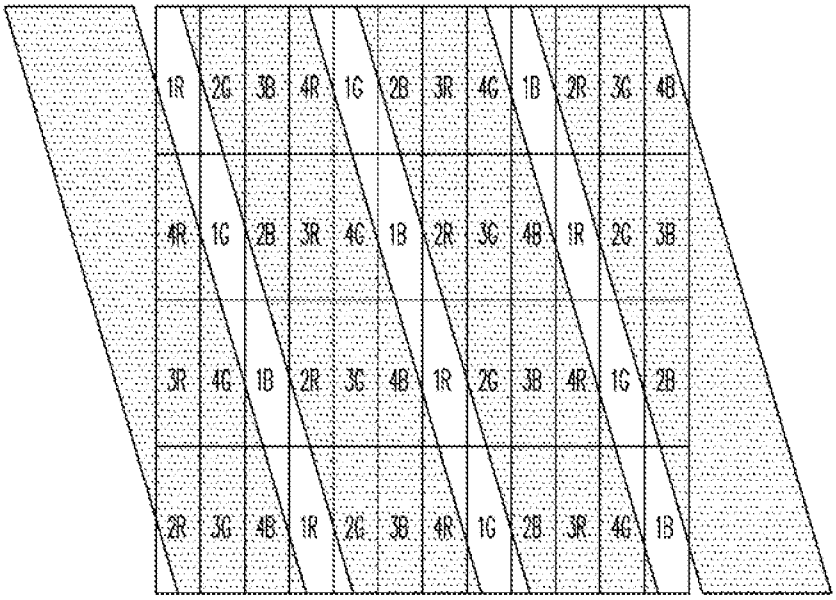

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2R 3G 4B 1R 2G 3B 4R 1G 2B 3R 4G 1B

FIG. 10

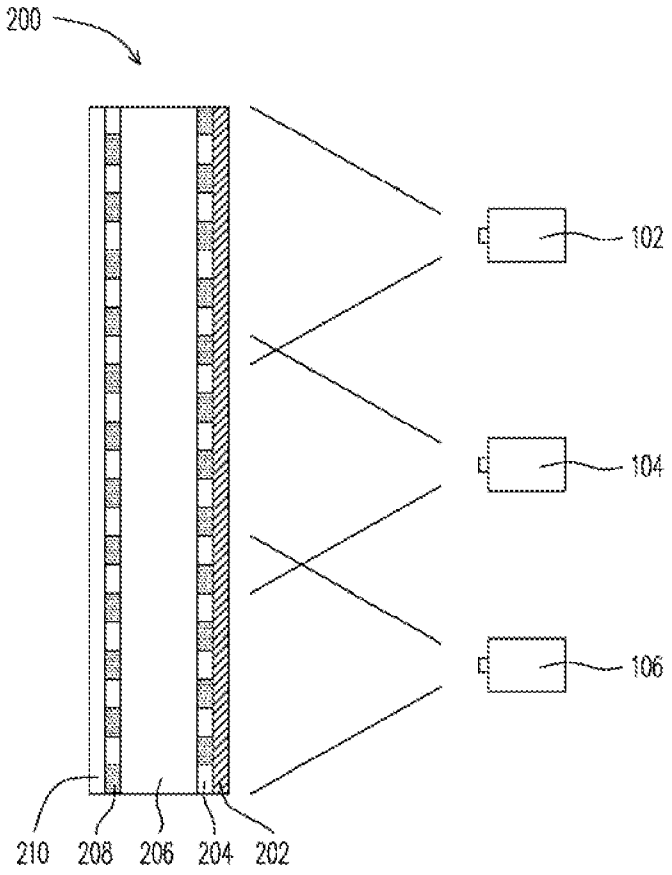


FIG. 11

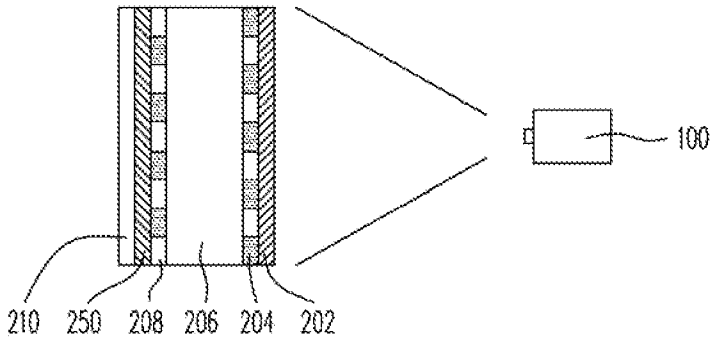


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN20 10/0746 17

A. CLASSIFICATION OF SUBJECT MATTER

Refer to the extra sheet

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)

IPC: G03G35, G02B27/22

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

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

TWABS, CPRSABS, VEN: autostereoscopic, display, stereoscopic, project or projecting or projection or projector

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	TW243960B (ITRI)21Nov.2005(21.11.2005)the whole document	1-26
A	TW265315B (ITRI et al.)01Nov.2006(01 .11 .2006) the whole document	1-26
A	WO2008075258A1 (PHIG)26.Jun.2008(26.06.2008)the whole document	1-26
A	US2002067466A1 (EAST)06Jun.2002(06.06.2002) the whole document	1-26
A	CN1264849 A(YU, Zechen)30Aug.2000(30.08.2000) the whole document	1-26

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

* Special categories of cited documents:

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"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 another 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	Date of mailing of the international search report
25Mar.2011(25.03.2011)	**07 Apr. 2011 (07.04.2011)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 facsimile No. 86-10-62019451	Authorized officer XING, Jinhui Telephone No. (86-10)62085572

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/CN2010/074617

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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		US2010033680A1	11.02.2010
		EP2095173B1	16.06.2010
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		US7230759 B2	12.06.2007
		TW200600957 A	01.01.2006
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		TW200724975 A	01.07.2007
		US7738171 B2	15.06.2010

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/CN2010/074617

A. CLASSIFICATION OF SUBJECT MATTER

G03B35/00 (2006.01) i

G02B27/22 (2006.01) i

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