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(54) Title: METHOD AND SYSTEM FOR OCCLUSION CAPABLE COMPACT DISPLAYS

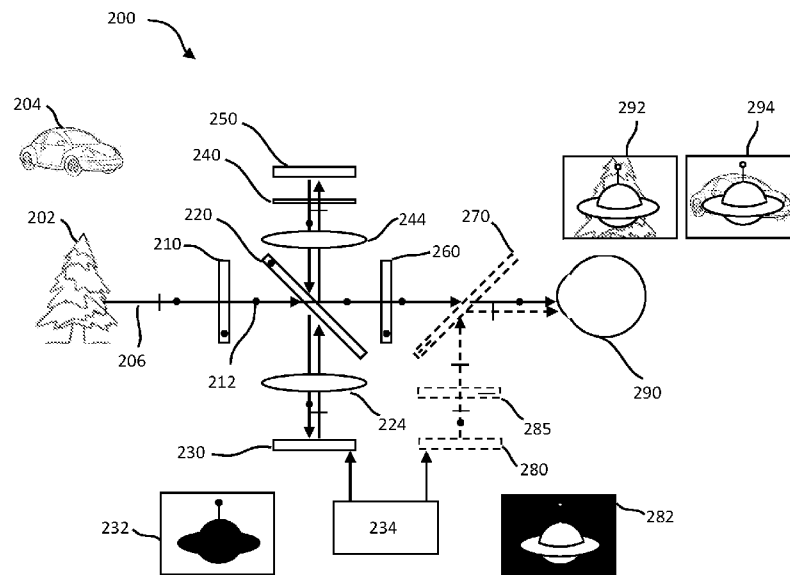


Figure 2.

(57) Abstract: In one embodiment, a method of rendering images includes providing eyewear having at least one lens. A display module routes image from an ambient real world environment first through a spatial light modulator so that selective portions of the real world scene can be occluded. The resultant image is then combined with another computer generated virtual image and then routed to the viewer. In another embodiment an electrically actuated switchable occlusion mechanism is provided within the display module that allows the ability to provide the occlusion capability only when needed.



Declarations under Rule 4.17:

- *of inventorship (Rule 4.17(iv))*

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:

26 December 2019 (26.12.2019)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2019/000076

A. CLASSIFICATION OF SUBJECT MATTER
 IPC(8) - G02B 27/01; G03H 1/00; G03H 1/02; H04N 13/302 (2019.01)
 CPC - G02B 27/0172; G02B 27/01; G03H 1/00; G03H 1/02; G06T 19/006; H04N 13/302 (2019.08)

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)
 See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
 USPC - 345/7; 345/8; 345/633 (keyword delimited)

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2009/0161040 A1 (KHAN et al) 25 June 2009 (25.06.2009) entire document	1-22, 37
A	US 2017/0184848 A1 (VALLIUS) 29 June 2017 (29.06.2017) entire document	35, 36, 38, 39
A	US 2016/0327789 A1 (MAGIC LEAP, INC.) 10 November 2016 (10.11.2016) entire document	35, 36, 38, 39
A	US 2001/0013977 A1 (TADIC-GALEB et al) 16 August 2001 (16.08.2001) entire document	1-22, 37
A	US 2013/0335795 A1 (SAMSUNG ELECTRONICS CO., LTD.) 19 December 2013 (19.12.2013) entire document	23-34
A	US 2005/0007673 A1 (CHAOULOV et al) 13 January 2005 (13.01.2005) entire document	23-34
A	US 2017/0336641 A1 (VON UND ZU LIECHTENSTEIN) 23 November 2017 (23.11.2017) entire document	1-39

 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 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

15 October 2019

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2019/000076

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

- 1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

- 2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

- 3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
See extra sheet(s).

- 1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
- 2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
- 3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

- 4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

- Remark on Protest**
- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
 - The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
 - No protest accompanied the payment of additional search fees.

Continued from Box No. III Observations where unity of invention is lacking

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-22, are drawn to an electronic display apparatus, comprising: a controller; at least one polarization based optical combiner, OC, located in the line of sight of the observer, and in close proximity of the observer's eye.

Group II, claims 23-34, are drawn to an electronic display apparatus, comprising: a controller; a first lens array located facing the real world scene; said lens array meant to convert light from angular domain to spatial domain.

Group III, claims 35-39, are drawn to an electronic display apparatus, comprising: a controller; at least two planar waveguides located between the real world scene and the observer's eye; each of said planar waveguides having a pair of in-coupling and out-coupling gratings.

The inventions listed as Groups I, II and III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention: at least one polarization based optical combiner, OC, located in the line of sight of the observer, and in close proximity of the observer's eye; said OC having a plurality of ports and comprising: an absorptive linear polarizer, LP, having a transmission axis, TLP; said LP located on a first port of said OC facing the real world scene; at least one reflective polarizer, RP, with a reflection polarization axis, RRP, that is substantially parallel to TLP; at least one spatial light modulator, SLM, located on a second port of said OC; said SLM comprising: a plurality of pixels; whereby each pixel can modulate light; and said SLM being connected to said controller; at least one powered optical element, Si, located along the light path between said LP and said SLM; a Quarter Wave Plate, QWP, whose slow axis is located at approximately 45 degrees from TLP; and a Mirror; wherein said QWP and said Mirror are located at a third port of said OC; wherein said third port is located opposing said second port of OC; at least one powered optical element, S2, located along the light path between said RP and said mirror in third port of said OC; wherein said LP polarizes the incoming light from the real world scene from said first port of OC in a preferred linear orientation along its transmission axis, TLP; wherein said RP is oriented at an angle such that it reflects the incoming polarized light from said LP in first port to said second port; wherein said powered optical element, Si, forms an image of the real world scene at said SLM for modulation purposes; wherein said SLM modulates the incoming polarized light from said second port and in turn provides outgoing modulated light in at least one of two states of linear polarizations; wherein said modulated light outgoing from said SLM is reflected back at said second port of the OC; wherein one of the modulated light states of linear polarization from said second port is substantially perpendicularly polarized to RRP and hence it transmits from RP and emerges at said third port as claimed therein is not present in the invention of Groups II and III. The special technical feature of the Group II invention: a first lens array located facing the real world scene; said lens array meant to convert light from angular domain to spatial domain; wherein said SLM is located a first distance, D1, away from said first lens array; a 2" lens array located near the observer's eye; said lens array meant to convert light back from spatial domain to angular domain; wherein said 2" lens array is located a first distance, D2, away from said SLM; wherein said controller commands said SLM to attenuate light from selected pixels of said SLM such that viewer perceives the objects at corresponding angular locations in the real world scene to be blocked or attenuated in their visible intensity from their view as claimed therein is not present in the invention of Groups I or III. The special technical feature of the Group III invention: at least two planar waveguides located between the real world scene and the observer's eye; each of said planar waveguides having a pair of in-coupling and out-coupling gratings; at least one spatial light modulator, SLM, comprising an array of pixels; whereby each pixel can modulate light; and said SLM being connected to said controller; at least one lens; and at least one Mirror; wherein said SLM is located between a first out-coupling grating of the first planar waveguide and said lens; wherein light field from the real world scene routes through the first planar waveguide, in-coupling and out-coupling gratings to said SLM; wherein said lens forms a spatial image of the real world scene on said SLM; whereupon said controller commands said SLM to attenuate light from selected pixels of said SLM; whereupon said modulated image light reflects from said Mirror, and encounters said 2nd planar waveguide, the 2nd pair of in-coupling and out-coupling gratings and emerges in the Eyebox such that observer perceives the objects at corresponding angular locations in the real world scene to be blocked or attenuated in their visible intensity from their view as claimed therein is not present in the invention of Groups I or II.

Groups I, II and III lack unity of invention because even though the inventions of these groups require the technical feature of an electronic display apparatus, comprising: a controller; at least one spatial light modulator, SLM, comprising an array of pixels; whereby each pixel can modulate light; and said SLM being connected to said controller, this technical feature is not a special technical feature as it does not make a contribution over the prior art.

Specifically, US 2017/0336641 to von und zu Liechtenstein Maximilian Ralph Peter teaches an electronic display apparatus, comprising: a controller; at least one spatial light modulator, SLM, comprising an array of pixels; whereby each pixel can modulate light; and said SLM being connected to said controller (Paras. [0072-0073], [0081]).

Since none of the special technical features of the Group I, II or III inventions are found in more than one of the inventions, unity of invention is lacking.