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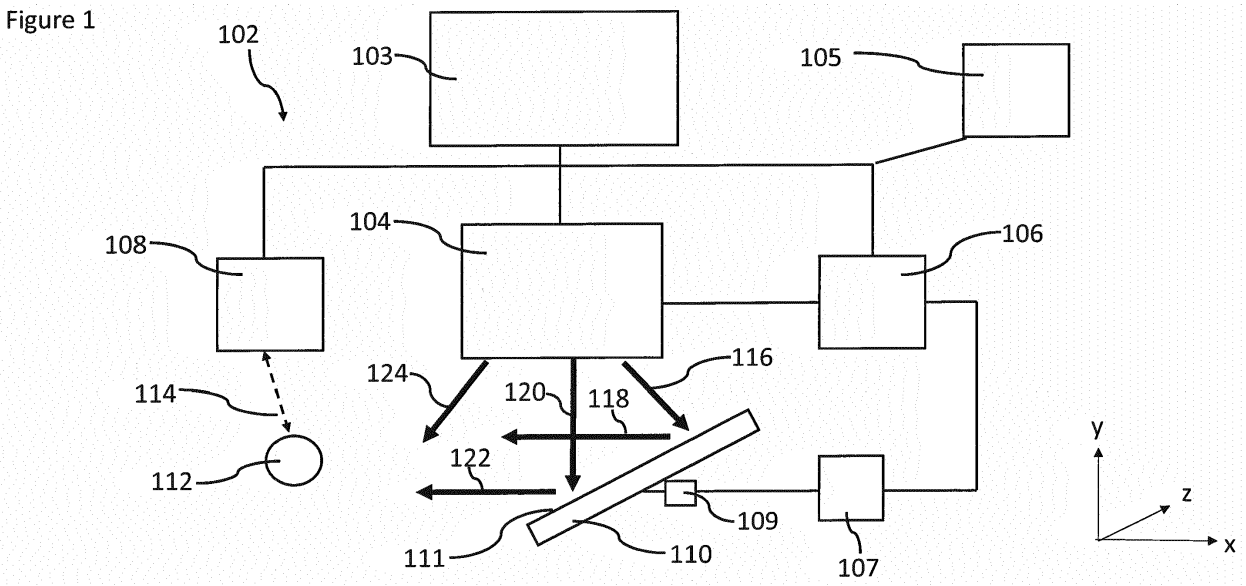
(54) SPEAKER ASSEMBLY

(57) There is disclosed a speaker assembly (102). The speaker assembly (102) comprises one or more speakers (104) for producing sound and one or more movable reflectors (110) configured and arranged to reflect sound produced by the one or more speakers (104). There is further provided a controller (106), the controller being configured to receive information of a location of one or more users (112). In response to receiving that information, the controller (106) is configured to cause adjustment of a position of the one or more reflectors (110) without causing adjustment of a position of the one or more speakers (104), so as to direct sound produced by the one or more speakers (104) towards the one or more users.

Figure 1



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Description

Technical Field

[0001] The present disclosure relates to a speaker assembly.

Background

[0002] Speaker assemblies are known. A typical speaker assembly comprises a speaker for generating or producing sound waves in response to electrical signals provided to the speaker, so as to recreate sounds such as speech or music. Speaker assemblies may be stand-alone speakers connected to a device, or a speaker assembly may be integrated in to a device such as a mobile phone or a television or the like.

Summary

[0003] According to a first aspect disclosed herein, there is provided a speaker assembly comprising: one or more speakers for producing sound; one or more movable reflectors configured and arranged to reflect sound produced by the one or more speakers; and a controller, the controller configured to receive information of a location of one or more users, and in response to receiving that information, the controller being configured to cause adjustment of a position of the one or more reflectors without causing adjustment of a position of the one or more speakers, so as to direct sound produced by the one or more speakers towards the one or more users.

[0004] According to an example, the speaker assembly comprises a location sensor configured to detect the information of a location of one or more users, and to provide that information to the controller.

[0005] According to an example the location sensor comprises an ultrasonic sensor or a sound sensor.

[0006] According to an example the location sensor is configured and arranged to detect a location of one or more articles.

[0007] According to an example the speaker assembly comprises a sensor for distinguishing the one or more users from the one or more articles.

[0008] According to an example, the sensor for distinguishing the one or more users from the one or more articles comprises a camera.

[0009] According to an example, the controller is configured to receive information of a location of the one or more articles and the information of a location of one or more users, and to cause adjustment of a position of the one or more reflectors so as to reflect sound around the one or more articles and towards the one or more users.

[0010] According to an example, the controller is in communication with a user interface, via which user interface a user can provide the information of a location of one or more users.

[0011] According to an example the adjustment of a position of the one or more reflectors comprises one or more of: translational movement; rotational movement.

[0012] According to an example one or more of the one or more reflectors comprises a curved reflective surface.

[0013] According to an example one or more of the one or more reflectors comprises a flat reflective surface.

[0014] According to an example the one or more reflectors is arranged to partially enclose the one or more speakers.

[0015] According to an example the one or more reflectors comprises a plastic material.

[0016] According to an example the one or more reflectors comprises a metal material.

Brief Description of the Drawings

[0017] To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically a speaker assembly according to an example;

Figure 2 shows schematically a speaker assembly according to an example;

Figure 3 shows schematically a speaker assembly according to an example;

Figure 4 shows schematically a speaker assembly according to an example.

Figure 5 shows schematically a speaker assembly according to an example.

Figure 6 shows schematically a speaker assembly according to an example.

Detailed Description

[0018] The present disclosure has applicability to speakers or speaker assemblies. Speakers may also be referred to as loudspeakers. Speakers are used to project or amplify sound in response to electrical signals received from an associated device. For example a speaker on a television is used to produce sound related to music or dialogue associated with a programme or film being shown on the television screen. Speakers may similarly be provided on devices such as personal computers, laptops, tablets, etc. Speakers are also provided on devices such as mobile phones to provide speech (or indeed any other sound output) to a user of the mobile phone. Whatever the type of device, the speaker may be integrated into that device. Additionally or alternatively, a speaker may be provided separate to the associated device. Such a separate speaker may be attached in a wired or wireless manner to its associated device.

[0019] Sounds from the speaker that a user or listener experiences will be dependent upon where the user is located relative to the speaker. For example a user stood in front of and two metres away from a speaker may experience a different sound to a different user (or the same user moving to a new position) located to the side of and five metres away from the speaker. Furthermore, obstacles or articles between the speaker and the user may affect the quality of sound experienced by the user. Simply increasing the sound volume in order to try and ensure that a user or all users can adequately hear the sound output may waste energy and also provide an excessively loud sound experience for some users.

[0020] Figure 1 shows an example speaker system or assembly 102. The speaker assembly 102 comprises a speaker or speaker element 104. The speaker 104 comprises those parts of the speaker assembly 102 which are operable to produce or generate sound waves to be heard by one or more listeners or users. For example the speaker 104 may comprise one or more cones or diaphragms arranged to vibrate so as to generate sound waves. The speaker 104 is associated with a device 103, the speaker 104 being operable to receive electrical signals from the device 103 in order to cause the speaker 104 to create sound. The device may be, by way of non-limiting example, a television, personal computer, laptop, tablet, mobile phone etc. The speaker 104 may be integrated with the device (e.g. an integrated television speaker) or separate from the device and connected thereto in a wired or wireless manner. Where the speaker 104 is connected to the device 103 in a wireless manner, a wireless protocol such as WiFi or Bluetooth may be used.

[0021] The speaker assembly 102 comprises a movable reflector or sound reflector 110. The reflector 110 is configured and arranged to reflect sound waves produced by the speaker 104. In the example of Figure 1 the sound waves produced by speaker 104 are schematically represented by the bold arrows. For example the sound wave 116 is reflected as sound wave 118 by reflector 110. Sound wave 120 is reflected as sound wave 122 by reflector 110. Sound wave 124 does not impact or impinge upon reflector 110, and therefore is not reflected. Owing to the movable nature of the movable reflector 110, a direction in which the sound waves are reflected can be adjusted. As schematically shown in Figure 1 the movable reflector 109 comprises an attachment 109 for attaching the movable reflector 110 to the speaker assembly 102. The attachment 109 may comprise, for example, a joint such as a hinge, a ball and socket joint, and/or another kind of mechanical linkage such as a four bar linkage. The attachment 109 is configured and arranged to allow rotation and/or translation of the movable reflector 110. In the example of Figure 1 a motor 107 is provided to enable the movement of the movable reflector 110. The movement could be along any one of or any combination of the x, y and z (z being into and out of the paper when viewing Figures 1 and 2) axes, and additionally or alternatively rotation around any of these axes.

[0022] A user or listener is shown at 112. According to examples, the movable reflector 110 is arranged to move so as to reflect sound waves towards the user 112. In one example a location sensor 108 is provided for detecting a location and/or motion of the user 112. In one example the location sensor 108 comprises an ultrasonic sensor which detects reflection of ultrasonic waves from the user 112, as shown by dashed line 114. In another example the location sensor 108 may operate by detecting a time taken for sound waves to be reflected back from the user 112. These may be sound waves generated by the location sensor 108, or sound waves generated by speaker 104. In some examples the location sensor may additionally or alternatively comprise a camera or another optical sensor configured and arranged to sense or detect user 112 (or indeed multiple users). In some examples the camera is programmed with an algorithm to distinguish a user from other objects or articles (e.g. furniture), or indeed to distinguish users from each other. Such an algorithm may comprise a deep-learning algorithm. Additionally or alternatively a position of a user 112 may be input to the system 102 via a user (which may be the user 112). For example this information may be input via a user interface on the device 103 or on another device in communication with controller106. However the position of the user 112 is determined, this may be updated periodically or continuously. Accordingly a position and/or orientation of the movable reflector 110 may adjust in response to received updates of position information of a user 112 or users. In one example, the movable reflector 110 moves in real-time as the user 112 moves within a room or location containing the speaker 104.

[0023] A controller 106 is provided to control operations of the speaker assembly 102. The controller 106 comprises at least one memory and at least one processor. For example the controller 106 may transmit and receive signals to and from any one or more of device 103, speaker 104, position sensor 108, and movable reflector 110 (and/or its motor 109). Furthermore, a power source 105 is provided to provide power to the system 102. The power source may comprise a mains power supply. Alternatively the power source 105 may comprise a battery. The power source 105 may be integrated in the device 103.

[0024] Figure 2 shows the system of Figure 1, except in Figure 2 the user 112 has moved from a first position (Figure 1) to a second position (Figure 2), relative to the speaker 104. Alternatively the assembly has determined to direct the sound towards a different user (user 112 in Figure 2) located at a different position to another user (user 112 in Figure 1). As shown, the user 112 in Figure 2 is located further down and to the right compared with the position of the user in Figure 1 (from the perspective of viewing these Figures). This is of course by way of example only and the user 112 could be in a different position to that shown in Figure 2.

[0025] In Figure 2, movable sound reflector 110 has

moved relative to the position of the reflector 110 in Figure 1, so as to account for the updated position of the user 112 and to direct the sound waves towards the user. That is, in the example of Figure 2, the movable reflector 110 has rotated clockwise relative to the position shown in Figure 1 (from the perspective of viewing these Figures). Thus in Figure 2 sound wave 130 is reflected as sound wave 132 towards user 112. Sound wave 134 is reflected as sound wave 136 towards user 112. Sound wave 138 does not impact or impinge upon reflector 110 and therefore is not reflected by reflector 110.

[0026] In Figures 1 and 2 the reflector 110 is shown having a generally flat or planar reflecting surface 111. It will be understood that this is by way of example only and that other shapes may be used. For example, Figure 3 shows an example where the reflector 310 is curved or arced. Accordingly the reflective surface 311 is curved or arced. In the example of Figure 3 the speaker 304 is partially surrounded or enclosed by the reflector 310. A user is schematically shown at 312. Sound wave 330 is reflected as sound wave 332 towards listener 312. Sound wave 334 is reflected as sound wave 336 towards listener 312. Sound wave 338 is reflected as sound wave 340 towards listener 312. Thus it will be understood that sounds waves which would not have been directed towards user 312 without the presence of reflector 310, are reflected by reflector 310 towards user 312 so as to improve or enhance the listening experience of user 312.

[0027] Figure 4 is a perspective view of a speaker assembly 402 comprising a speaker 404 and a movable sound reflector 410. Again, in this example the reflector 410 comprises a curved sound reflecting surface 411. In some examples the reflector 410 comprises a cone i.e. is conical. In some examples the reflector 410 is frustoconical. In some examples the reflector 410 comprises a section of a cone or a frustocone.

[0028] Although the examples of Figures 1 and 2 show a single user 112, a single speaker 104 and a single reflector 110, it will be understood that in other examples there may be any combination of one or more users, one or more speakers and one or more sound reflectors.

[0029] Figure 5 shows an example speaker assembly 502 where there is a speaker 504 and two movable sound reflectors 510 and 540. An obstacle or article 542, such as furniture or a pillar or the like, is positioned between the speaker 504 and a user or listener 512. Ordinarily, the obstacle 542 would block at least some of the sound waves from the speaker 504, which may adversely affect the sound heard by the user 512. In the example of Figure 5, in response to determining the position of the user 512 and the obstacle 542 (e.g. using a location sensor 108 as discussed with respect to Figure 1, or in response to user input via a user interface), the movable reflectors 510 have been caused by the controller to be positioned so as to deflect sound waves around the obstacle 542 and towards the user 512. That is in Figure 5 sound wave 544 from speaker 504 is deflected as sound wave 546 from reflector 510. Sound wave 546 is reflected by reflector 540 as sound wave 548 towards user 512.

[0030] Figure 6 shows an example speaker system 604 comprising first and second movable sound reflectors 610 and 640. A first user 612 is positioned at a first location, and a second user 650 is positioned at a second location, the second location being different from the first location. In this example the first user 612 is positioned in front of the speaker 604 and the second user 650 is positioned behind speaker 604. In response to determining locations of the first and second users (e.g. using a location sensor 108 as discussed with respect to Figure 1, or in response to user input via a user interface), the movable reflectors 610 and 640 have been caused by the controller to be positioned so as to reflect sound towards the two users. For example sound wave 644 from speaker 604 is reflected by reflector 610 as sound wave 646 towards user 612. Sound wave 648 from speaker 604 is reflected by reflector 640 as sound wave 652 towards user 650. Thus it can be understood that examples enable high (or at least improved) quality sound to be experienced by multiple users at different locations in a room or space.

[0031] In the described examples the controller (e.g. controller 106) is configured to move the one or more sound reflectors, without moving the speaker itself (other than movements of the speaker required to produce sound e.g. vibrations of a speaker cone). That is in examples the reflectors are capable of moving independently of the speaker. In this context the "speaker" may be considered those elements of the speaker assembly used to produce or generate the sound. Thus it may be considered that the controller is arranged to receive information of a location of one or more users, and in response to receiving that information, the controller is configured to cause adjustment of a position of one or more reflectors without causing adjustment of a position of one or more speakers, so as to direct sound produced by the one or more speakers towards the one or more users.

[0032] In some examples the one or more reflectors comprise a plastic material. In some examples the one or more reflectors comprise a metal material. In some examples the combined weight of the one or more reflectors is less than the weight of the speaker.

[0033] Utilising movable reflectors to reflect sound to account for varying user locations may have some advantages over a system where a movable speaker is used to achieve the same effect. As set forth above, in some examples the combined weight of the one or more reflectors is less than the weight of the speaker. Therefore less power may be required to move the reflectors than to move the speaker. Additionally, a speaker is itself a component with moving parts (e.g. vibrating cone). Making the speaker itself movable may add cost and complexity to an overall assembly, which is obviated by the examples in the present disclosure. Furthermore, having movable reflector(s) rather than a movable speaker or speakers may increase the lifetime of the speaker(s).

[0034] It will be understood that the processor referred to herein may in practice be provided by a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), digital signal processor (DSP), graphics processing units (GPUs), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

[0035] Reference is made herein to memory, for example for storing data. This may be provided by a single device or by plural devices. Suitable devices include for example a hard disk and non-volatile semiconductor memory.

[0036] Although at least some aspects of the embodiments described herein with reference to the drawings comprise computer processes performed in processing systems or processors, the invention also extends to computer programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice. The program may be in the form of non-transitory source code, object code, a code intermediate source and object code such as in partially compiled form, or in any other non-transitory form suitable for use in the implementation of processes according to the invention. The carrier may be any entity or device capable of carrying the program. For example, the carrier may comprise a storage medium, such as a solid-state drive (SSD) or other semiconductor-based RAM; a ROM, for example a CD ROM or a semiconductor ROM; a magnetic recording medium, for example a floppy disk or hard disk; optical memory devices in general; etc.

[0037] The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

Claims

1. A speaker assembly comprising:

one or more speakers for producing sound;
one or more movable reflectors configured and arranged to reflect sound produced by the one or more speakers;
and a controller, the controller configured to receive information of a location of one or more users, and in response to receiving that information, the controller being configured to cause adjustment of a position of the one or more reflectors without causing adjustment of a position of the one or more speakers, so as to direct sound produced by the one or more speakers towards the one or more users.

2. A speaker assembly according to claim 1, comprising a location sensor configured to detect the information of a location of one or more users, and to provide that information to the controller.

3. A speaker assembly according to claim 2, wherein the location sensor comprises an ultrasonic sensor or a sound sensor.

4. A speaker assembly according to claim 2 or claim 3, the location sensor configured and arranged to detect a location of one or more articles.

5. A speaker assembly according to claim 4, comprising a sensor for distinguishing the one or more users from the one or more articles.

6. A speaker assembly according to claim 5, the sensor for distinguishing the one or more users from the one or more articles comprising a camera.

7. A speaker assembly according to claim 5 or claim 6, the controller configured to receive information of a location of the one or more articles and the information of a location of one or more users, and to cause adjustment of a position of the one or more reflectors so as to reflect sound around the one or more articles and towards the one or more users.

8. A speaker assembly according to claim 1, the controller being in communication with a user interface, via which user interface a user can provide the information of a location of one or more users.

9. A speaker assembly according to any of claims 1 to 8, wherein the adjustment of a position of the one or more reflectors comprises one or more of: translational movement; rotational movement.

10. A speaker assembly according to any of claims 1 to

9, wherein one or more of the one or more reflectors comprise a curved reflective surface.

11. A speaker assembly according to any of claims 1 to 10, wherein one or more of the one or more reflectors comprise a flat reflective surface.

12. A speaker assembly according to any of claims 1 to 11, wherein the one or more reflectors is arranged to partially enclose the one or more speakers.

13. A speaker according to any of claims 1 to 12, wherein the one or more reflectors comprise a plastic material.

14. A speaker according to any of claims 1 to 12, wherein the one or more reflectors comprise a metal material.

Figure 1

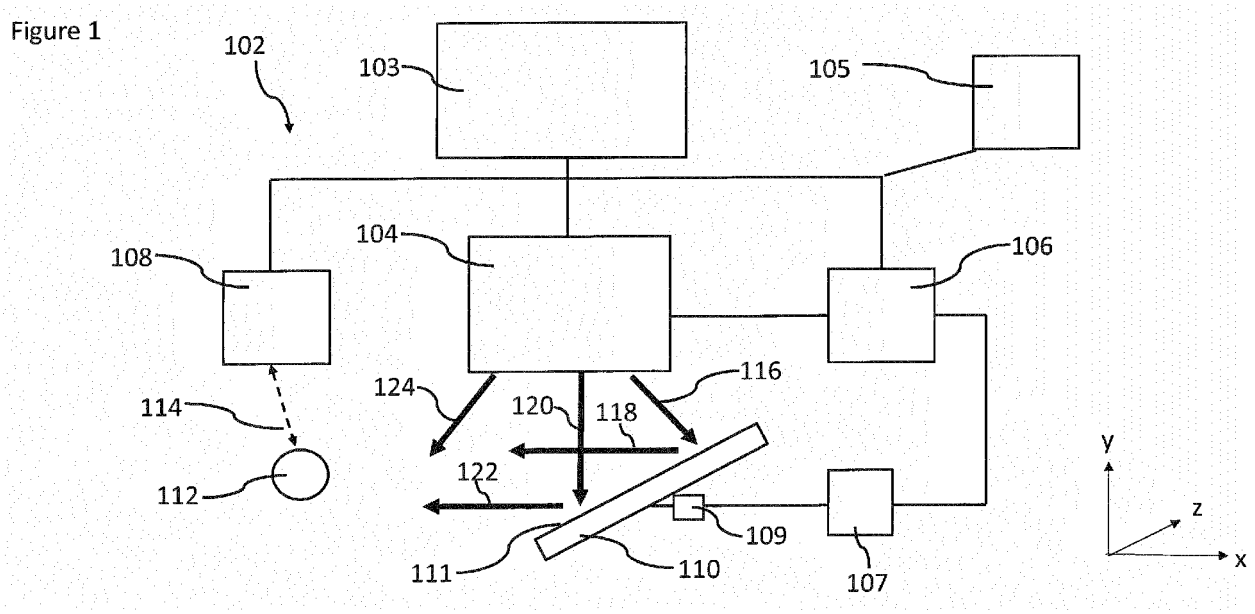
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Figure 2

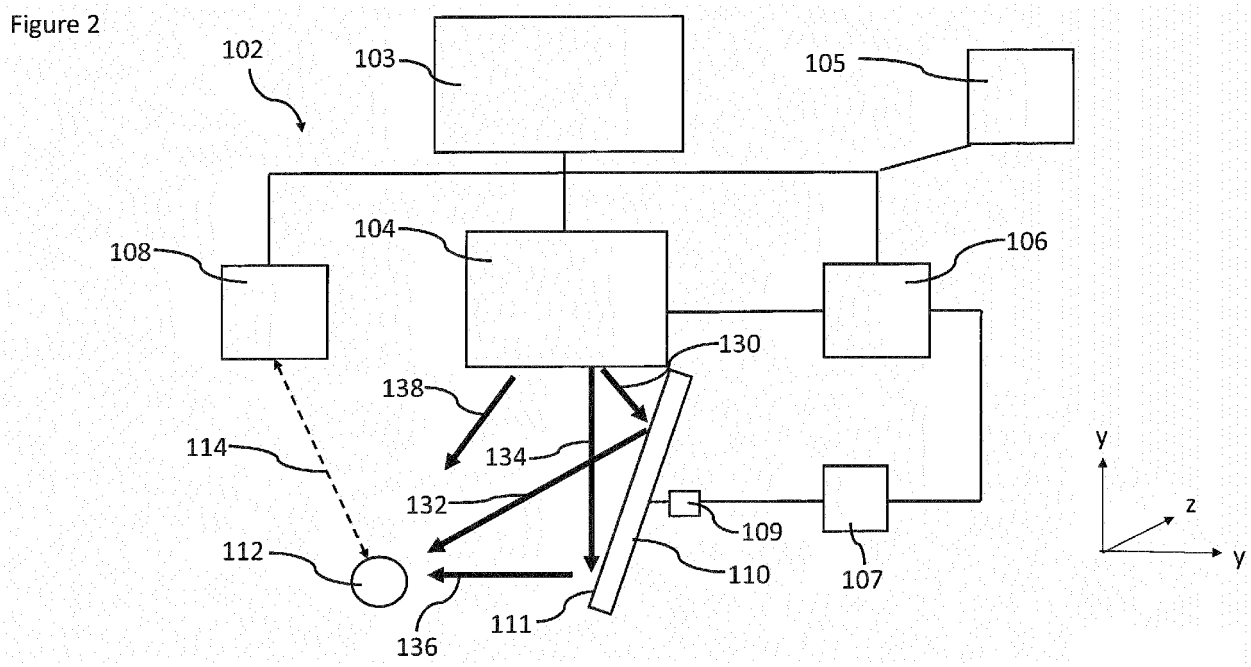
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Figure 3

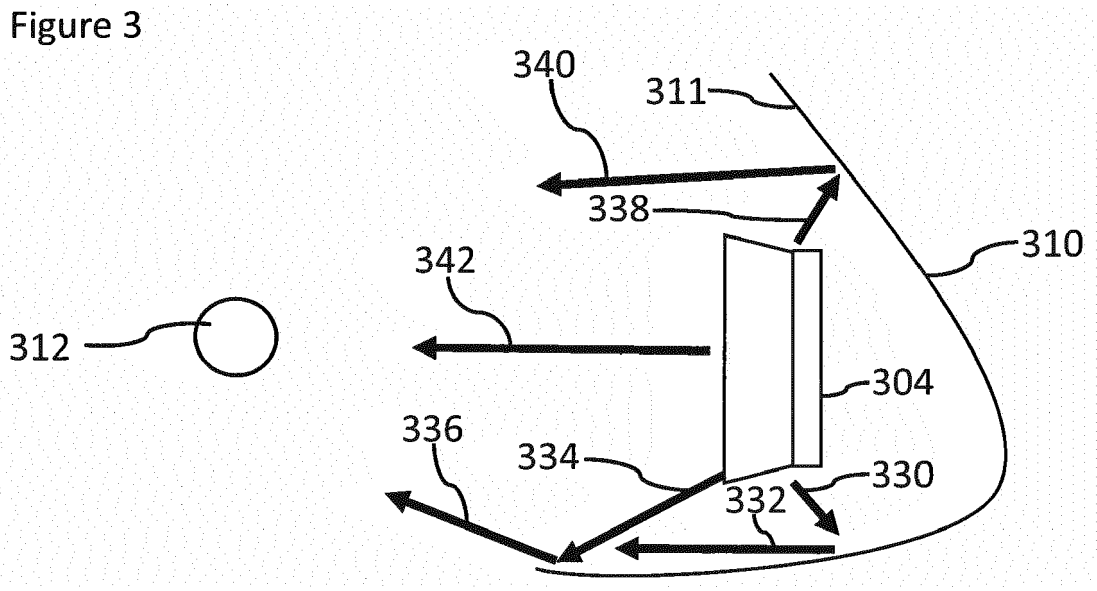


Figure 4

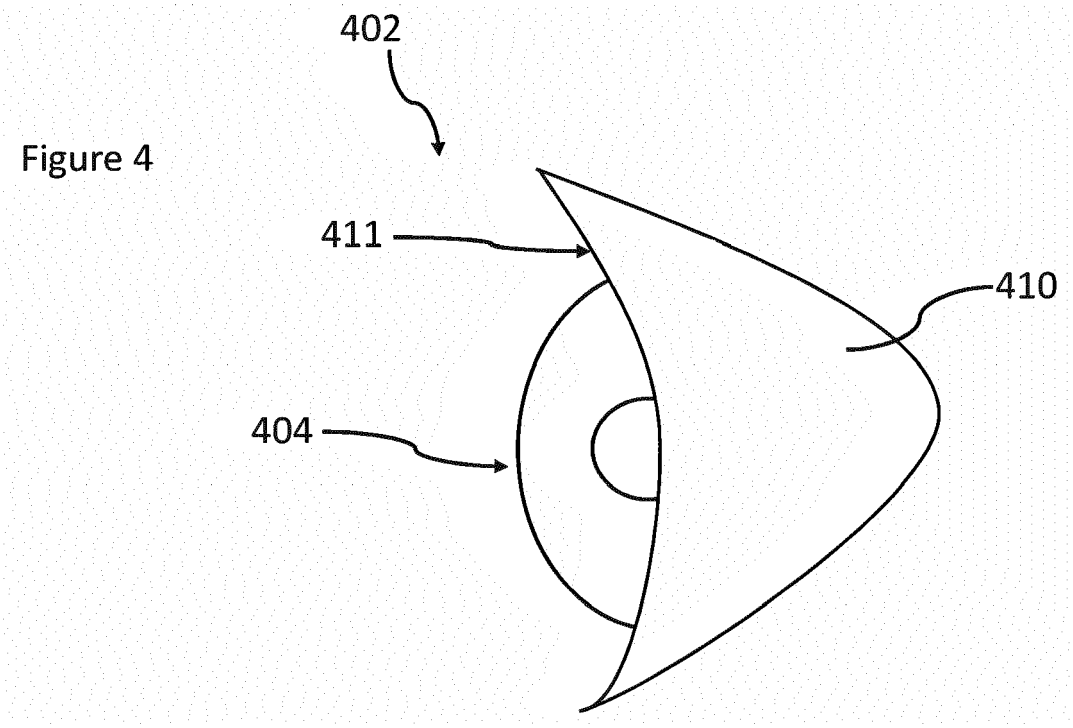


Figure 5

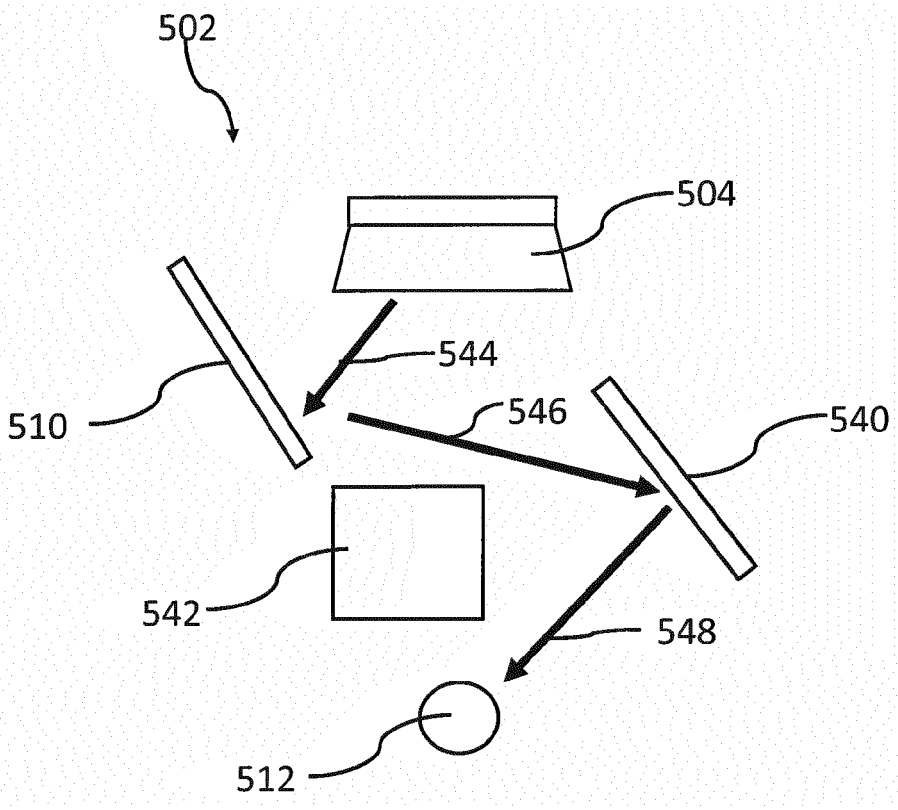
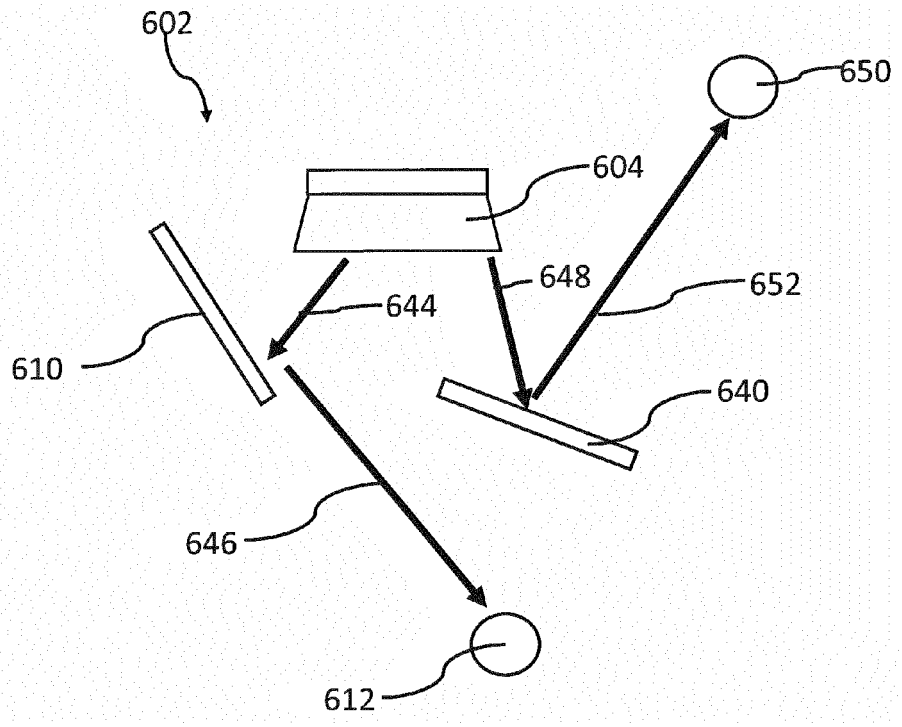


Figure 6



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EUROPEAN SEARCH REPORT

Application Number
EP 17 19 3832

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 2009/202099 A1 (HSU SHOU-HSIU [TW] ET AL) 13 August 2009 (2009-08-13) * the whole document * -----	1,4-14 2,3	INV. H04S7/302
A	US 2006/222191 A1 (HUNG WEN-CHI [TW] ET AL) 5 October 2006 (2006-10-05) * the whole document * -----	1-14	
Y	US 6 445 804 B1 (HIRAYANAGI KOUJI [JP]) 3 September 2002 (2002-09-03) * the whole document * -----	2,3	
A	WO 2012/013744 A2 (FRAUNHOFER GES FORSCHUNG [DE]; SILZLE ANDREAS [DE]; HEISE ULRIK [AT];) 2 February 2012 (2012-02-02) * the whole document * -----	1-14	
A	US 2015/382128 A1 (RIDIHALGH ROBERT LUCAS [US] ET AL) 31 December 2015 (2015-12-31) * the whole document * -----	1-14	
A	EP 1 284 586 A2 (DAIMLER CHRYSLER AG [DE]) 19 February 2003 (2003-02-19) * the whole document * -----	1-14	TECHNICAL FIELDS SEARCHED (IPC) H04S H04R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	3 April 2018	Timms, Olegs

CATEGORY OF CITED DOCUMENTS

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03-04-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009202099 A1	13-08-2009	TW 200934279 A	01-08-2009
		US 2009202099 A1	13-08-2009
US 2006222191 A1	05-10-2006	NONE	
US 6445804 B1	03-09-2002	JP 3000982 B2	17-01-2000
		JP H11164383 A	18-06-1999
		US 6445804 B1	03-09-2002
WO 2012013744 A2	02-02-2012	AU 2011284704 A1	14-03-2013
		AU 2011284705 A1	14-03-2013
		CA 2806932 A1	02-02-2012
		CA 2806933 A1	02-02-2012
		CN 103155592 A	12-06-2013
		CN 103155593 A	12-06-2013
		EP 2599331 A2	05-06-2013
		EP 2599332 A2	05-06-2013
		JP 5503808 B2	28-05-2014
		JP 5789663 B2	07-10-2015
		JP 2013539263 A	17-10-2013
		JP 2013541240 A	07-11-2013
		KR 20130041988 A	25-04-2013
		KR 20130056301 A	29-05-2013
		RU 2013108829 A	10-09-2014
		US 2013140862 A1	06-06-2013
		US 2013142353 A1	06-06-2013
		WO 2012013744 A2	02-02-2012
		WO 2012013745 A2	02-02-2012
US 2015382128 A1	31-12-2015	US 2015382128 A1	31-12-2015
		US 2016309276 A1	20-10-2016
		WO 2016003842 A1	07-01-2016
EP 1284586 A2	19-02-2003	DE 10140646 A1	13-03-2003
		EP 1284586 A2	19-02-2003
		JP 2003163986 A	06-06-2003
		US 2003035552 A1	20-02-2003

EPO FORM P0459

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