(12) UK Patent Application (19) GB (11) 2563189 (13) A

(43) Date of A Publication 12.12.2018

(21) Application No: 1702616.2

(22) Date of Filing: 17.02.2017

(71) Applicant(s):
China Industries Limited
(Incorporated in the United Kingdom)
Creative Industries Centre,
Wolverhampton Science Park, Mammoth Drive,
WOLVERHAMPTON, WV10 9TG, United Kingdom

(72) Inventor(s):
James Edward Alexander Wyatt
Graeme Taylor
Mark Neil Gasson

(74) Agent and/or Address for Service:
Lincoln IP
9 Victoria Street, ABERDEEN, AB10 1XB,
United Kingdom

(51) INT CL:
G02B 27/01 (2006.01)

(56) Documents Cited:
WO 2005/067584 A2 **WO 1995/024713 A1**
CN 205003394 U **US 20170045746 A1**

(58) Field of Search:
INT CL **G02B**
Other: **EPODOC, WPI**

(54) Title of the Invention: **Reality Viewer**
Abstract Title: **Reality viewer comprising reflective and partially reflective surfaces switchable between augmented and virtual reality modes**

(57) A reality viewer comprises a main body 2 having a viewing axis 11 and a screen locator 20 comprising an optical system 23 and a frame 21, wherein the frame is attached to the main body by a pivot mounting 22. The screen locator provides the reality viewer with a means of interchanging between a first viewing position, suitable for providing virtual reality, wherein the frame is coincident with the viewing axis and a second viewing position, suitable for providing augmented reality, wherein the frame is offset from the viewing axis. The main body may comprise a first surface 12 perpendicular to the viewing axis comprising on or more eyeholes 14 and this surface may further comprise a nose cavity 15. The optical system may comprise pivotally mounted reflective 30 and partially reflective 31 surfaces, which may be mounted parallel to one another. A method of configuring such a reality viewer in order to select between augmented and virtual reality modes of operation is also claimed. The reality viewer may have the advantages of being mobile and low cost.

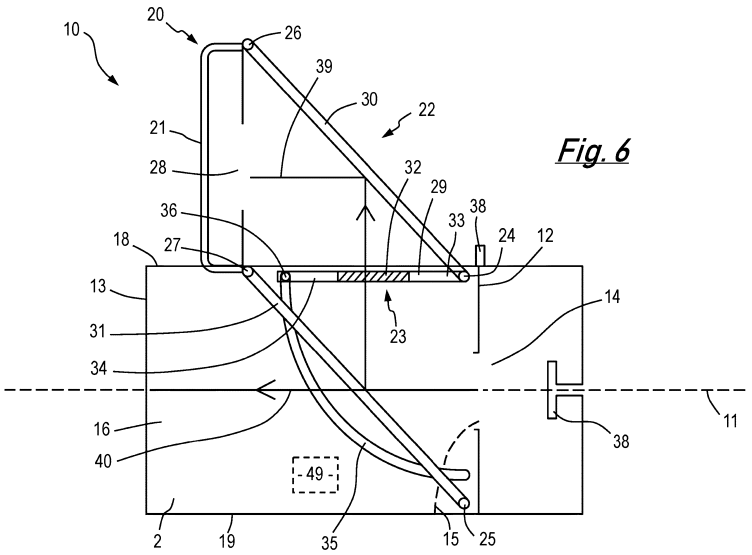


Fig. 6

GB 2563189 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

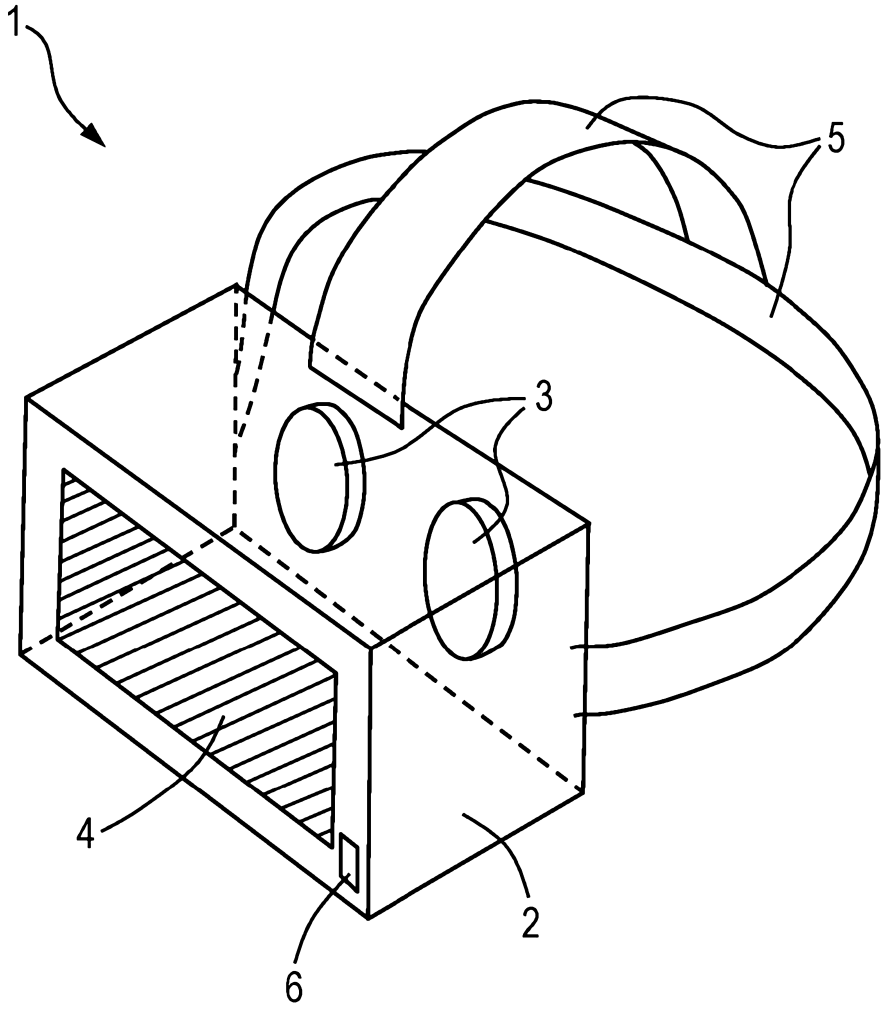


Fig. 1
(Prior Art)

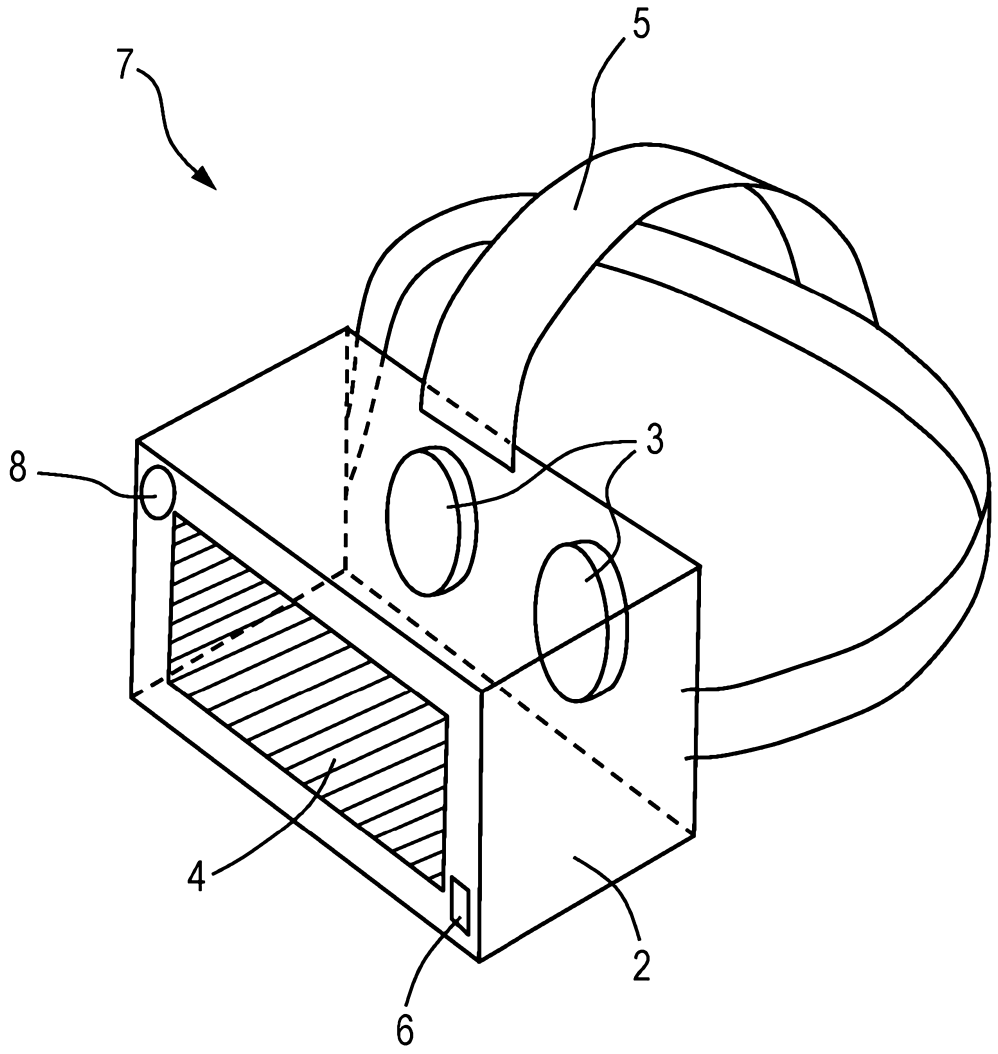


Fig. 2
(Prior Art)

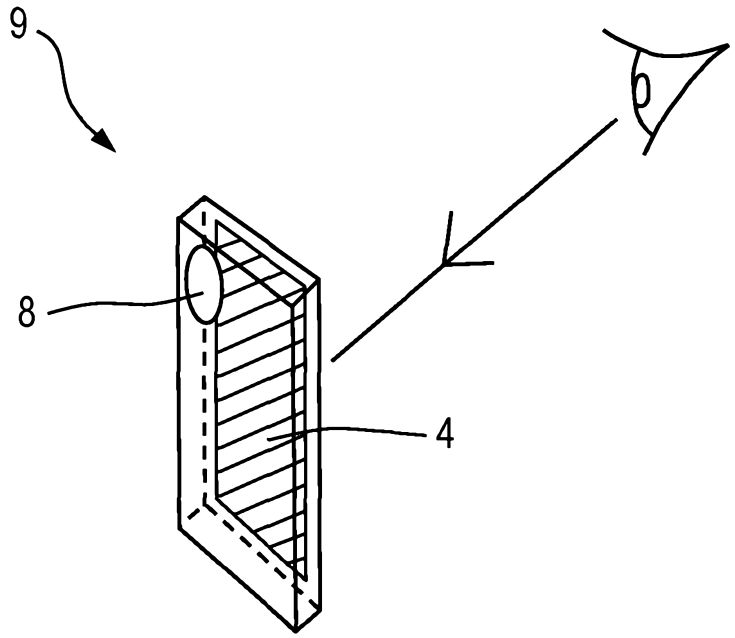


Fig. 3
(Prior Art)

03 04 18

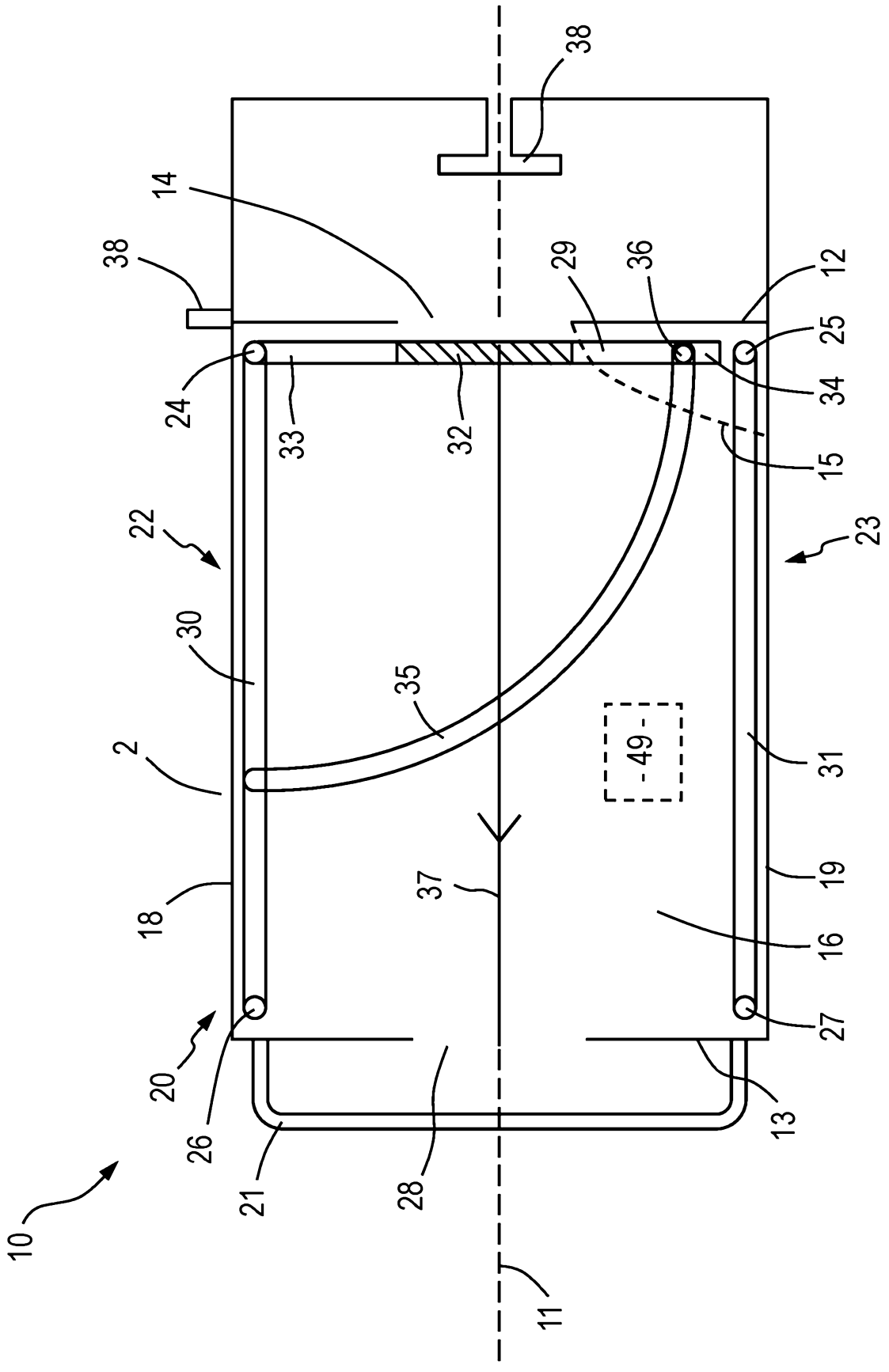

10
11
12
13
14
15
16
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
38
49

Fig. 4

03 04 18

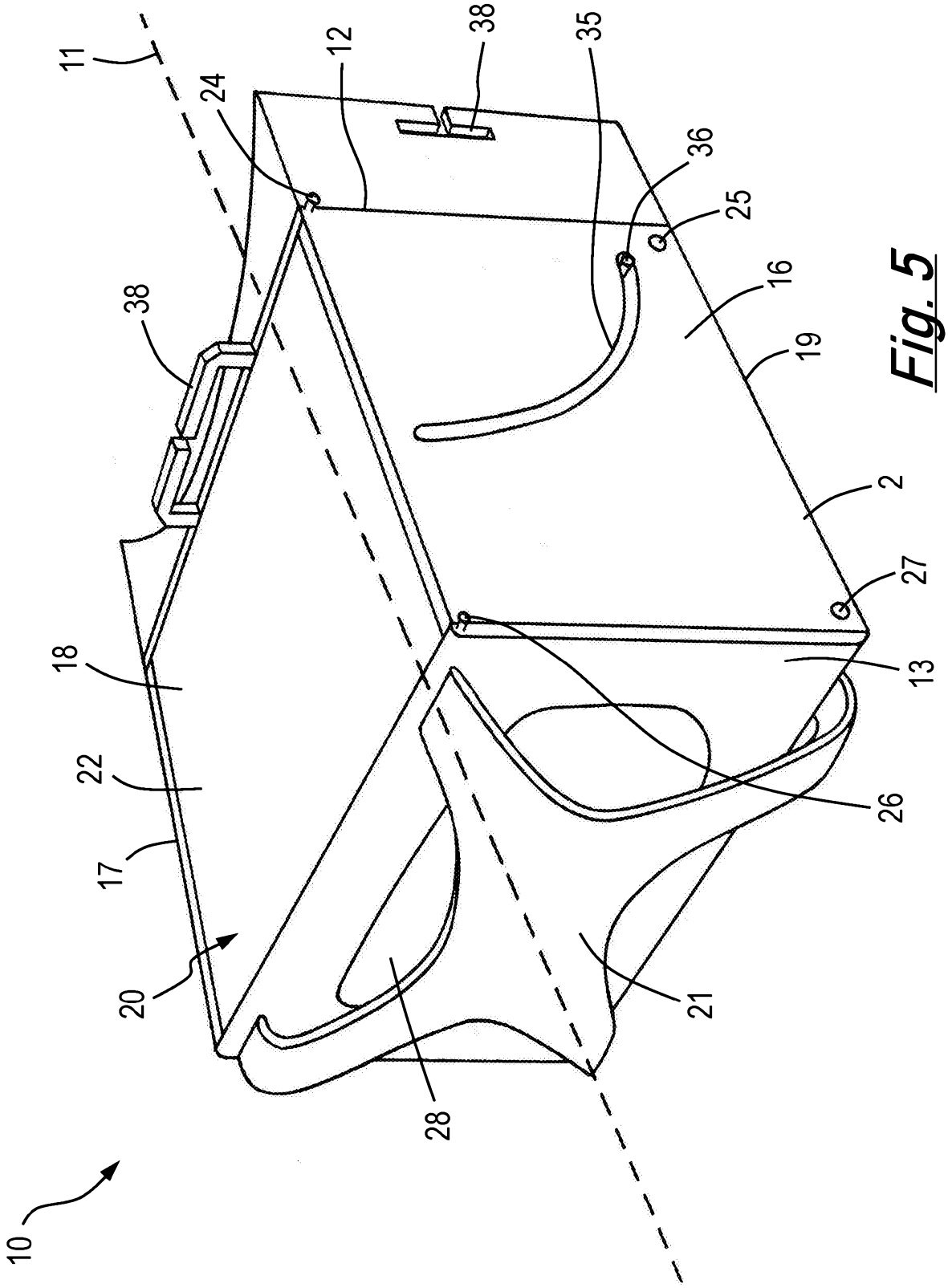
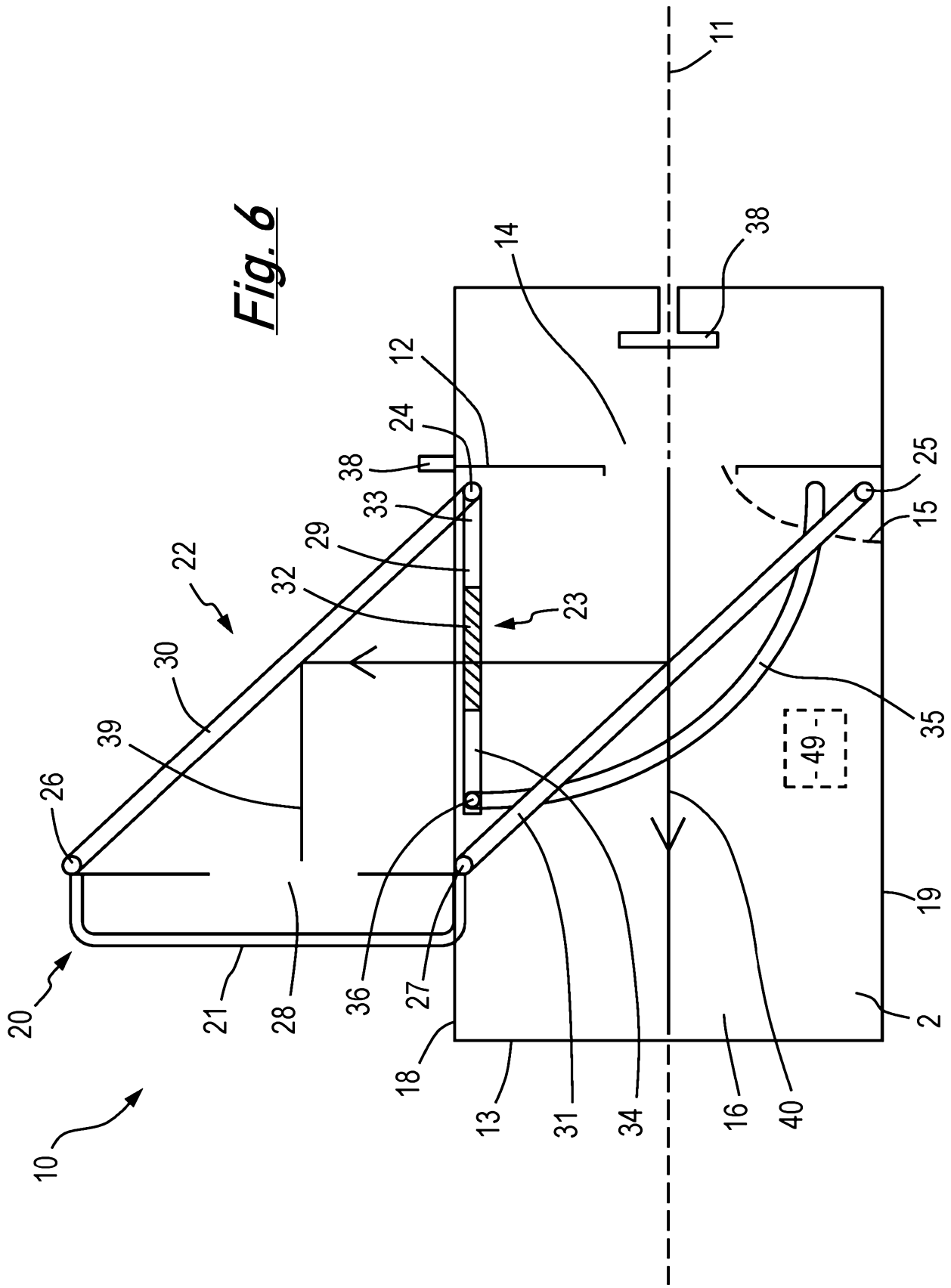


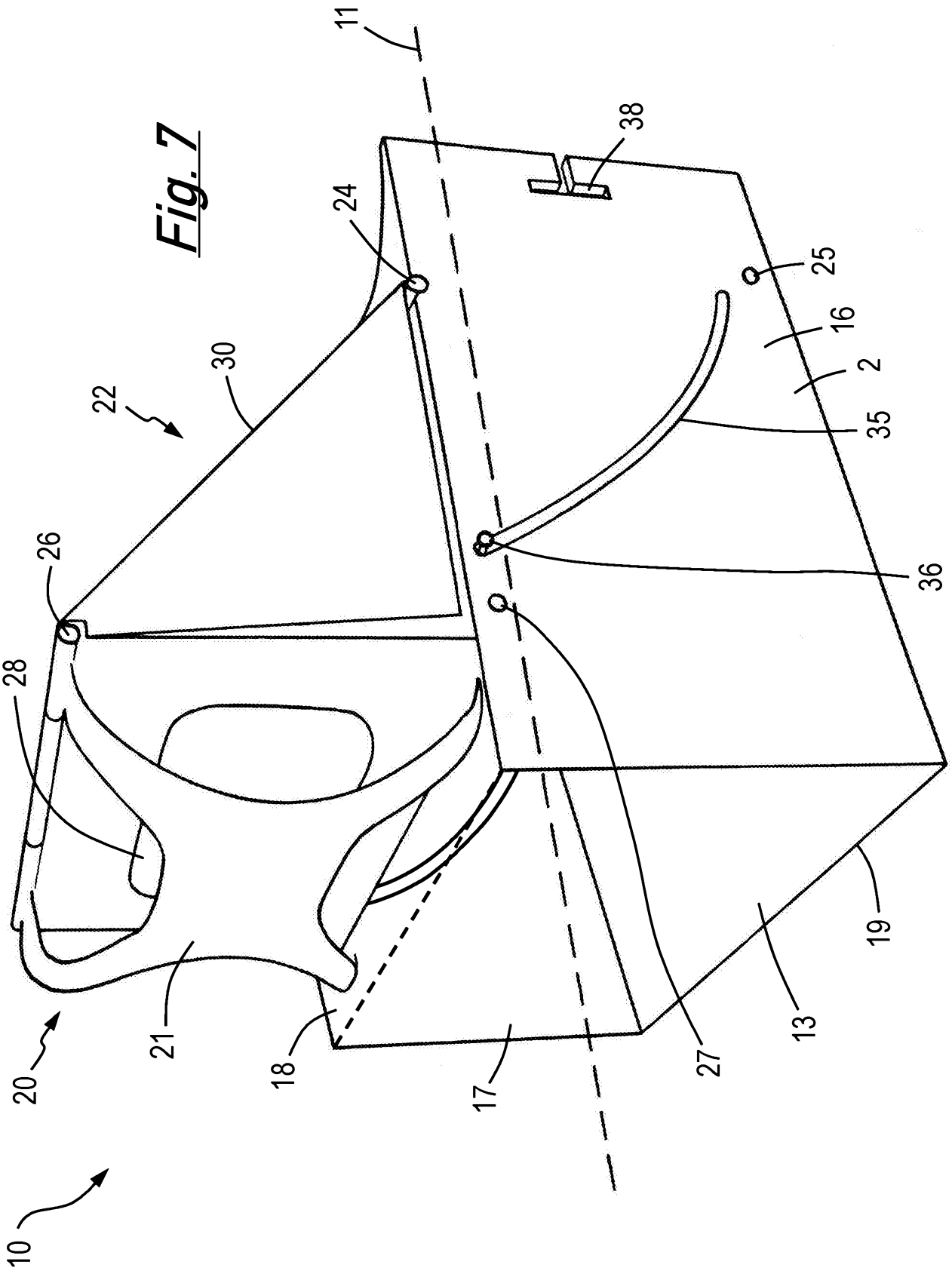
Fig. 5

Fig. 6


10
11
12
13
14
15
16
18
19
2
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
38
38
39
40
49

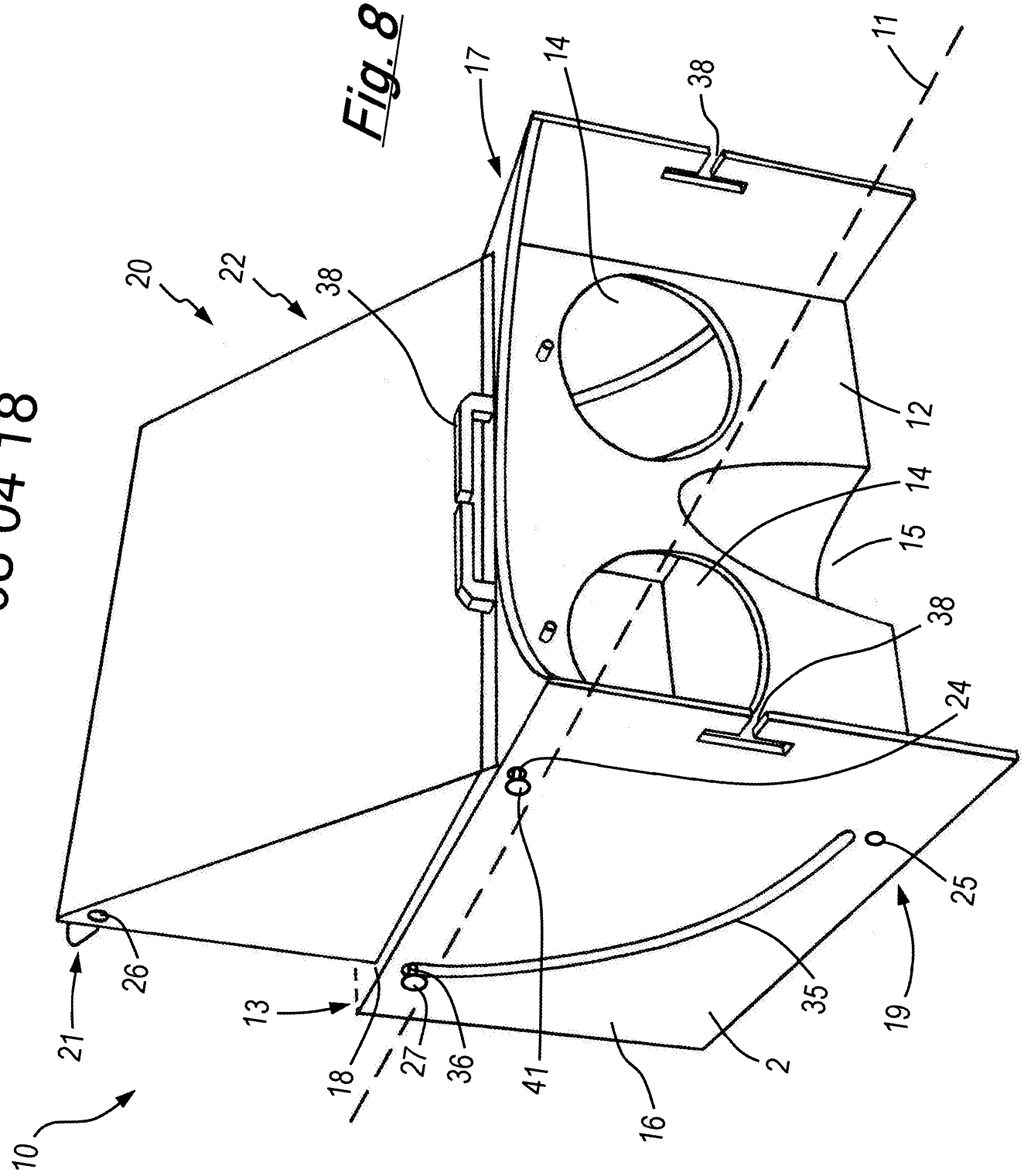
03 04 18

Fig. 7



03 04 18

Fig. 8



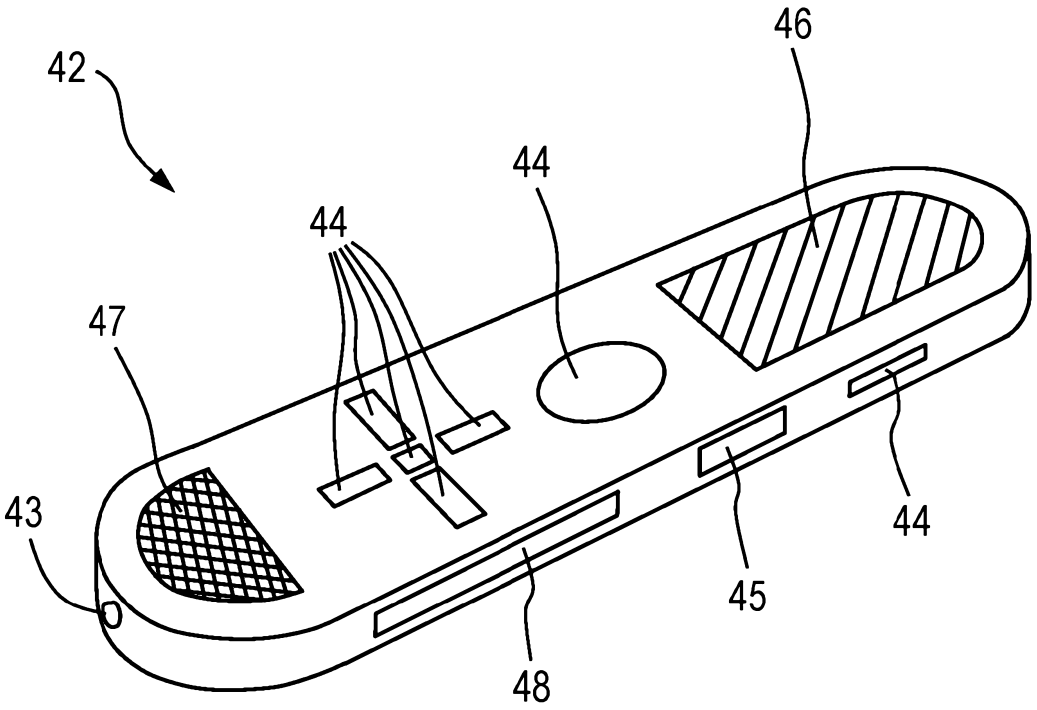


Fig. 9

Reality Viewer

The present invention relates to viewer apparatus and in particular a reality viewer for observing virtual or augmented reality.

Background to the Invention

Virtual reality is an interactive artificial environment created by a computer. The environment can be experienced in real time through multiple sensory features produced by the computer such that a user can respond to the environment, then influence and determine the evolution of the environment.

An example of a device employed to experience a virtual reality is a virtual reality viewer, or alternatively referred to as a virtual reality headset. Numerous examples of these already exist in the market place.

Figure 1 presents an exemplary virtual reality viewer 1 known in that art. The virtual reality viewer 1 can be seen to comprise a main body 2 attached to which are two eye pieces 3

which focus onto an electronic screen 4. The virtual reality viewer 1 is held in place by head straps 5 attached to the main body 2.

The virtual reality viewer 1 allows a user to see a virtual reality displayed upon the electronic screen 4. As an example of the interactive aspect of the virtual reality viewer 1, they may further comprise motion sensors 6 which can detect movement in the real world, such as rotation of the virtual reality viewer 1. This movement can be incorporated into the user's experience to change the direction of view within the virtual environment.

There are limitations to the applications of the virtual reality viewer 1. In particular, there are limitations to the interaction that the virtual reality viewer 1 can provide within the virtual reality. For example, a user can move different parts of their body to interact with the virtual reality. However, the user cannot safely walk whilst wearing the virtual reality viewer 1 as they cannot see where they are going in the real world.

An alternative reality experience is termed augmented reality. Augmented reality is based upon a real-time direct or indirect view of the real world where the real world is supplemented with computer generated interactive sensory features.

Augmented reality can be experienced through an augmented reality viewer. Such devices are known in that art. An example of an augmented reality viewer 7, as shown in Figure 2, is a device comprising many of the same features as the virtual reality viewer 1, but the augmented reality viewer 7 generally also comprises a camera 8, such that an electronic screen 4 displays a view of the real world as captured by the camera 8. This allows a user to walk around the real world, as viewed through the augmented reality viewer 7. In addition, the real world, as perceived through the viewer 7, can be supplemented by adding computer generated features. The augmented reality viewer 7 as just described can be referred to as a pass through augmented reality viewer.

There are limitations to augmented reality viewers. For instance, an image of the real world provided by a camera can deprive a user of depth perception which is required to safely traverse through the real world. There are a range of augmented reality viewers on the market which vary in technical implementation and expense.

In practice, the electronic screen 4 of the reality viewers 1, 7 may take the form of a portable electronic device such as a tablet or phone. Such devices typically have motion sensors 6 built in. The portable electronic device is removable as the reality viewers may comprise a frame to hold the portable electronic device.

The field of view, in the context of a human, is the proportion or extent of the real world that is observed by both eyes at a given instance. More specifically, humans have an almost 180 degree forward-facing horizontal field of view. In the context of, for example, a virtual reality, the field of view is limited by the proportion or extent of the virtual reality observed at a given instance.

The reality viewers 1, 7, as described above, typically have a horizontal field of view ranging between 90 to 120 degrees. The field of view depends of the size of the electronic screen 4. For example, where the electronic screen 4 takes the form of a relatively small portable electronic device this would result in a small field of view (e.g. 90 degrees). The reality viewers 1, 7 do not have a fully immersive field of view as the perceived virtual or augmented reality does not make up the entire extent of the user's spatial range in vision.

An alternative device to experience an augmented reality is simply a portable electronic device 9, such as a phone or tablet, held at arm's length by a user, as depicted by Figure 3. Where a portable electronic device 9 differs from the augmented reality viewer 7 is that it has a narrower field of view. This means the user has a partial, direct view of the real world facilitating safely walking around. However, the narrow field of view is non-immersive and provides a limited experience of the augmented reality.

Summary of the Invention

It is an object of an aspect of the present invention to provide a reality viewer that obviates or at least mitigates one or more of the aforesaid disadvantages of reality viewer known in the art.

A reality viewer comprising:

- a main body having a viewing axis;
- a screen locator comprising an optical system and a frame the frame being attached to the main body by a pivot mounting;

- wherein the screen locator provides a means for moving the frame between a first viewing position wherein the frame is coincident with the viewing axis and a second viewing position wherein the frame is offset from the viewing axis.

The reality viewer is therefore interchangeable between a first position that allows for a virtual reality experience and a second position that allows for an augmented reality experience.

The frame is preferably pivotally mounted upon the pivot mounting.

The main body preferably comprise a first surface, substantially perpendicular to the viewing axis, the first surface comprising one or more eyeholes. The first surface may also comprise a nose cavity.

Most preferably, the optical system is moveable in conjunction with the screen locator.

Preferably, the optical system comprises one or more lenses.

Optionally, the optical system further comprises a lens adjuster that provides a means for varying the focal distance of the one or more lenses. Adjusting the focal distance of the one or more lenses allows for the focus length of the reality viewer to be optimised between first and second positions and for different users.

Preferably, the optical system may comprise a pivotally mounted reflective surface.

Preferably, the optical system may also comprise a pivotally mounted partially reflective surface.

Most preferably, the pivotally mounted reflective surface is parallel to the pivotally mounted partially reflective surface.

In the first viewing position, the pivotally mounted reflective surface and the pivotally mounted partially reflective surface do not bisect the viewing axis. In comparison, when in the second viewing position the pivotally mounted reflective surface and the pivotally

mounted partially reflective surface bisect the viewing axis. Most preferably the pivotally mounted reflective surface and the pivotally mounted partially reflective surface bisect the viewing axis at 45 degrees.

The pivotally mounted reflective surface may comprise a mirror. Alternatively, the pivotally mounted reflective surface comprises a prism. In a similar manner, the partially reflective surface may comprise a mirror or a prism

The main body may comprise one or more slots suitable for receiving one or more pins of the screen locator. The one or more slots and pins provide a means for assisting movement of the reality viewer between the first and second viewing positions.

The main body may comprise one or more fixtures that provide a means for attaching the reality viewer to a head strap.

Optionally, the reality viewer comprises an electric motor arranged to automatically move the reality viewer between the first and the second viewing positions.

Optionally, the reality viewer comprises a universal controller. The universal controller provides a means for remotely controlling a portable electronic device mounted in the frame of the reality viewer. The universal controller may also provide additional means for a user to interact with the virtual or augmented reality.

A method of configuring a reality viewer the method comprising:

- selecting between a first or second mode of operation for the reality viewer by;
- moving a frame of the reality viewer to a first viewing position wherein the frame is coincident with a viewing axis of the reality viewer when the first mode or operation is selected; or
- moving the frame of the reality viewer to a second viewing position wherein the frame is offset from the viewing axis of the reality viewer when the second mode or operation is selected.

Preferably, the frame pivots between the first and second modes of operation.

Most preferably, the first viewing position provides a means for viewing a virtual reality generated by an electronic screen housed within the frame.

Most preferably, the second viewing position provides a means for viewing an augmented reality generated by an electronic screen housed within the frame.

Optionally the method of configuring the reality viewer further comprises adjusting the focal length of one or more lenses.

The method of configuring the reality viewer may further comprises remotely controlling a portable electronic device located within the frame.

Brief Description of Drawings

There will now be described, by way of example only, various embodiments of the invention with reference to the drawings, of which:

Figure 1 presents a perspective view of a prior art virtual reality viewer;

Figure 2 presents a perspective view of a prior art augmented reality viewer;

Figure 3 presents a perspective view of a prior art portable electronic device for use to experience an augmented reality;

Figure 4 presents a cross-section schematic of a reality viewer in accordance with an embodiment of the present invention within a first viewing position;

Figure 5 presents a perspective view of the first viewing position of the reality viewer of Figure 4;

Figure 6 presents a cross-section schematic of the reality viewer of Figure 4 in a second viewing position;

Figure 7 presents a perspective view of the second viewing position of the reality viewer of Figure 4;

Figure 8 presents an alternative perspective view of the second viewing position of the reality viewer of Figure 4; and

Figure 9 presents a perspective view of a universal controller for the reality viewer of Figure 4.

In the description which follows, like parts are marked throughout the specification and drawings with the same reference numerals. The drawings are not necessarily to scale and the proportions of certain parts have been exaggerated to better illustrate details and features of embodiments of the invention.

Detailed Description of the Preferred Embodiments

An explanation of the present invention will now be described with reference to Figures 4 to 9. Figures 4 and 5 show a reality viewer 10 in a first viewing position and Figures 6 to 8 show the reality view in a second viewing position. Figure 9 shows an additional component of an alternative embodiment of reality viewer 10.

From these figures the reality viewer 10 can be seen to comprises a main body 2. The main body 2 is substantially cuboid. A viewing axis 11 passes through the centre of the main body 2, intersecting a first surface 12 and second surface 13 opposing surfaces of the main body 2. The first surface 12 comprises eye holes 14 and a nose cavity 15.

The main body 2 further comprises a third surface 16, a fourth surface 17, a fifth surface 18 and a sixth surface 19, which are all substantially parallel to the viewing axis 11 and all substantially perpendicular to the first 12 and second 13 surfaces. The third 16 and fourth 17 surfaces are preferably equally offset on opposing sides of the viewing axis 11. The fifth 18 and sixth 19 surfaces are substantially perpendicular to the third 16 and fourth 17 surfaces. Similarly, the fifth 18 and sixth 19 surfaces are preferably equally offset on opposing sides of the viewing axis 11. These surfaces, (12, 13, 16, 17, 18, 19), can be clearly seen in the perspective view of the reality viewer shown by Figure 5.

The reality viewer 10 further comprises a screen locator 20 best seen in Figures 6 to 8. The screen locator 20 comprises a frame 21, attached to the main body 2 via a pivot

mounting 22, and an optical system 23. The pivot mounting 22 is attached to the main body 2 at pivot axes 24 and 25. The frame 21 is attached to the pivot mounting 22 at the pivot axes 26 and 27. The pivot axes 24, 25, 26 and 27 extend between the third 16 and fourth 17 surfaces.

The frame 21 provides a means for holding a portable electronic device 9 comprising an electronic screen 4. There is a screen hole 28 in the second surface 13 of the main body 2 suitable for receiving the electronic screen 4. The portable electronic device 9 fits within the frame 21 such that the electronic screen 4 is integrated with the second surface 13. The electronic screen 4 faces towards, and is substantially parallel to, the first surface 12. The viewing axis 11 is coincident and substantially normal to the frame 21.

The optical system 23 comprises a lens plane 29, a reflective surface 30 and a partially-reflective surface 31. The lens plane 29 can be seen to comprise one or more lenses 32.

The lens plane 29 has a proximal end 33 and a distal end 34. The proximal end 33 of the lens plane 29 is attached to the pivot axis 24. The third 16 and fourth 17 surfaces of the main body 2, each comprise a slot 35. The slots 35 are curved. Attached to the distal end 34 of the lens plane is a pin 36, extending through the lens plane 29, between the third 16 and fourth 17 surfaces. The pin 36 passes through the slots 35 on the third 16 and fourth 17 surfaces. The distal end 34 of the lens plane 29 therefore moves and pivots as guided by the slots 35 and pin 36.

When the reality viewer 10 is configured in the first viewing position, the lens plane 29 of the optical system 23 is adjacent and substantially parallel to the first surface 12 such that it bisects the viewing axis 11. In this configuration, the one or more lenses 32 of the lens plane 29 align with the eye holes 14. The second surface 13 is positioned at the focal distance of the one or more lens 32. As a result, there exists a direct optical path 37 between the eye holes 14 and electronic screen 4 when in situ within the frame 21.

The reflective surface 30 and semi-reflective surface 31 are not an active component of the optical system 23 in the first viewing position of the reality viewer 10. The reflective surface 30 is connected to pivot axes 24, 26 and is stored substantially coplanar with the fifth surface 18. While, the partially-reflective surface 31 is connected to pivot axes 25, 27 and is stored substantially coplanar with the sixth surface 19.

The reality viewer 10 further comprises head strap fixtures 38 upon the third 16, fourth 17 and fifth 18 surfaces such that the head straps can be attached to the main body 2.

In the second viewing position, as shown by Figure 6 to 8, the screen locator 20 provides a means for configuring the frame 21 such that it is offset from the viewing axis 11. The pivot mounting 22, pivots such that the frame 21 is offset from the viewing axis 11 in a direction substantially perpendicular to the fifth 18 and sixth 19 surfaces.

The reflective surface 30 and the partially reflective surface 31 pivot with the pivot mounting 22 such that these surfaces 30, 31 are at an angle relative to viewing axis 11. Preferably, this angle is 45 degrees.

The reflective surface 30 and the partially reflective surface 31 provide a diverted optical path 39 to the electronic screen 4, when in situ in the frame 21, when in the second viewing positon. This optical system 23 is analogous to a periscope. As an alternative to reflective surfaces 30, 31, the optical system 23 could employ prisms to divert the optical path 39.

In the second viewing position the lens plane 29 pivots about the pivot axis 24 such that it is parallel and adjacent to the fifth surface 18. The diverted optical path 39 bisects the lens plane 29. However, the lens plane 29 no longer bisects the viewing axis 11.

As the frame 21 and lens 32 do not bisect the viewing axis, there is a direct optical path 40 through the main body 2, along the viewing axis 11, providing a view of the real world. This optical path 40 passes through the partially reflective surface 31. Furthermore, the partially reflective surface 31 provides a means to superimpose the image from the electronic screen 4, via optical path 39, upon the direct view, optical path 40, of the real world.

It will be apparent to the skilled reader that the first viewing position of the reality viewer 10 is suitable for experiencing a virtual reality while the second viewing position of the reality viewer 10 is suitable for experiencing an augmented reality.

The optical path 37 in the first viewing position from the eye holes 14 to the electronic screen 4 may be a different length to the corresponding optical path 39 in the second viewing position. For the reality viewer 10 to remain in perfect focus it may require adjusting the focal distance of the lens 32. In practice, adjustment of the focal distance is not always found to be necessary as the path difference is sufficiently small and negligible that most user's eyesight, particularly younger users, could naturally compensate for this path difference.

Nevertheless, the reality viewer 10 may further comprise the functionality to adjust the focal distance of the lens 32 so that the reality viewer 10 remains in focus when configured in both first and second viewing positions and to fine tune the focus when required. As shown by Figure 8, the adjustment means may take the form of a rotating lens adjustment knob 41 connected to pivot axis 24. The pivot axis 24 is connected to the proximal end 33 of the lens plane 29.

The reality viewer 10 may further comprise a universal controller 42, see Figure 9. The portable electronic device 9, when mounted in the frame 21 of the reality viewer 10 may be more difficult to access such that it is cumbersome to change settings and run computer programs. The universal controller 42 is a device that provides a means of remotely controlling the portable electronic device 9 as well as facilitating additional interactive features to enhance the virtual or augmented reality experience. An example of a similar controller is disclosed in UK patent publication number GB 2,524,993 A.

The universal controller 42 comprises a communication module 43, one or more buttons 44, one or more internal sensors 45, a small electronic screen 46, a speaker 47 and an expansion port 48. The communication module 43 allows the universal controller 42 to communicate with the portable electronic device 9. The buttons 44 facilitate selecting and adjusting the settings of the portable electronic device 9, such as the volume, or responding to a feature in the virtual or augmented reality. The sensors 45 detect, for example, movements of a user which may be in response to the virtual or augmented reality. The small electronic screen 46 can display settings, such as the battery life of the portable electronic device 9. The expansion port 48 facilitates updating or running alternative computer software future proofing the universal control 42.

When interchanging between the first and second viewing positions of the reality viewer, the position of the moving components, such as the screen locator 20, can be manually altered by a user. Alternatively, this movement could be automated with an electric motor 49 incorporated into the reality viewer 10.

The above described reality viewer 10 offers a number of advantages over apparatus known in the art. A key advantage is the reality viewer 10 can be used to observe both a virtual reality or an augmented reality by interchanging between a first and second viewing positions. Furthermore, the reality viewer 10 can provide both reality experiences with an immersive, maximised field of view.

Another key advantage of the reality viewer 10 is that in the second viewing position, suitable for augmented reality, there is a direct view of the real world. This direct view provides the user with, for example, depth perception.

In addition, the reality viewer 10 is mobile, portable and universal. More specifically, it is compatible with numerous portable electronic devices 9 which a user may already own. The relatively expensive and more complex technology required to generate and evolve a virtual or augmented reality, such as interactive software and sensors, is typically contained within the portable electronic device 9. As a result, within the reality viewer 10 itself there is a minimal amount of electronic and optical technology. This makes the reality viewer 10 a low cost and a flexible platform to adapt and build upon.

A reality viewer is disclosed. The reality viewer comprises a central viewing axis and a frame suitable for holding a portable electronic device. The reality viewer can interchange between a first viewing position wherein the frame is coincident with the viewing axis and a second viewing position wherein the frame is offset from the viewing axis. The reality viewer has the advantage that it is suitable for both, virtual reality in the first viewing position, and augmented reality in the second viewing position. In addition, the reality viewer is mobile; universal; low cost; has a low technological barrier; has an immersive, maximised field of view; provides a real world view in the second viewing configuration and provides a platform to build upon.

The foregoing description of the invention has been presented for purposes of illustration and description and is not intended to be exhaustive or to limit the invention to the precise

form disclosed. The described embodiments were chosen and described in order to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best utilise the invention in various embodiments and with various modifications as are suited to the particular use contemplated. Therefore, further modifications or improvements may be incorporated without departing from the scope of the invention as defined by the appended claims.

Claims

1) A reality viewer comprising:
   - a main body having a viewing axis;
   - a screen locator comprising an optical system and a frame, the frame being attached to the main body by a pivot mounting;
   - wherein the screen locator provides a means for moving the frame between a first viewing position wherein the frame is coincident with the viewing axis and a second viewing position wherein the frame is offset from the viewing axis.

2) A reality viewer as claimed in claim 1 wherein the frame is pivotally mounted upon the pivot mounting.

3) A reality viewer as claimed in claim 1 or 2 wherein the main body comprises a first surface, substantially perpendicular to the viewing axis, the first surface comprising one or more eyeholes.

4) A reality viewer as claimed in claim 3 wherein the first surface further comprises a nose cavity.

5) A reality viewer as claimed in any of the preceding claims wherein the optical system is moveable in conjunction with the screen locator.

6) A reality viewer as claimed in any of proceeding claims wherein the optical system comprises one or more lenses.

7) A reality viewer as claimed in claim 6 wherein the optical system further comprises a lens adjuster that provides a means for varying the focal distance of the one or more lenses.

8) A reality viewer as claimed in any of the proceeding claims wherein the optical system comprises a pivotally mounted reflective surface.

9) A reality viewer as claimed in any of the proceeding claims wherein the optical system comprises a pivotally mounted partially reflective surface.

10) A reality viewer as claimed in claim 9 wherein the pivotally mounted reflective surface is mounted parallel to the pivotally mounted partially reflective surface.

11) A reality viewer as claimed in either of claims 9 or 10 wherein the first viewing position, the pivotally mounted reflective surface and the pivotally mounted partially reflective surface do not bisect the viewing axis.

12) A reality viewer as claimed in claims 9 to 11 wherein the second viewing position the pivotally mounted reflective surface and the pivotally mounted partially reflective surface bisect the viewing axis.

13) A reality viewer as claimed in claim 12 wherein the pivotally mounted reflective surface and the pivotally mounted partially reflective surface bisect the viewing axis at 45 degrees.

14) A reality viewer as claimed in claims 8 to 13 wherein the pivotally mounted reflective surface comprise a mirror.

15) A reality viewer as claimed in claims 8 to 13 wherein the pivotally mounted reflective surface comprises a prism.

16) A reality viewer as claimed in claims 9 to 15 wherein the partially reflective surface comprises a mirror or a prism.

17) A reality viewer as claimed in any of the proceeding claims wherein the main body comprises one or more slots suitable for receiving one or more pins of the screen locator.

18) A reality viewer as claimed in any of the proceeding claims wherein the main body comprises one or more fixtures that provide a means for attaching the reality viewer to a head strap.

19) A reality viewer as claimed in any of the proceeding claims wherein the reality viewer further comprises an electric motor arranged to automatically move the reality viewer between the first and the second viewing positions.

20) A reality viewer as claimed in any of the proceeding claims wherein the reality viewer further comprises a universal controller.

21) A reality viewer as claimed in claim 20 wherein the universal controller provides a means for remotely controlling a portable electronic device mounted in the frame of the reality viewer.

22) A reality viewer as claimed in claim 20 and 21 wherein the universal controller provides a means for a user to interact with the virtual or augmented reality provided by a portable electronic device.

23) A method of configuring a reality viewer the method comprising:
- selecting between a first or second mode of operation for the reality viewer by;
- moving a frame of the reality viewer to a first viewing position wherein the frame is coincident with a viewing axis of the reality viewer when the first mode or operation is selected; or
- moving the frame of the reality viewer to a second viewing position wherein the frame is offset from the viewing axis of the reality viewer when the second mode or operation is selected.

24) A method of configuring a reality viewer as claimed in claim 23 wherein the frame pivots between the first and second modes of operation.

25) A method of configuring a reality viewer as claimed in either of claims 23 and 24 wherein the first viewing position provides a means for viewing a virtual reality generated by an electronic screen housed within the frame.

26) A method of configuring a reality viewer as claimed in any of claims 23 to 25 wherein the second viewing position provides a means for viewing an augmented reality generated by an electronic screen housed within the frame.

27) A method of configuring a reality viewer as claimed in any of claims 23 to 26 wherein the method of configuring the reality viewer further comprises adjusting the focal length of one or more lenses.

28) A method of configuring a reality viewer as claimed in any of claims 23 to 27 wherein the method further comprises remotely controlling a portable electronic device located within the frame.

Intellectual Property Office

Application No:	GB1702616.2	**Examiner:**	Sophie Cartmell
Claims searched:	1-28	**Date of search:**	13 July 2017

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-7 and 17-28	US 2017/045746 A1 (ELLSWORTH and CLEMENTS) See particularly paragraphs 23 and 39 and figures 2A and 2B
X	1-7 and 17-28	WO 95/24713 A1 (OPTICS 1) See particularly particularly page 11, paragraph 3; page 19, paragraph 2 and page 22, paragraph 2 and figures 1, 3 and 6
X	1-7 and 17-28	WO 2005/067584 A2 (INTERACTIVE IMAGING SYSTEMS) See particularly page 3, paragraphs 2 and 3 and figures 3A-3C and 5A-5C
X	1-7 and 17-28	CN 205003394 U (XU WEIBO) See particularly figure 1 and abstract

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

G02B

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI

International Classification:

Subclass	Subgroup	Valid From
G02B	0027/01	01/01/2006