Title of the Invention: Dual Camera OIS
Abstract Title: Dual camera with optical image stabilization actuators separated by air gap only

A dual camera has two cameras 1, 2 each with an image sensor and a lens. Each camera has an actuator for optical image stabilization. One or more moving elements of the first actuator are positioned directly next to one or more moving elements of the second actuator with an air gap separation only. Two cases may be provided each with a cut-away 3 on the joining wall. Another dual camera has a single case (11, figure 4a) with a partition 12 between the two cameras. The actuators may be shape memory alloy actuators. Optical image stabilization endstops 4 may be provided on the moving elements of the camera actuators. The cameras may be miniature cameras used in mobile phones.
Dual Camera OIS

This invention concerns Optical Image Stabilization (OIS) in cameras such as miniature cameras used in portable electronic devices such as mobile phones. In particular in concerns OIS for dual or multiple cameras where size minimization is important.

OIS in miniature cameras can be effected by detecting camera shake (with for example a gyro) and using the detected movements to control an actuator to move the camera lens stack in opposition to cancel the shake. Suitable OIS mechanisms may comprise for example Voice Coil Motor (VCM) actuators or Shape Memory Alloy (SMA) actuators. SMA actuators are described in for instance the co-owned international patent publications WO2013/175197 and WO2014/083318. The OIS actuators comprise four SMA wires arranged to move the lens stack in two dimensions perpendicular to the optic axis.

In some cases, two or more cameras may be provided, for example to improve image quality or performance. The cameras may for example have different sensitivities or different focal lengths. An OIS actuator may be provided for each camera. In a mobile phone, space is always at a premium and it is always desirable to minimise the size of the components. This is especially the case as the number of cameras increases. VCM actuators contain magnets and generate electromagnetic fields and as such, can only be located close together if they are suitably shielded from each other.

Miniature cameras are usually provided with a screening can to contain and protect the camera. This screening can acts as an actuator case and shielding component, also termed a shield can. A dual camera arrangement therefore results in two screening cans located next to each other. It has been appreciated that some space can be saved by modifying the screening cans, especially in the case of SMA actuators where complete shielding is not required.

The following description considers cameras with dimension 9.5mm square, but the described designs could equally apply to other sizes.

In a first aspect of the invention, there are two cameras with OIS actuators wherein the moving elements of the two actuators are positioned directly next to each other with an air gap separation only. To achieve this, there are two shield cans each with a cutaway to one wall, which walls are then conjoined, such that there is an air gap between the two actuators. This is illustrated in Figure 1, in perspective view in Fig 1a and in plan view in Fig 1b. The two shield cans 1, 2 each have a cut away 3 on the joining wall. The joining wall is also configured to form the end stops 4 for the central sides of the actuator, saving some space. In all the long dimension of the dual camera is reduced from 19mm to 18.7mm.

Pros and cons of the figure 1 design are:
Pros:
- Low actuator yield loss costs (modular actuators can be tested before being combined)
- Size

Cons:
- New design, longer development time
- Endstop on AF shield can – possible yield loss increase
- LH & RH OIS parts (different base plates)
- Sealing issues
- 2 shield can components
A modification to this design is shown if Figure 2, wherein the footprint of the autofocus unit, which includes the lenses and is housed within the screening can, is reduced on one side, as shown in Figure 2a. In addition, the SMA wires 5,6 are slanted such that the crimps 7,8 do not overlap in the optic axis direction, Figure 2c. This again allows the space between the actuators to be reduced. The long dimension in this case may be 18 mm as opposed to 19mm.

The pros and cons of the Figure 2 design are:
Pros:
- Low actuator yield loss costs (modular actuators can be tested before being combined)
- Size
Cons:
- New design, longer development time
- Significant AF modification required – may not be possible
- Significant OIS modification required
- endstop on AF shield can – possible yield loss increase
- LH & RH OIS parts (different base plates)
- Sealing issues
- 2 shield can components

In a further aspect of the invention, shown in figures 3a and3b., a single shielding can 9 covers both cameras 1,2. The can includes formed endstops 10 at the centre, shown more clearly in Figure 3b. This design has benefits of reduced dimension and low part count.

As an alternative to the designs of Figures 1-3, a further aspect of the invention is shown in Figure 4, wherein there is a single shielding 11 can over two cameras 1,2, but the can includes a partition 12 between the cameras. The partition 12 forms a robust end stop for the two cameras. The partition 12 may be a metal sheet welded into place, for example by laser welding. The benefits of this design include reduced size, low part count and robustness.

In a further aspect of the invention, shown in figure 5, there is a single shield can 13, with the gap 14 between the central endstops minimised to minimise excess wire strain in shock. This design is appropriate for designs in which both OIS actuators are always on, with the same stroke.
1. A dual camera comprising a first and second camera each comprising an image sensor and a lens; a first and second actuator for optical image stabilization; wherein one or more moving elements of the first actuator are positioned directly next to one or more moving elements of the second actuator with an air gap separation only.

2. The dual camera of claim 1 wherein each camera has its own actuator case which case is cut away locally to allow the actuators to be directly next to each other.

3. The dual camera of claim 1 wherein a single case covers both cameras

4. The dual camera of claim 3 wherein endstops for image stabilization are provided by features on the fixed actuator case

5. The dual camera of claim 3 wherein the optical image stabilization endstops are provided on the moving elements of the camera actuators

6. The dual camera of claim 1 wherein one or more elements of one camera actuator overlap one or more elements of the second actuator.

7. The dual camera of preceding claims wherein the actuators are shape memory alloy actuators.

8. A multiple camera including one or more further cameras added to the dual camera of preceding claims.

9. A dual camera comprising a first and second camera each comprising an image sensor and a lens; a first and second actuator for optical image stabilization; and wherein a single case covers both cameras and includes a partition between the two cameras

10. A dual camera according to claim 9 wherein the partition is a metal sheet

11. A dual camera according to claim 10 wherein the partition is welded into place

12. A dual camera according to claim 11 wherein the partition is welded into place by laser welding.

13. A dual camera of claims 9-12 wherein the partition provides end stops for both actuators

14. A dual camera of claims 9-13 wherein the actuators are shape memory alloy actuators.

15. A multiple camera including one or more further cameras added to the dual camera of claims 9-14.
**Application No:** GB1718847.5  
**Examiner:** Mr Conal Clyne

**Claims searched:** 1-8  
**Date of search:** 14 May 2018

**Patents Act 1977**  
**Corrected Search Report under Section 17**

**Documents considered to be relevant:**

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<th>Category</th>
<th>Relevant to claims</th>
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| X        | 1-8                | US2016/316150 A1  
(MICROSOFT TECHNOLOGY LICENSING LLC) see figures 5a-b and paragraph 27 especially |
| X        | 1-8                | WO2016/156996 A1  
(COREPHOTONICS LTD) see figures 1a-d especially |
| X        | 1-8                | US2016/231528 A1  
(APPLE INC) see figure 6b and paragraph 171 especially |
| X,E      | 1 & 3              | EP3293572 A2  
(SAMSUNG ELECTRONICS CO LTD) see figures 1a-c especially |
| A,E      | 1 & 3              | US2017/336699 A1  
(TDK TAIWAN CORP) see figures 7-9 especially |
| A,E      | 1 & 3              | US2017/094182 A1  
(APPLE INC) see figures 7a-c and paragraph 224 especially |
| A        |                    | US2015/367958 A1  
(NEARMAP AUSTRALIA PTY LTD) |

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- **P** Document published on or after the declared priority date but before the filing date of this invention.
- **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:

| Worldwide search of patent documents classified in the following areas of the IPC |
| G02B, H04N |
The following online and other databases have been used in the preparation of this search report

Epdoc, WPI

**International Classification:**

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