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(54) BULLET HOLE DETECTION DEVICE

(57) A bullet hole detection device (1) comprising a stand (2) and a camera (3) configured to capture images of at least one target (4); the camera (3) is rotatably connected to the stand (2) and is designed to be switched between a plurality of pointing configurations, each adapted to be associated with at least one respective target (4), wherein said camera (3) frames a respective target (4); the detection device (1) comprises drive means (5) associated with the camera (3) to switch it through the respective pointing configurations; the detection device (1) comprises a control unit (6) comprising: an acquisition module (61) configured to receive position data (10) representative of the position of a plurality of targets (4) and pointing data (11) representative of the pointing direction of said camera (3); a processing module (62) in signal communication with the acquisition module (61) and configured to generate a control signal (12) based on the position data (10) and the pointing data (11); an actuation module (63) in signal communication with the drive means (5) to send said control signal (12) to the drive means (5) and orient the camera (3) according to the control signal (12).

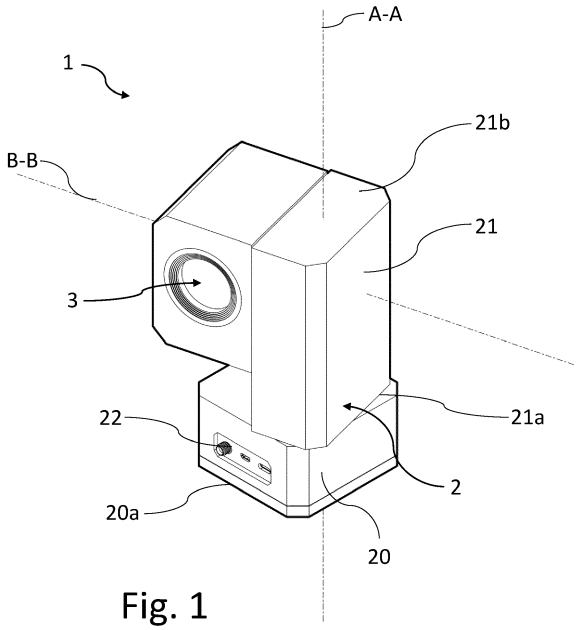

Fig. 1

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Description

Field of the invention

[0001] The present invention relates to a bullet hole detection device, for example on a shooting target, for use in sports or military training.

State of the art

[0002] Bullet hole detection devices, namely for long-range shooting, are known in the art. Such detection devices comprise a base, a vertical rod connected to the base, and a camera fixed to the rod and configured to capture images of shooting targets. The camera of the prior art device has fixed pointing features and captures images of a single target. In particular, once the target has been hit, a user analyzes the images captured by the camera and performs hole detection. Once the holes have been detected, the user must replace the target to continue his/her exercise. Therefore, the user must move from the shooting area to place a new target in the position of the previous target.

Problem of the prior art

[0003] The prior art detection device requires the user to move from the shooting area to the target area whenever the target has to be changed. This affects user training because the user will take away time from the exercise each time he/she has to position a new target.

[0004] In addition, if the user is not the only shooter, moving from the shooting area to the target area may be a hazard.

Summary of the invention

[0005] Therefore, the technical purpose of the present invention is to provide a detection device that can obviate the drawbacks of the prior art.

[0006] In particular, an object of the present invention is to provide a detection device that limits user's movements from the shooting area to the target area.

[0007] Another object of the present invention is to provide a detection device that allows the user to optimize the training time.

[0008] A further object of the present invention is to provide an automatic bullet hole detection device for use in long-range shooting.

[0009] The aforementioned technical purpose and the specified objects are substantially fulfilled by a detection device that incorporates the technical features as set forth in one or more of the annexed claims.

Benefits of the invention

[0010] This invention solves the technical problem. It provides a detection device that can be configured to detect bullet holes in multiple targets without requiring the user to move from the shooting area.

[0011] Advantageously, the detection device of the present invention can capture images of a plurality of targets by autonomously moving the pointing feature of the camera.

BRIEF DESCRIPTIONS OF THE DRAWINGS

[0012] Further features and advantages of the present invention will result more clearly from the illustrative, non-limiting description of a preferred, non-exclusive embodiment of a detection device as shown in the accompanying figures, in which:

- Figure 1 is a perspective view of a first embodiment of a bullet hole detection device according to the present invention;
- Figure 2 is a first perspective view of a second embodiment of a bullet hole detection device according to the present invention;
- Figure 3 is a second perspective view of the device of Figure 2;
- Figure 4 shows a third perspective view of the device of Figure 2;
- Figure 5 shows a target for use in combination with the detection device of Figure 1 or 2;
- Figure 6 shows an adhesive sheet for use in combination with the detection device of Figure 1 or 2;
- Figure 7 shows a top view of a detail of the device of Figure 1 or 2;
- Figure 8 shows a block diagram representative of the operation of the detection device of Figures 1 and 2.

DETAILED DESCRIPTION

[0013] Particularly referring to the accompanying figures, numeral 1 designates a bullet hole detection device according to the present invention.

[0014] The detection device 1 comprises a stand 2. Preferably, the stand 2 comprises a support portion 20 and an arm 21 which extends between a lower end 21a and an upper end 21b along a longitudinal direction A-A.

[0015] More in detail, the arm 21 is rotatably connected to the support portion 20 at the lower end 21a. In particular, the arm 21 is able to rotate about the longitudinal direction A-A, which is preferably vertical. Preferably, the arm 21 can be rotated by 360°.

[0016] The support portion 20 has a lower surface 20a which, in use, rests upon an outer supporting surface. Advantageously, the support portion 20 can keep the detection device 1 in a stable position during use.

[0017] Preferably, the support 2 comprises connection ports 22. These connection ports 22 are located at the support portion 20 and are accessible from the outside.

[0018] The detection device 1 comprises a camera 3 which is configured to capture images of at least one

target 4. The camera 3 is rotatably connected to the stand 2 and is designed to be switched through a plurality of pointing configurations, each adapted to be associated with at least one respective target 4. In each pointing configuration , the camera 3 frames a respective target 4. More in detail, the camera 3 is rotatably connected to the arm 21 proximate to the upper end 21b. In particular, the camera 3 is able to rotate about an axis B-B transverse to the longitudinal direction A-A. In one aspect, the transverse axis B-B is orthogonal to the longitudinal direction A-A. In other words, in use the transverse axis B-B is oriented horizontally.

[0019] In addition, the camera 3 comprises a focusing system configured to vary the focal length of the camera 3. This is advantageous because it provides sharp and clean images of at least one target 4.

[0020] In a first embodiment, the focusing system is automatic and is configured to automatically adjust the focal length so that each framed target 4 will be in the focal plane of the camera 3.

[0021] In a second embodiment, as shown in Figure 2, the focusing system is manual and comprises a ring 9 rotating about an axis concentric therewith. In particular, the ring 9 is configured to vary the focal length of the camera 3 following a rotation about such concentric axis. More in detail, the support 2 has a user accessible slot 23 in which the ring 9 of the focusing system of the camera 3 is located. A user may impart a rotation to the ring through the slot 23 to manually adjust the focus of the camera 3.

[0022] The detection device 1 further comprises drive means 5 associated with the camera 3 to switch it through the respective pointing configurations. More in detail, the drive means 5 are operable on the arm 21 and on the camera 3. The drive means 5 are configured to rotate the arm 21 about the longitudinal direction A-A and the camera 3 about the transverse axis B-B, simultaneously or individually, to vary the pointing direction of the camera 3. In the preferred embodiment, the drive means 5 may comprise electric motors configured to rotate the arm 21 and the camera 3, respectively.

[0023] In addition, the device 1 comprises sensors 6a associated with the camera 3 for detecting pointing data 11 representative of the pointing direction of the camera 3.

[0024] The detection device 1 comprises a control unit 6. By way of example, the control unit 6 may comprise an electronic board and/or a single-board computer. The control unit 6 is in signal communication with the connection ports 22 of the stand 2.

[0025] The control unit 6 comprises an acquisition module 61 configured to receive position data 10 representative of the position of a plurality of targets 4 and pointing data 11 representative of the pointing direction of said camera 3. In particular, the acquisition module 61 is in signal communication with the camera 3 for receiving images of at least one target 4. The sensors 6a are namely configured to send the pointing data 11 to the acquisition module 61.

[0026] In addition, the acquisition module 61 is in signal communication with a communication device 7 associated with the detection device 1. More in detail, the acquisition module 61 is configured to receive position data 10 from a user via the communication device 7. Furthermore, the acquisition module 61 may be in wired signal communication with the communication device 7 via the connection ports 22.

[0027] Advantageously, a user may effectively communicate with the acquisition module 61 through the communication device 7 without having to move from the shooting area .

[0028] The communication device 7 may comprise an electronic device 15, such as a tablet or a mobile phone. Namely, the electronic device 15 comprises a display 16. The electronic device 15 is designed for wired connection with the connection ports 22 of the stand 2. The electronic device 15 is also configured to be in wireless signal communication with the control unit 6.

[0029] The control unit 6 further comprises a processing module 62 in signal communication with the acquisition module 61. In particular, the processing module 62 is configured to receive the position data 10 and the pointing data 11 from the acquisition module 61. This processing module 62 is configured to generate a control signal 12 based on the position data 10 and the pointing data 11. The control signal 12 comprises the instructions to drive the camera 3. Namely, the control signal 12 comprises the instructions to actuate the handling means 5. More in detail, the control signal 12 comprises the instructions to actuate one or more electric motors and is representative of their operating time for switching the camera 3 between two different pointing configurations.

[0030] In one aspect, the processing module 62 is configured to receive images of at least one target 4. In detail, the processing module 62 is configured to receive such images from the acquisition module 61. The processing module 62 is configured to analyze the images of least one target 4, detect at least one bullet hole 4a in at least one target 4 and generate an output signal 13 representative of the number and/or position of the holes 4a. It should be noted that the processing module 62 is configured to detect partially overlapping holes 4a in at least one target 4.

[0031] In one aspect, the output signal 13 comprises a numerical value assigned to each hole 4a detected on the target 4 as a function of the distance from the center of the target. Advantageously, the numerical value may represent the coordinates of the hole 4a on the target 4 and/or a scoring system that provides indications about the training progress. In addition, the output signal 13 may comprise a unique code representative of a target 4 in which the at least one hole 4a has been detected and/or of the user associated with each hole 4a. This is advantageous because it affords identification of the specific target 4 of the plurality of targets 4 on which the hole 4a has been detected.

[0032] In one aspect, the processing module 62 is configured to associate each detected hole 4a with a single user selected from a plurality of users. This is advantageous if more than one user is exercising. In other words, the detection device 1 can effectively detect the holes 4a even when multiple users are exercising at the same time, each user shooting at the same target 4.

[0033] In one embodiment, the processing module 62 is configured to identify graphical representations of codes 14 associated with a respective target 4 in the images. Such codes 14 are two-dimensional codes comprising high-contrast graphic elements, preferably adhesives. As shown in Figure 6, the codes 14 may be printed in groups of four in default positions on a rectangular adhesive sheet 25. Advantageously, since the codes 14 can be applied to any surface, the detection device 1 is not limited to a specific type of target 4. In addition, the identification of graphic representations of codes 14 associated with a respective target 4 imparts greater user-friendliness and versatility to the detection device 1 as compared with prior art devices.

[0034] In addition, the processing module 62 is configured to perform perspective correction on the analyzed images. In particular, the processing module 62 is configured to extract and crop the figure of a target 4 from the analyzed images. Each target 4 may comprise four graphic representations of codes 14 associated with the target 4, one for each corner of a rectangular target 4. In detail, the processing module 62 is configured to extract and crop the target figure 4 using the graphic representations of codes 14.

[0035] Advantageously, by extracting and cropping the figure of at least one target 4 from the analyzed images the amount of memory required for possible storage of images may be reduced.

[0036] The control unit 6 further comprises an actuation module 63 in signal communication with the drive means 5 to send the control signal 12 to the drive means 5 and orient the camera 3 according to such control signal 12. In particular, the actuation module 63 is configured to receive the control signal 12 from the processing module 62.

[0037] In one embodiment, the control unit 6 further comprises a transmission module 64 in signal communication with the acquisition module 61 and/or with the processing module 62. In addition, the transmission module 64 is configured to receive the images of at least one target 4 from the acquisition module 61 and/or the output signal 13 from the processing module 62. The transmission module 64 is configured to send the images of at least one target 4 and/or the output signal 13 to a communication device 7 associated with the detection device 1 and/or a storage device 8 configured to store the images and/or the output signal 13.

[0038] Advantageously, a user may display the images of at least one target 4 via the communication device 7 and/or receive the output signal 13 with utmost safety without having to move from the shooting area. In particular, a user may view a representation of the output signal 13 on the display 16 of the electronic device 15. In detail as shown in Figure 7, the representation of the output signal 13 is a vector representation.

[0039] In particular, the storage device 8 is configured to store at least the images and/or the output signal 13 via a decentralized storage system. More in detail, the images and/or the output signal 13 are made accessible to a personal device associated with a user. This is advantageous in that a user can receive the images of targets 4 and/or the output signal 13 on the personal device associated with him/her whenever he/she wishes to evaluate and optimize his/her exercise.

[0040] In one aspect, the transmission module 64 and/or the acquisition module 61 are configured to be in signal communication with the communication device 7 associated with the detection device 1/ or with the storage device 8 via a network. Preferably, the network is an LPWA or a GSM network. The images of at least one target 4 and/or the output signal 13 and/or the position data 10 are transmitted over said network. In particular, the network enables long-range connectivity.

[0041] In addition, the detection device 1 may comprise an antenna 17 configured to connect to the aforementioned network and in signal communication with the control unit 6 via the connection ports 22. More in detail, the antenna 17 is in signal communication with the transmission module 64 to receive and transmit the images of at least one target 4 and/or the output signal 13 and/or the position data 10 over the network

[0042] Advantageously, the antenna 17 and the long-range connectivity allow the detection device 1 of the present invention to be used in exercising long-range shooting, a situation in which the communication device 7 and the detection device 1 associated therewith may be placed kilometers away. Advantageously, the use of an LPWA network provides a cost-effective transmission system.

[0043] In one embodiment, the electronic device 15 may be connected to the stand 2 and in signal communication with the control unit 6 and with the camera 3 to display the images captured by the camera 3. In particular, by interacting with the display 16 a user can switch the camera 3 to default positions, to display the images captured by the camera 3 and indicate which default position corresponds to a pointing configuration. In other words, using the display 16 the user may modify the pointing direction of the camera 3 and indicate in which direction a target 4 is positioned.

[0044] In one embodiment, the detection device 1 is armored and bullet-proof. More in detail, the detection device 1 comprises a bullet-proof frame configured to at least partially protect the stand 2, the camera 3, the drive means 5 and the control unit 6 from bullets. In particular, this bullet-proof frame is made of ballistic steel.

[0045] In addition, the detection device 1 comprises a microphone 18 in signal communication with the control unit 6, in particular, with the acquisition module 61. The

microphone 18 is configured to generate an audio content 19 representative of the ambient noise in the shooting area and send such audio content 19 to the acquisition module 61. Furthermore, the processing module 62 is configured to receive such audio content 19 from the acquisition module 61 and generate an acknowledgement signal based on the audio content 19 and the images of the target 4. In particular, the audio content 19 comprises the recording at least one shot. The processing module 62 is configured to detect the recording of a shot in the audio content 19 and to associate the shot with a hole 4a identified in the images of the target 4. The acknowledgement signal is representative of the consistency between the detection of the shot and the detection of a hole 4a in the images of the target 4. In other words, the processing module 62 is able to determine whether the bulled shot by a user has hit a target 4. This is advantageous because, considering also the failed shots, the detection device 1 affords a higher quality of the user's training.

[0046] The present invention also relates to a kit which also comprises, in addition to the detection device 1, a communication device 7 associated therewith. The kit further comprises at least one target 4 or adhesive codes 14. It should be noted that the codes 14 may be applied to any surface, allowing that surface to be identified as a target 4.

Claims

1. A bullet hole detection device (1) comprising a stand (2) and a camera (3) configured to capture images of at least one target (4);
characterized in that:

- the camera (3) is rotatably connected to the stand (2) and is designed to be switched through a plurality of pointing configurations, each adapted to be associated with at least one respective target (4), wherein said camera (3) frames a respective target (4);
- the detection device (1) comprises drive means (5) associated with the camera (3) to switch it through the respective pointing configurations;
- the detection device (1) comprises a control unit (6) comprising

  - an acquisition module (61) configured to receive position data (10) representative of the position of a plurality of targets (4) and pointing data (11) representative of the pointing direction of said camera (3);
  - a processing module (62) in signal communication with the acquisition module (61) and configured to generate a control signal (12) based on the position data (10) and the pointing data (11);
  - an actuation module (63) in signal communication with the drive means (5) to send said control signal (12) to the drive means (5) and orient the camera (3) according to the control signal (12).

2. A detection device (1) as claimed in the preceding claim, wherein the acquisition module (61) is in signal communication with the camera (3) for receiving images of at least one target (4).

3. A detection device (1) as claimed in claim 2, wherein the processing module (62) is configured to analyze said images and detect at least one bullet hole (4a) in at least one target (4) and generate an output signal (13) representative of the number and/or position of the holes (4a).

4. A detection device (1) as claimed in claim 2 or 3, wherein the processing module (62) is configured to identify, in said images, graphic representations of codes (14) associated with a respective target (4) and to apply perspective correction to said images.

5. A detection device (1) as claimed in any of claims 2 to 4, wherein the control unit (6) comprises a transmission module (64) in signal communication with the acquisition module (61) and/or with the processing module (62) and configured to send said images of at least one target (4) and/or said output signal (13) to a communication device (7) associated with the detection device (1) and/or with a storage device (8) configured to store said images and/or said output signal (13).

6. A detection device (1) as claimed in any of the preceding claims, wherein the acquisition module (61) is in signal communication with a communication device (7) associated with the detection device (1) and configured to receive position data (10) from a user via said communication device (7).

7. A detection device (1) as claimed in any of claims 5 to 6, wherein the transmission module (64) and/or the acquisition module (61) are configured to be in signal communication with a communication device (7) associated with the detection device (1) or with a storage device (8) via an LPWA or GSM network.

8. A detection device (1) as claimed in any of the preceding claims, wherein the stand (2) comprises a support portion (20) and an arm (21) extending between a lower end (21a) and an upper end (21b) along a longitudinal direction (A-A), said arm (21) being rotatably connected to the support portion (20) at the lower end (21a), said camera (3) being rotatably connected to said arm (21) proximate to the upper end (21b), the drive means (5) being operable

on the arm (21) of the stand (2) and on the camera (3).

9. A kit comprising a detection device (1) as claimed in any of the preceding claims, a communication device (7) associated with the detection device (1) and at least one target (4).

10. A method of detecting holes in a plurality of targets, comprising the steps of:

- providing a camera (3) configured to capture images of at least one target (4) and having drive means (5) configured to rotate it to change its pointing direction;
- receiving position data (10) representative of the position of a plurality of targets (4) and pointing data (11) representative of the pointing direction of said camera (3);
- generating a control signal (12) based on the position data (10) and the pointing data (11);
- orienting the camera (3) according to the control signal (12) to frame at least one target (4);
- capturing images of at least one target (4);
- analyzing said images and detecting at least one hole (4a) in at least one target (4);
- generating an output signal (13) representative of the number and/or position of the holes (4a);
- transmitting said output signal (13) and/or said images.

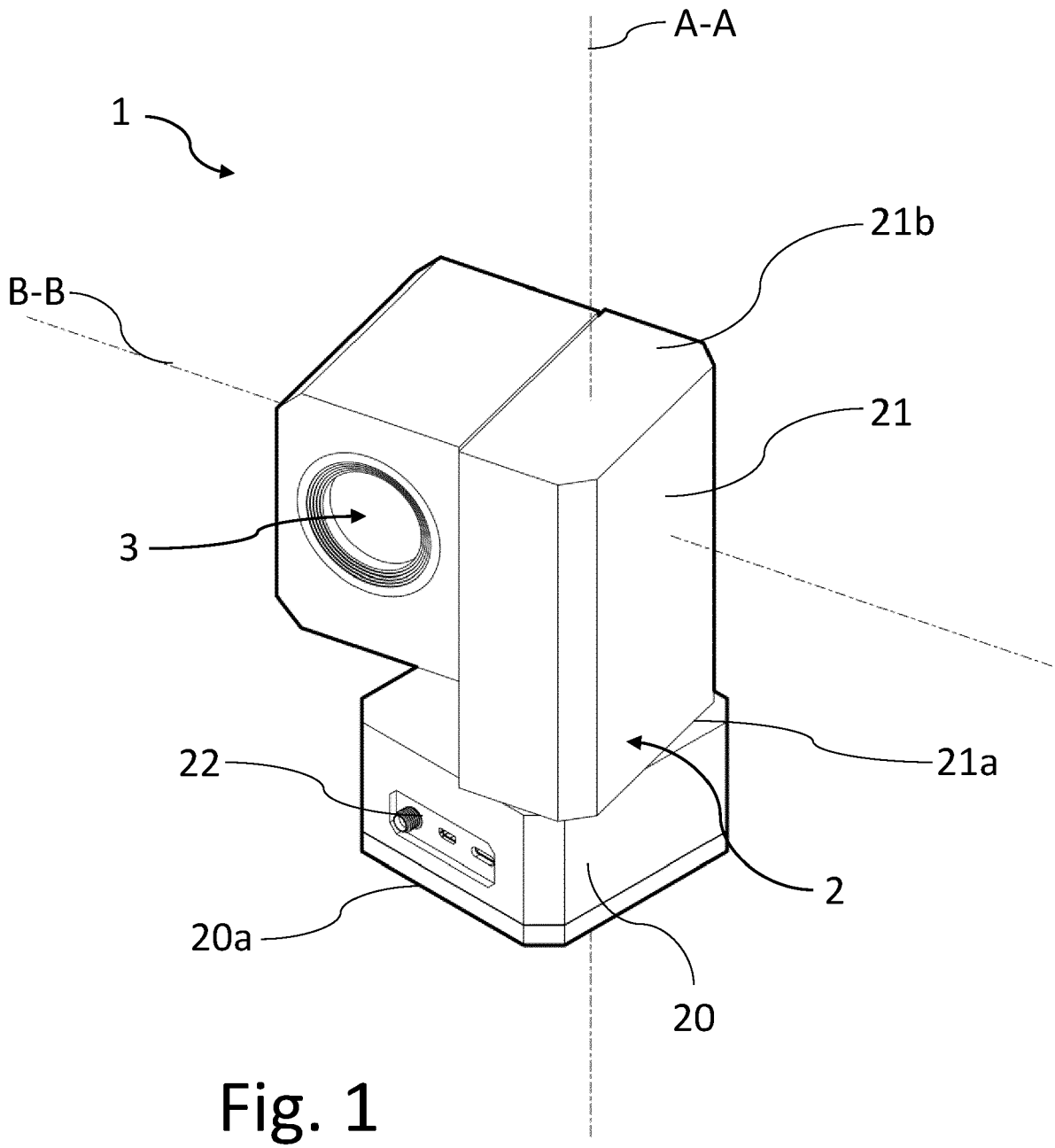

Fig. 1

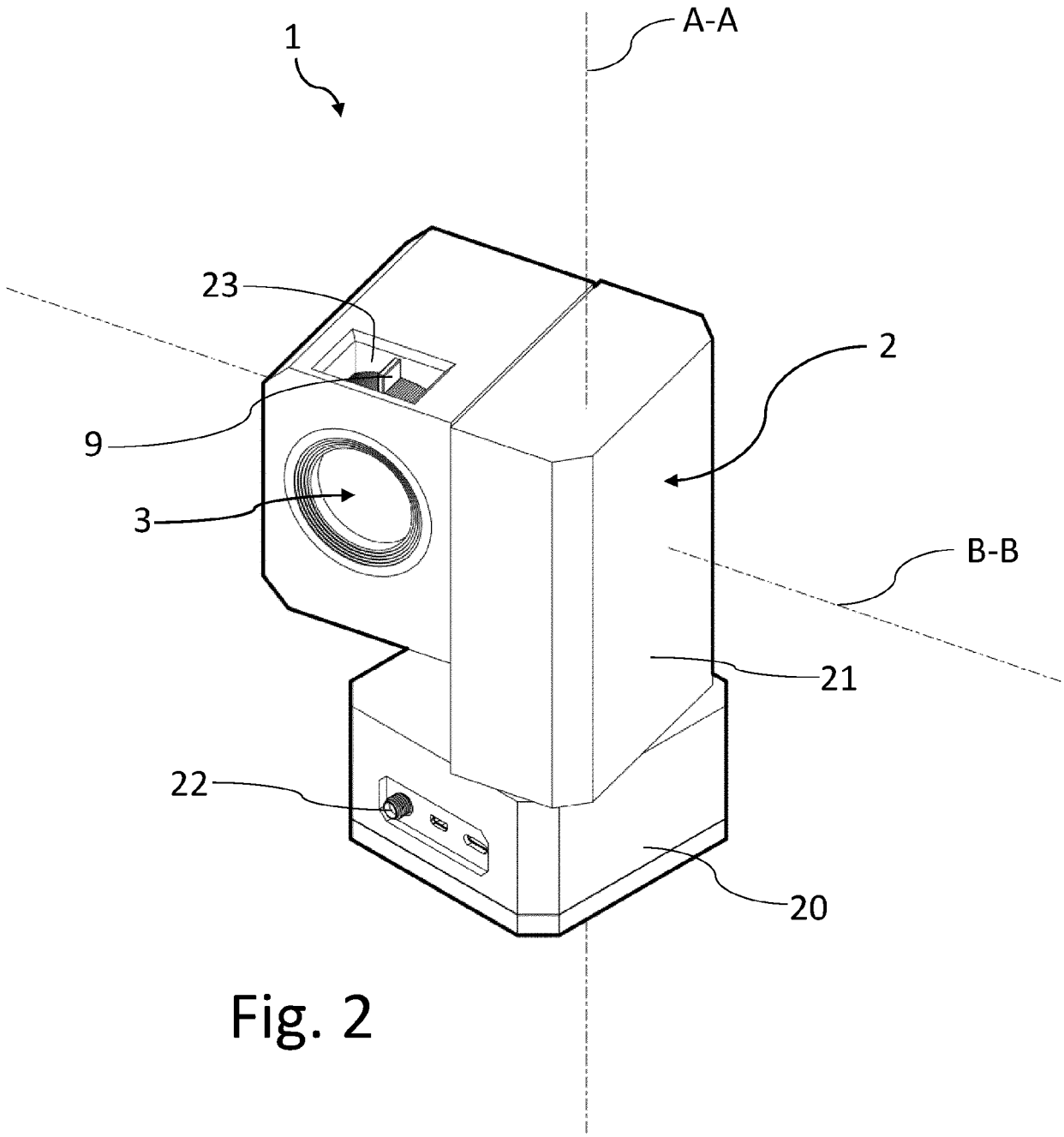

Fig. 2

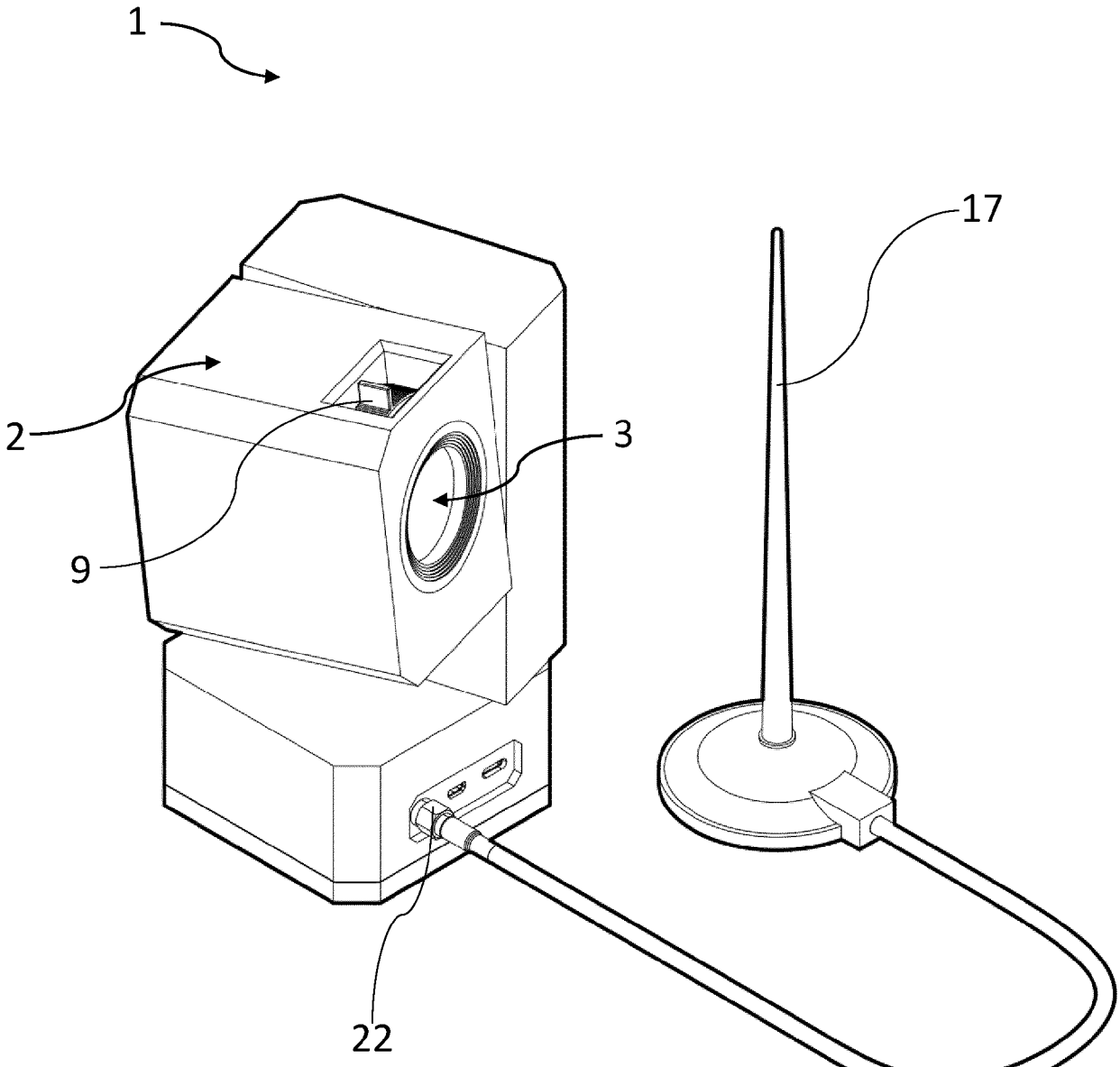

Fig. 3

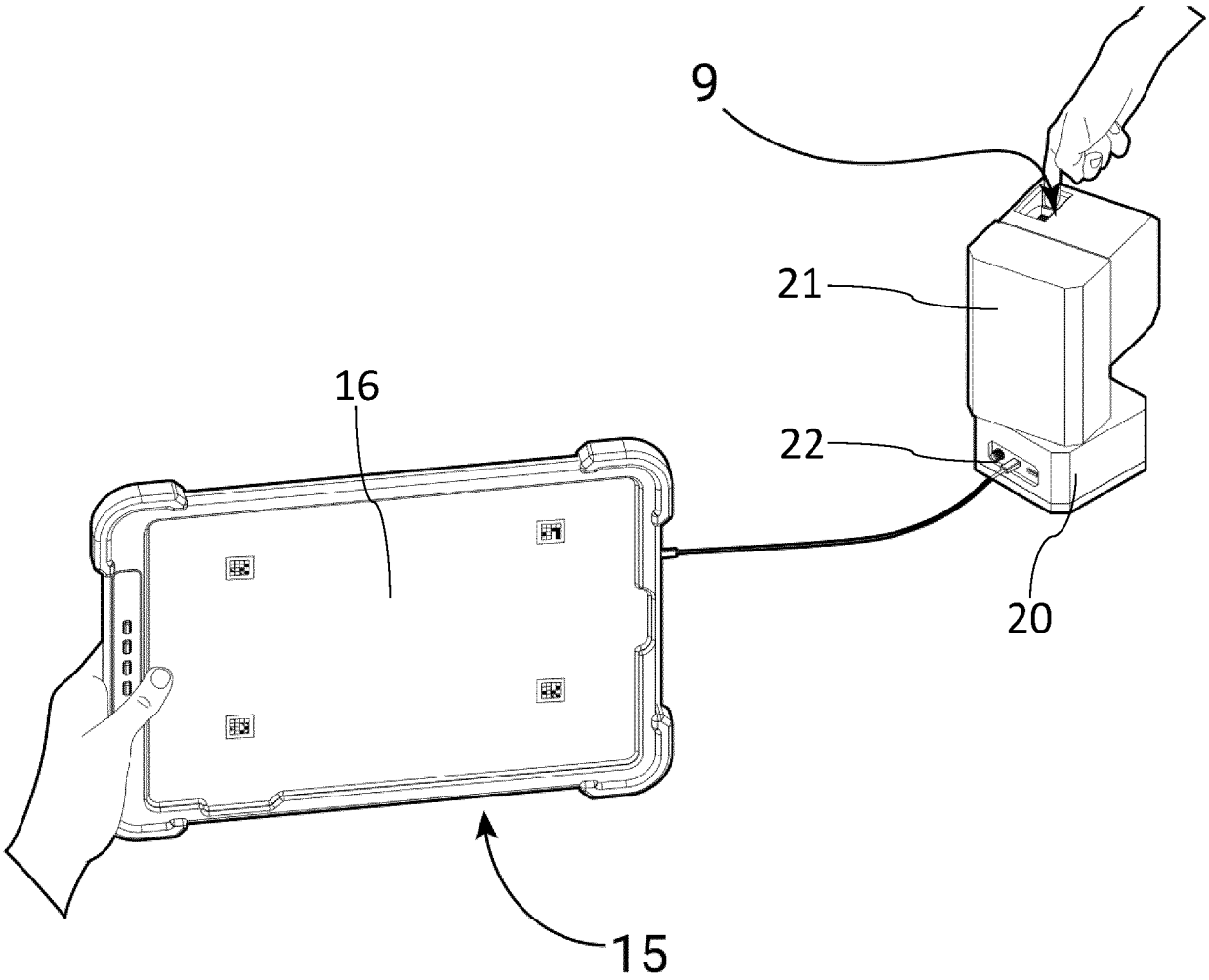

Fig. 4

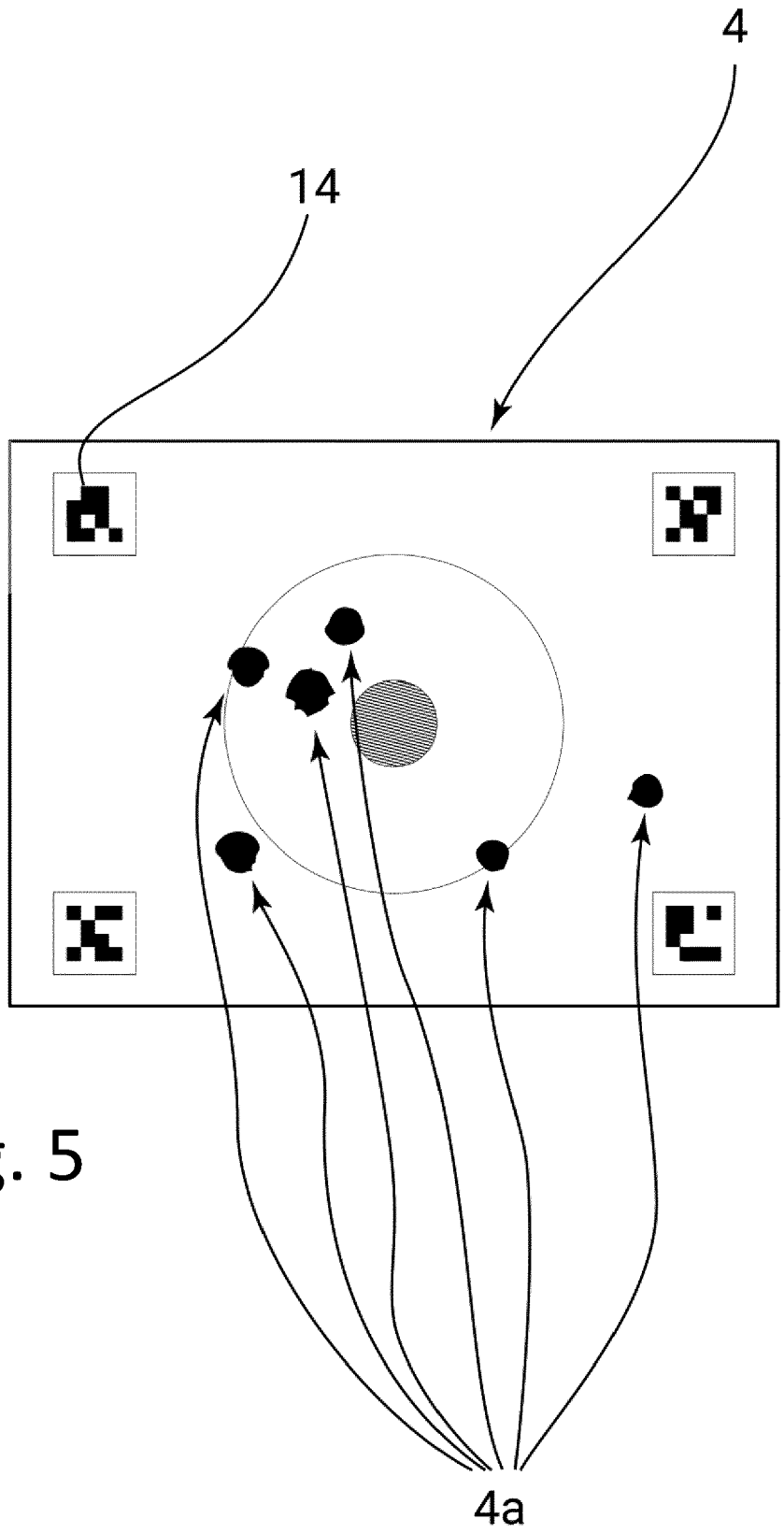

Fig. 5

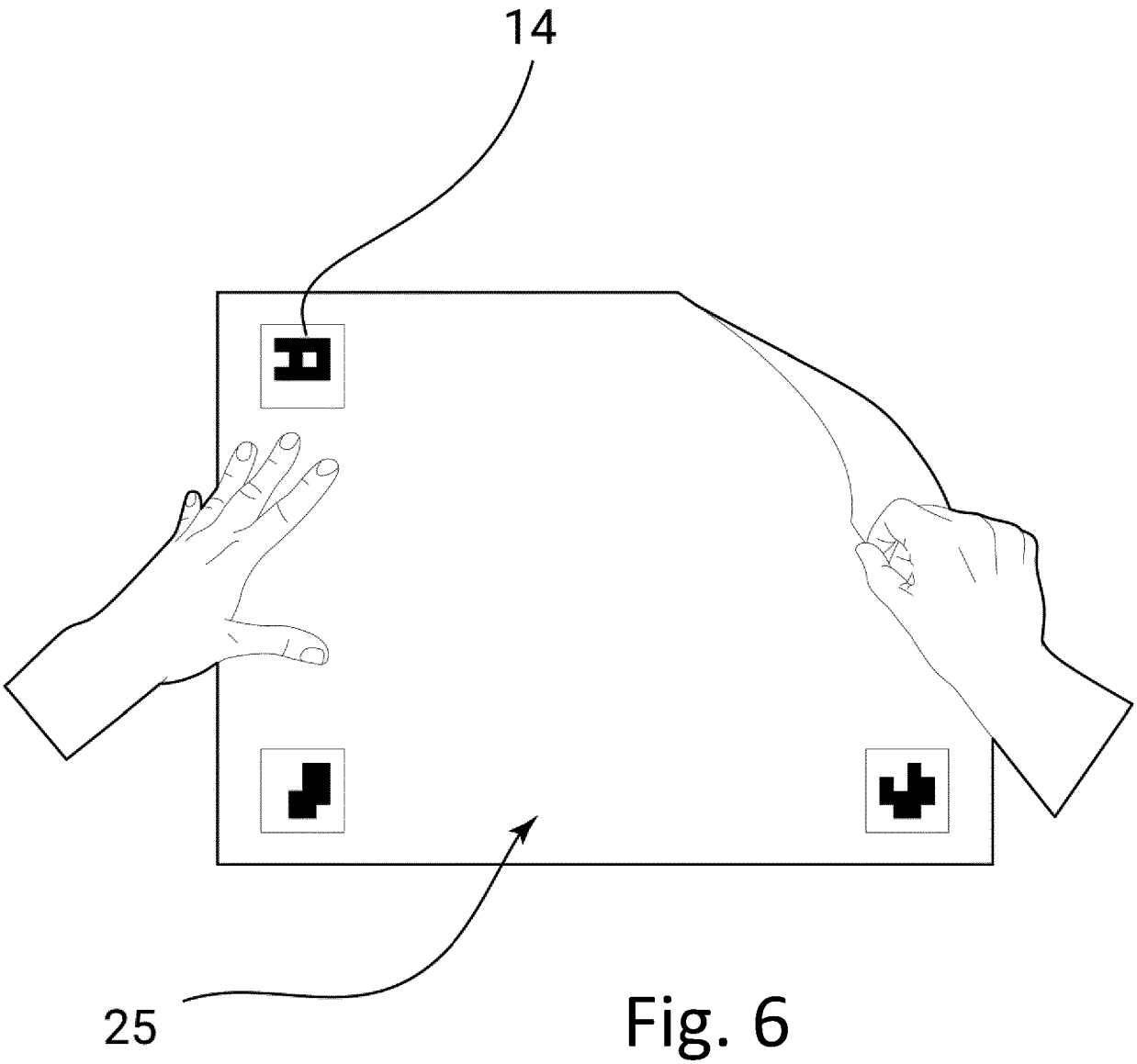

Fig. 6

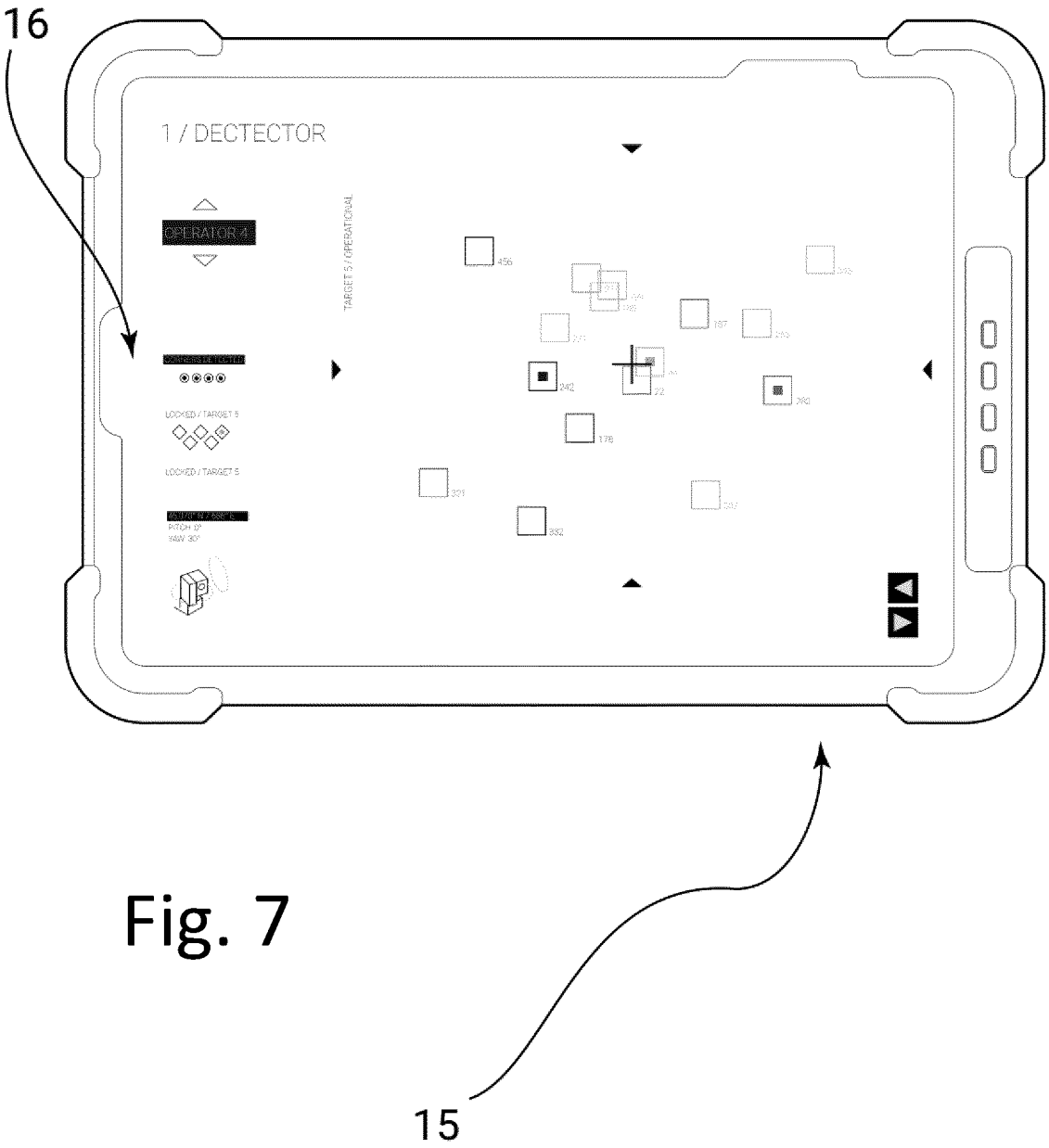

Fig. 7

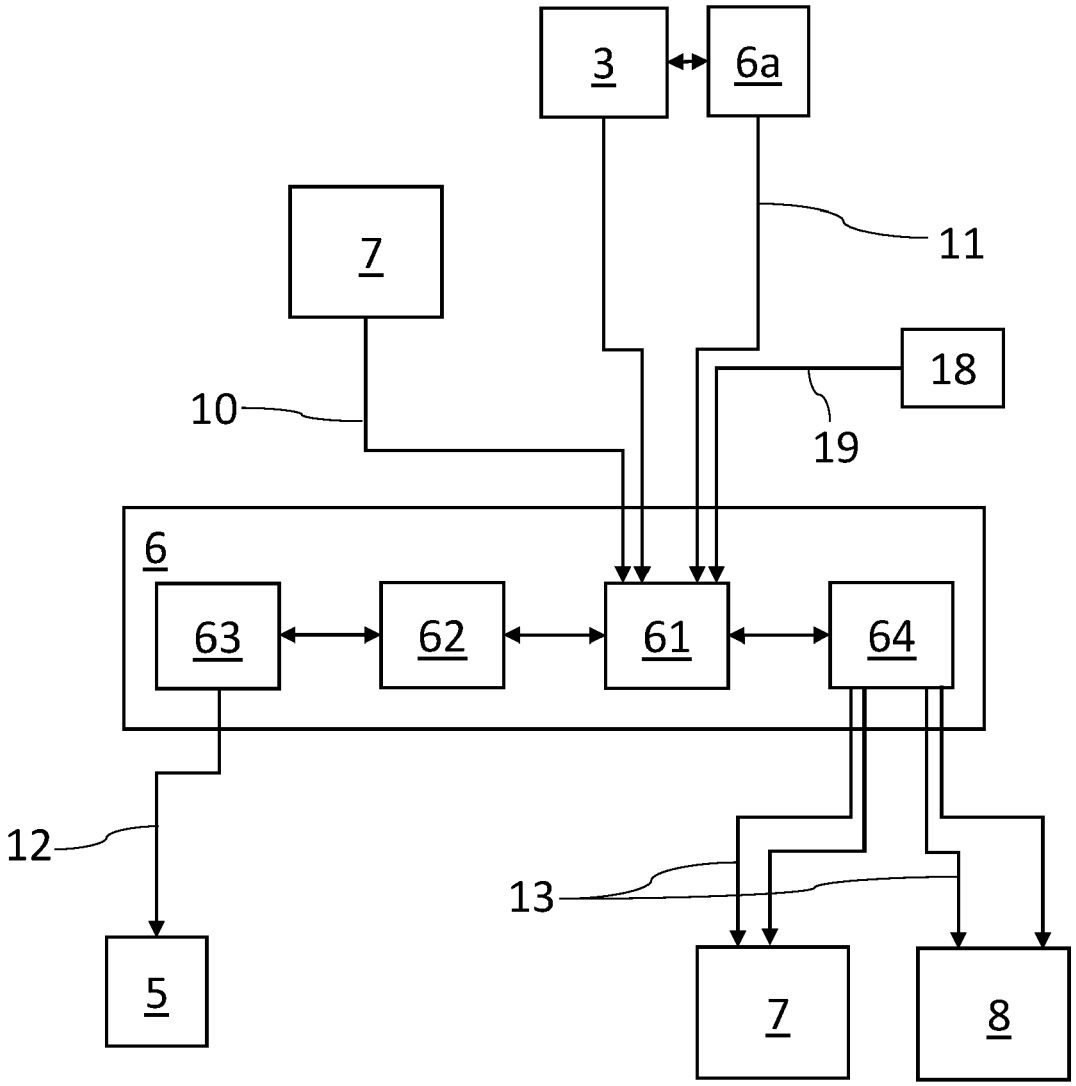

Fig. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 2850

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 2014/092245 A1 (MOORE ORRIN LEE [US] ET AL) 3 April 2014 (2014-04-03) * paragraphs [0012] - [0014], [0017]; claims 1,6; figure 6 *	1,2,4-9 3,10	INV. F41J5/10
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A	US 2014/315156 A1 (AVERILL KEITH A [US]) 23 October 2014 (2014-10-23) * paragraphs [0040], [0041], [0048], [0053], [0057], [0058], [0061], [0065]; figures 1,2,6 *	1-10	
			TECHNICAL FIELDS SEARCHED (IPC)
			F41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 April 2022	Seide, Stephan

CATEGORY OF CITED DOCUMENTS

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