

(19) **DANMARK**



Patent- og
Varemærkestyrelsen

(12)

Oversættelse af europæisk patentskrift

(10) **DK/EP 3867896 T3**

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- (51) Int.Cl.: **G 09 B 19/00 (2006.01)** **G 06 V 40/20 (2022.01)** **G 09 B 5/02 (2006.01)**
A 61 B 5/00 (2006.01) **A 61 B 5/024 (2006.01)** **A 61 B 5/11 (2006.01)**
A 61 B 5/22 (2006.01)
- (45) Oversættelsen bekendtgjort den: **2023-08-21**
- (80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2023-05-31**
- (86) Europæisk ansøgning nr.: **18799446.2**
- (86) Europæisk indleveringsdag: **2018-10-17**
- (87) Den europæiske ansøgnings publiceringsdag: **2021-08-25**
- (86) International ansøgning nr.: **EP2018078417**
- (87) Internationalt publikationsnr.: **WO2020078546**
- (84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
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- (54) Benævnelse: **TRÆNINGSMODUL**
- (56) Fremdragne publikationer:
DE-A1-102012 101 152
DE-A1-102017 102 144
US-A1- 2013 004 928
US-A1- 2013 171 601
US-B1- 8 795 138

DESCRIPTION**TECHNICAL FIELD OF THE INVENTION**

The present invention relates to a training module, in particular an interactive training module for the human body.

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DESCRIPTION OF THE RELATED ART

To train the body, many people go to a gym, where they can perform exercises supervised by an instructor. The exercises can be performed in group classes or individual classes, which take place at predetermined times. Accordingly, it is not possible to exercise at any time. To increase the flexibility and individuality of the training, instructional videos are offered. These can be played independently on a screen at home, for example. The exercises are displayed on the screen and instructions are given over the loudspeakers. A user of such an instructional video has no way of knowing whether he or she is performing the exercises, or instructions, correctly. It is also the case that an exercise must be selected in advance and then it runs automatically, regardless of the exercise being performed by the user. If the selected exercise does not correspond to the user's performance level, the user must manually select another exercise.

US 2013/0004928 A1 discloses a training module having a plurality of adjacent image-displaying walls, in which images are projected onto the walls by means of projectors, the projectors being arranged on a structure independent of the walls.

DE 10 2012 101 152 A1, DE 10 2017 102 144 A1 and US
2013/0171601 A1 disclose training modules with a single image
displaying wall.

5 DESCRIPTION OF THE INVENTION

One object of the present invention is to provide a training
module that allows independent training without a physical
instructor, with a high quality of training adapted to the
user.

10 This object is solved by a training module with the features
of claim 1. Further embodiments of the training module, a
training system, and a method for operating a training module
are defined by the features of further claims.

An interactive training module according to the invention
15 comprises at least one image-displaying wall with which
motion sequences and/or objects can be displayed to a user,
at least one position sensing device with which the positions
of at least the hands of the user can be detected, and a
control unit with which these positions can be compared with
20 those which are stored in the control unit, wherein the
control unit can display correction information to the user
by means of the at least one image-displaying wall on the
basis of the difference between the stored position and the
detected position.

25 Such a training module allows independent training with an
optimal training effect. By continuously detecting the
position of at least the hands, their movement can be
determined by means of the control unit. The position
detection or the movement detection can also take place in
30 intervals, the time intervals of which can be set; for

example, short time intervals for fast exercises and longer time intervals for slower exercises.

The movement sequences can be sequences for only individual limbs or can affect the entire body. For example, individual exercises such as push-ups, squats or the like can be displayed, or several sequences to be performed in succession can be displayed, such as in yoga, tai chi or the like. Such a training module can cover a wide range of requirements, for example in the field of rehabilitation and/or elderly care.

10 The training module offers the possibility of predefining player types, which differ, for example, in their physical and mental capabilities. The user can select a player type and the system compares the defaults with the movements performed by the user. Alternatively, the system may require 15 the user to complete a tutorial that allows the system to assign a player type. This can be carried out before each training session to verify current performance.

Alternatively, this may be carried out only for the first time, or the system may require the user to do this if their 20 last workout was a long time ago. The system can suggest a different player type if it is detected that the movements performed by the user deviate too much from the defaults. The training module therefore offers a demand and promotion optimally adapted to the user and thus balanced and maximally 25 effective training is guaranteed. The adaptation to the individual needs can be carried out in real time.

Alternatively or additionally, movement instructions can be displayed in the form of objects that indicate to the user in which direction he should move which limbs. For example, a 30 route can be displayed which the user should follow. By

moving the limbs, the user can indicate or change his direction of movement. The route may include obstacles that prompt the user to dodge, jump up, or duck. A visual feedback on the wall can show the user how well he has followed the
5 given route.

In one embodiment, the position sensing device comprises at least one camera, with which the area in front of the wall can be detected, whereby the movements of a user in front of the wall can be detected. All joints on the body are tracked
10 with a camera or a comparable technology, i.e. their movement is recorded and evaluated. This enables a very accurate comparison of the training instruction with the actual movement performed, which allows a qualitatively high level of feedback regarding the execution of the movement. This
15 information can also be used to instruct the improvement of the movements at the next attempt. Accordingly, the training can be optimized and injuries, for example due to overload, can be avoided.

The user can wear special clothing or can wear markings that
20 improve the detection of movements by means of the camera. Alternatively or additionally, the position sensing device comprises at least one inductive, capacitive or infrared light detecting sensor with which the area in front of the wall can be detected. For example, the sensor can detect the
25 light of an infrared laser.

In one embodiment, the interactive training module comprises at least one speaker with which instructions can be given. For example, the exercise to be completed can be explained. Alternatively or additionally, acoustic correction
30 instructions can be given. For example, the user may be

prompted to react faster or move more accurately.

Alternatively or additionally, motivational or animating comments or music may be provided. For example, the user may be prompted to persevere a little longer or music may be played that matches the intensity of the exercise being completed. The speakers can also be used to communicate with other users. In this case, the training module also includes at least one microphone.

10 In one embodiment, the interactive training module comprises at least one heart rhythm sensor with which the user's heart rhythm can be detected continuously and/or at intervals. For example, the resting heart rate can be detected before the exercise begins. The training module then suggests an exercise that is matched to the detected resting pulse.

15 Further information can be recorded before the start of the exercise, which can then be used by the training module for optimum exercise selection or optimum suggestion of an exercise. For example, age, weight and general fitness can be entered. In addition, preferences can be specified regarding the visual representation of the exercises on the wall. For example, a technical representation or a natural representation can be selected.

25 In one embodiment, the control unit uses the sensed heart rhythm to adjust the difficulty and/or intensity of the exercise program. The adjustment may occur during the exercise, or it may occur afterward. For example, the adjustment may be made in real time and without the intervention of an instructor or trainer, thereby always keeping the user in their optimal exercise state. For example, if it is determined during an exercise that the user's heart rhythm, or pulse, is very high, the speed at

which the predetermined movements are to be performed may be reduced, or the intensity of the movements may be reduced. For example, the intensity of the exercise can be reduced, i.e. the size of the movements can be reduced. Alternatively
5 or additionally, the time intervals between the exercises to be completed can be increased. Conversely, the movements can be increased and the time intervals can be decreased if the exercises are to be intensified.

In one embodiment, the interactive training module comprises
10 a force sensor integrated into the at least one image-displaying wall. The wall may also comprise several integrated force sensors, which are arranged evenly or randomly distributed over the surface. By means of the force sensors, the control unit can detect the location and
15 intensity of a contact with the wall. Based on the evaluation of the recorded data, the control unit can indicate to the user on the wall whether his touches were too inaccurate, too strong or too weak, or occurred at an incorrect time.

In one embodiment, the at least one image-displaying wall is
20 a screen.

In one embodiment, the interactive training module comprises at least one projector with which an image can be displayed on the image-displaying wall. A displayed image may cover a portion, portions, or the entire wall. For example,
25 projection of a 150 inch image at a distance of 50 centimeters is possible with an ultra-short distance laser projector. Such projectors are characterized by a very high contrast value. Thus, a high-quality image can be projected even in low light conditions.

In one embodiment, the at least one image-displaying wall comprises a supporting first layer and a haptic second layer, wherein the haptic layer is disposed on the side of the supporting layer facing the user.

- 5 In one embodiment, the first layer comprises an MDF board and the second layer comprises a foam board, a silicone board, or a silicone foam board that is glued to the MDF board.

In one embodiment, the at least one image-displaying wall comprises an optical third layer, wherein the optical layer
10 is disposed on the side of the haptic layer facing the user.

In one embodiment, the third layer comprises a canvas stretched over at least the foam or silicone sheet.

According to the invention, the interactive training module comprises a first wall and at least two second walls
15 laterally adjacent to the first wall in the intended use position, wherein the at least two second walls are oriented at an angle to the first wall.

The first wall and the at least two second walls each enclose an angle of 90 degrees or more on the side facing the user.

- 20 For example, an angle of 110 degrees. The second walls may be connected in an articulated manner to the first wall, allowing the angle spanned by the two walls to be adjustable. Alternatively, however, the angle may be less than 90 degrees.

- 25 Additional walls may be provided, for example, a total of four, five, six or more walls may be provided, which together form an open area or a closed area. In the case of a closed area, a door may be provided or one of the walls may be pivotable or slidable. In addition to the side walls, a
30 ceiling may be provided, which may also serve as an image-

displaying wall and may also include integrated force sensors. Alternatively, the open areas of the training module can be closed with a curtain or a rouleau. This applies to the side, i.e. the walls, as well as to the ceiling.

5 In one embodiment, the walls comprise at least one panel and a portion of a corner piece connecting the first wall to the second wall in a substantially seamless manner. The corner piece may also be sharp-edged. Likewise, it is conceivable that a wall comprises a plurality of panels which are butt-
10 joined. In an alternative embodiment without a corner piece, two adjacent panels can be arranged adjoining one another at an angle. It is also possible to join two adjacent panels together in an articulated manner, whereby the panels can be arranged at any angle to each other. The panels of a wall can
15 also be arranged on rails at least partially offset from one another, whereby the width of the wall can be easily adjusted. Likewise, one or both side walls may be designed to be movable, whereby the space between the walls can be easily changed. A panel can comprise one or more plates, which are
20 arranged vertically and/or horizontally next to or above each other.

According to the invention, the interactive training module comprises three or more projectors, wherein an image can be displayed on each of the walls with at least one of the
25 projectors. Single or multiple partial images may also be displayed. Alternatively or additionally, a projector may display an image on two walls adjacent to each other.

According to the invention, the interactive training module comprises a framework on which at least the walls are
30 arranged. The framework can be arranged free-standing in the

room or can be firmly connected to the floor, the walls or the ceiling.

The framework projects upwards above the walls in the intended use position and the projectors are arranged on the part of the framework projecting above the walls. The projectors may be arranged directly on the framework or they may be arranged on the framework with a mounting, for example a retaining plate. The retaining plate may be attached to one or more beams of the framework.

In one embodiment, the position sensing device is arranged on the part of the framework projecting above the walls. Alternatively, the position sensing device may be arranged on a ceiling located above the training module. Likewise, it is possible to integrate the position sensing devices into the walls.

In one embodiment, the parts of the framework that project above the walls are connected to each other. The connection can be made partially or completely via profiles. For example, the profile parts may be connected to each other by a ceiling segment. For example, a wall may be a unit comprising a framework one or more panels, one or more projectors, and one or more position sensing devices. The projectors and position sensing devices may be preset to the corresponding wall. A plurality of such units may then be aligned and interconnected. The number of walls, their position in relation to each other, i.e. their order and their orientation can be entered in the system control unit, which allows for easy and versatile installation.

In one embodiment, the interactive training module comprises a floor, which can be designed to display images and/or which

is equipped with force sensors. The force sensors can be evenly or randomly distributed over the floor surface.

In one embodiment, the interactive training module includes at least one projector capable of displaying an image on the floor. Two or more projectors can also be provided, which can project an image onto the floor. Alternatively or additionally, these projectors can also project images or partial images onto the walls. The floor can serve as an interactive input element. It also serves as an orientation aid for the temporally, correct execution of the requested movements. The orientation aid is achieved with the help of audio-visual effects, which display the requested movement on the floor in real time. The floor can also show the starting position, which can vary depending on the size, mental and physical condition of each user.

The mentioned embodiments of the training module can be used in any combination, provided that they do not contradict each other.

An interactive training system according to the invention comprises a training module according to one of the preceding embodiments and at least one tracker which is wearable by a user and with which at least the position of a hand of the user can be detected. Such a tracker may, for example, transmit or receive an infrared signal.

In one embodiment, the interactive training system includes two or more trackers that can be held with the hands or that can be arranged on the user's body with attachment means.

In one embodiment, the attachment means are configured to attach the trackers to at least one of the group of body

sites that includes wrist, elbow, shoulder, neck, head, hip, knee, and ankle.

In one embodiment, the training system is designed in such a way that the movements of two or more users can be detected.

5 For this purpose, a corresponding number of position sensing devices is provided in the system and the control unit is designed accordingly. The following embodiments can also be implemented by providing the required number of position sensing devices and the corresponding programming or design
10 of the control unit.

In one embodiment, the recording can take place simultaneously. Alternatively, the recording can be time-delayed. In the time-shifted variant, a user can compete against himself or he can compete against the recorded
15 exercise of another. The system then compares the two users with each other and with the default. Accordingly, the users can perform an exercise together or they can compete against each other. It is possible that when users of different strength classes compete against each other, the stronger
20 player receives a handicap or the weaker player receives an advantage.

In one embodiment, simultaneous detection of multiple users can be performed in one training module and/or in multiple training modules. Thus, two users can act together in one
25 training module or they can each perform their exercise in separate training modules. The different training modules may be located in the same room, in the same building, or in completely different locations. The training modules may be connected to each other in a network, for example, they may
30 be connected to each other via the Internet. Accordingly, it

is possible for users from different continents to perform exercises with each other or compete against each other.

The mentioned embodiments of the training system can be used in any combination, provided that they do not contradict each other.

A method of operating a training module according to the invention comprises the following steps:

- Providing a training module according to one of the preceding embodiments;
- 10 - Selecting an exercise by a user;
- Starting the exercise by the control unit;
- Detecting at least the position of the user's hands by means of the at least one position sensing device;
- Compare the detected position with the position stored in the control unit;
- 15 - Display correction information on the image-displaying wall based on the difference between the stored position and the detected position.

In one embodiment, the method for operating a training module comprises at least one of the steps:

- Adjusting the exercise based on the evaluation of the difference between the stored positions and the corresponding detected positions over a specified period of time;
- 25 - Adjusting the exercise based on the measured heart rhythm over a given period of time.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments of the present invention are explained in further detail below with reference to figures. These are
5 for explanatory purposes only and are not to be construed restrictively. The figures show as follows:

Fig.1 shows a perspective view of an interactive training module according to the invention;

Fig.2 shows a perspective view of the framework of
10 Fig.1; and

Fig. 3 shows a partial sectional view through the structure of a wall of Fig. 1.

DETAILED DESCRIPTION OF THE INVENTION

15 Fig. 1 shows a perspective view of an interactive training module according to the invention. The training module comprises an image-displaying first wall 1 and two image-displaying second walls 2 arranged laterally adjacent thereto, which are arranged on a framework 5. The second
20 walls 2 are arranged at an angle of more than 90 degrees with respect to the first wall 1. In the embodiment shown, the angle included between the two walls 1, 2 is about 100 degrees. The first wall 1 comprises two panels 10 and each of the second walls 2 comprises two panels 20 which are butt-
25 joined. Between the first wall 1 and the second walls 2, corner pieces 11 are arranged which are butt-joined to the first wall 1 on their one side and which are butt-joined to the second walls 2 on their second side. The corner pieces are rounded, resulting in a substantially stepless transition

from the first wall 1 to the second walls 2. Force sensors 70 are arranged on the first and second walls 1, 2. For illustrative purposes, only one force sensor 70 is shown. However, multiple force sensors may be provided distributed across the panels 10, 20 of the walls 1, 2. A floor 6 is provided between the walls 1, 2, which may also be equipped with force sensors 60. Again, only one force sensor 60 is shown for illustrative purposes. The framework 5 comprises several profiles, as shown in detail in Fig. 2. The vertical profiles 50 project above the walls 1, 2 and are connected to each other by ceiling profiles 53, 54. The projectors 3, 4 and the position or movement detection devices 7 are arranged on the ceiling profiles 53, 54. For illustration purposes, only one motion sensor 7 is arranged.

Fig. 2 shows a perspective view of the framework 5 of Fig. 1. The framework 5 comprises five vertical profiles 50, wherein the central vertical profile 50 is assigned to the first wall 1 and wherein two lateral vertical profiles 50 are assigned to each of the second walls 2. On the vertical profile 50, which is assigned to the first wall 1, a first ceiling profile 53 is arranged, which extends away from the first wall 1 essentially horizontally between the two second walls 2. A second ceiling profile 54 is arranged at the respective upper end of the vertical profiles 50 associated with the second walls 2 and extends away from the respective second wall 2 essentially horizontally to the first ceiling profile 53. The vertical profiles 50 of the second walls 2 are connected to each other by first horizontal profiles 51, and the second ceiling profiles 54 are also connected to each other by first horizontal profiles 51. At the free end of the second walls 2, the vertical profile 50 and the second

ceiling profile 54 are connected to each other by a U-shaped connecting profile 55, wherein the legs of the connecting profile 55 are aligned with the first horizontal profiles 51. On the side of each second wall 2 facing the first wall 1, the vertical profiles 50 are connected to one another by angled second horizontal profiles 52, and the first ceiling profile 53 is connected on both sides to the second ceiling profiles 54 likewise by the angled second horizontal profiles 52. One leg of each of the second horizontal profiles 52 is aligned with each of the second horizontal profiles 51.

Fig. 3 shows a partial sectional view through the structure of a wall 1, 2 of Fig. 1. Each of the panels 10, 20 and each corner profile 11 has the same layered structure. The layered structure comprises a first layer 100 in the form of an MDF board, a second layer 101 in the form of a foam board arranged thereon, and a third layer 102 in the form of a canvas arranged thereon. The foam board 101 is glued to the MDF board and the canvas is stretched over the foam board and the MDF board.

REFERENCE SIGNS LIST

1	First wall	51	First horizontal
10	Panel		profile
11	Corner piece	52	Second horizontal
100	First layer		profile
101	Second layer	53	First ceiling profile
102	Third layer	54	Second ceiling profile
2	Second wall	55	Connecting profile
20	Panel	6	Floor
3	First projector	60	Force sensor
4	Second projector	7	Motion sensor
5	Framework	70	Force sensor
50	Vertical profile		

Patentkrav

1. Interaktivt træningsmodul omfattende en billedvisende første væg (1), to billedvisende andre vægge (2), som slutter sig til begge sider af den billedvisende første væg (1) på siderne af denne, tre projektorer (3,4), idet der med hver af 5 projektorerne (3,4) på hver af de billedvisende vægge (1,2) kan vises en bruger bevægelsesforløb og/eller objekt, mindst en positionsregistrering (7), med hvilken i det mindste brugerens hænders positioner kan registreres, og en styreenhed, med hvilken disse positioner kan sammenlignes med dem, der er lagret i styreenheden, idet styreenheden kan vise brugeren korrektionsangivelser på 10 grundlag af differensen mellem den lagrede position og den registrerede position ved hjælp af den mindst ene billedvisende væg (1,2), idet den billedvisende første væg (1) og hver af de to billedvisende andre vægge (2) på den mod brugeren rettede side hver især indeslutter en vinkel på mere end 90 grader, idet de billedvisende vægge (1,2) er anbragt på et stel (5), som i den tilsigtede 15 brugsstilling rager op over de billedvisende vægge (1,2), og idet projektorerne (3,4) er anbragt på de over væggene (1,2) ragende del af stellet (5).

2. Interaktivt træningsmodul ifølge krav 1, hvori positionsregistreringen (7) omfatter mindst et kamera, og/eller hvori positionsregistreringen (7) omfatter 20 mindst en induktiv, kapacitiv eller infrarødt lys registrerende sensor, med hvilken området foran væggen (1,2) kan registreres.

3. Interaktivt træningsmodul ifølge krav 1 eller 2 omfattende mindst en højttaler, med hvilken instruktioner kan gives, og/eller med hvilken akustiske 25 korrektionsangivelser kan foretages, og/eller med hvilken motiverende eller animerende kommentarer eller musik kan afgives.

4. Interaktivt træningsmodul ifølge et af de foregående krav omfattende mindst en hjerterytme-sensor, med hvilken brugerens hjerterytme kan registreres 30 kontinuerligt og/eller i intervaller, idet styreenheden kan anvende den registrerede hjerterytme til at tilpasse træningsprogrammets sværhedsgrad

og/eller intensitet.

5. Interaktivt træningsmodul ifølge et af de foregående krav omfattende en kraftsensor (70), som er integreret i den mindst ene billedvisende væg (1,2).

5

6. Interaktivt træningsmodul ifølge et af de foregående krav, hvori den mindst ene billedvisende væg (1,2) omfatter et bærende første lag (100) og et haptisk andet lag (101), der er anbragt på den mod brugeren rettede side af det første lag (100), og et optisk tredje lag (102), der er anbragt på den mod brugeren

10 rettede side af det andet lag (101).

7. Interaktivt træningsmodul ifølge krav 6, hvori det første lag (100) omfatter en MDF-plade, og hvori det andet lag (101) en omfatter en skumstof-plade, en silikone-plade eller en silikone-skumstof-plade, som er sammenklæbet med MDF-pladen (100).

15

8. Interaktivt træningsmodul ifølge krav 6, hvori det tredje lag (102) omfatter et lærred, som i det mindste er udspændt over skumstof-pladen, silikone-pladen eller silikone-skumstof-pladen (101).

20

9. Interaktivt træningsmodul ifølge et af de foregående krav, hvori positionsregistreringen (7) er anbragt på den over væggene (1,2) ragende del af stellet (5).

25 **10.** Interaktivt træningsmodul ifølge et af de foregående krav omfattende en bund (6), som kan være udformet billedvisende, og/eller som er bestykket med kraftsensorer (60), og omfattende mindst en projektor, med hvilken et billede kan vises på bunden (6).

30 **11.** Interaktivt træningssystem omfattende et træningsmodul ifølge et af de foregående krav og mindst en tracker, der kan bæres af en bruger, og med hvilken i det mindste positionen af en hånd på brugeren kan registreres.

12. Interaktivt træningssystem ifølge krav 11, hvilket træningssystem er udformet således, at to eller flere brugeres bevægelser kan registreres.

13. Interaktivt træningssystem ifølge krav 12, hvori registreringen kan foregå
5 samtidig.

14. Interaktivt træningssystem ifølge krav 12 eller 13, hvori den samtidige registrering af flere brugere kan foregå i et træningsmodul og/eller i flere træningsmoduler.

10

15. Fremgangsmåde til at drive et træningsmodul omfattende følgende trin:

- tilvejebringelse af et træningsmodul ifølge et af kravene 1 til 10;
- en brugers valg af en øvelse;
- start af øvelsen med styreenheden;

15 - registrering af i det mindste positionen af brugerens hænder ved hjælp af den mindst ene positionsregistrering (7);

- sammenligning af den registrerede position med den i styreenheden lagrede position;

- visning af korrektionsangivelser på den billedvisende væg (1,2) på grundlag af
20 differensen mellem den lagrede position og den registrerede position.

25

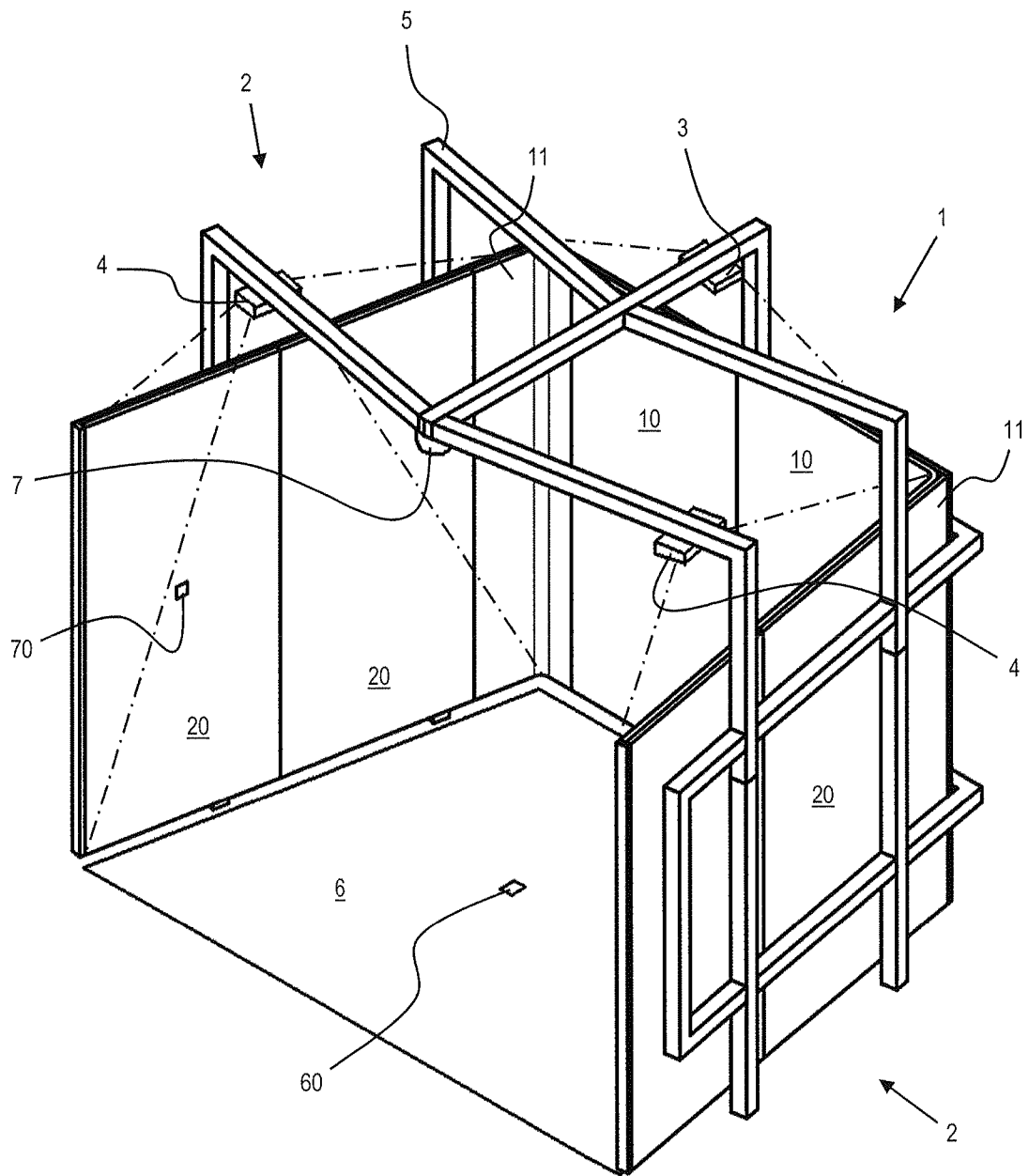


Fig. 1

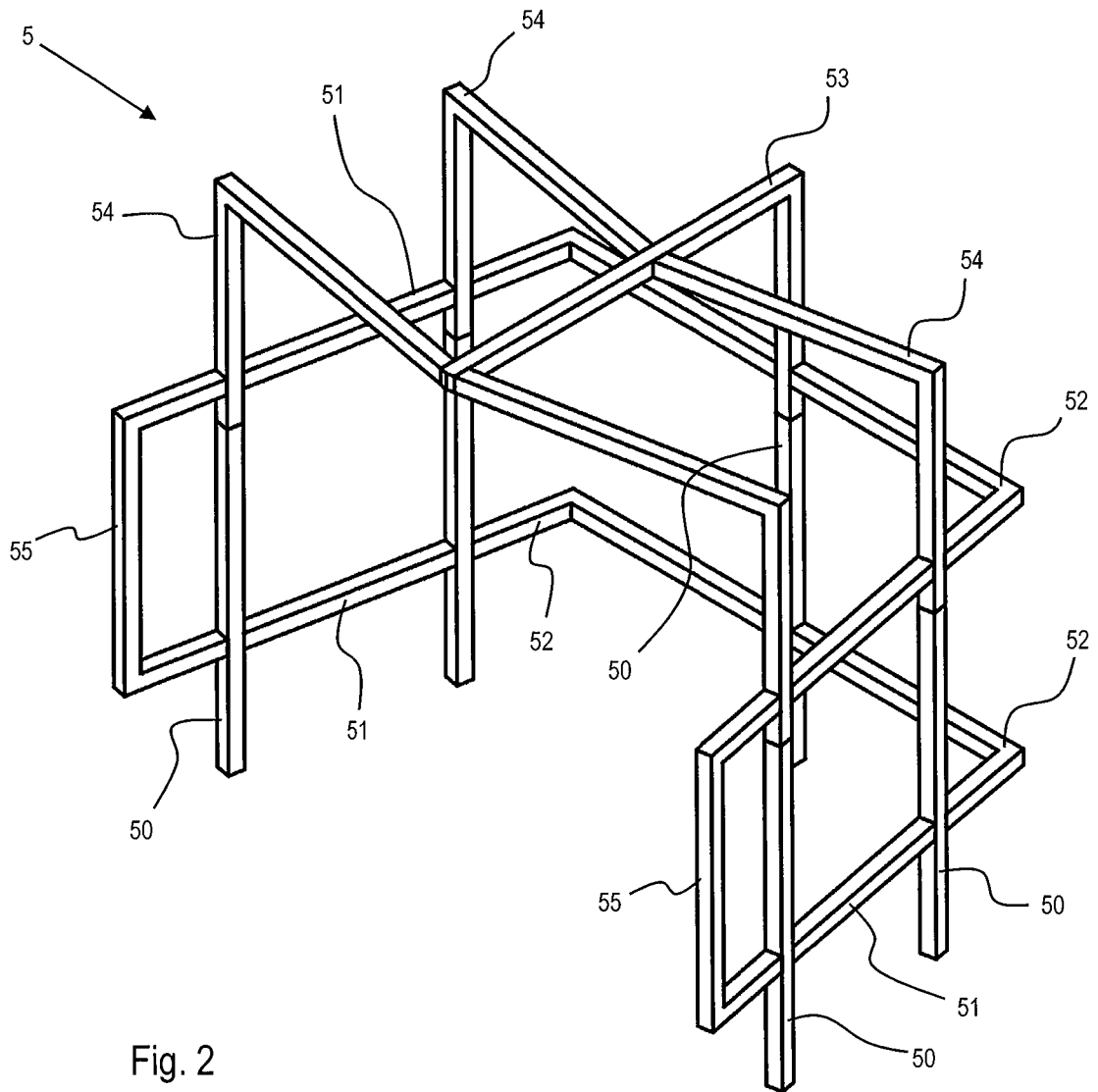


Fig. 2

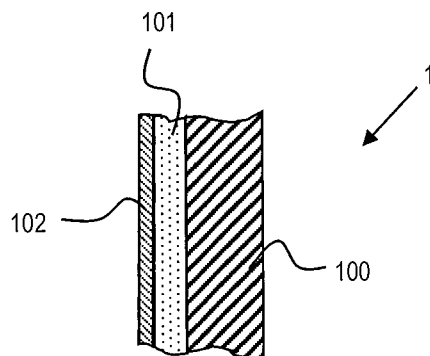


Fig. 3