



- (51) International Patent Classification:
G09F 9/00 (2006.01) *G02B 6/00* (2006.01)
G09G 3/20 (2006.01)
- (21) International Application Number: PCT/IB2013/001458
- (22) International Filing Date: 4 July 2013 (04.07.2013)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/667,944 4 July 2012 (04.07.2012) US
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Hazav, Oranit, 44813 (IL).
- (81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC,
SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments (Rule 48.2(h))

(54) Title: DISPLAY MODULE AND STRUCTURE WITH SUCH MODULE

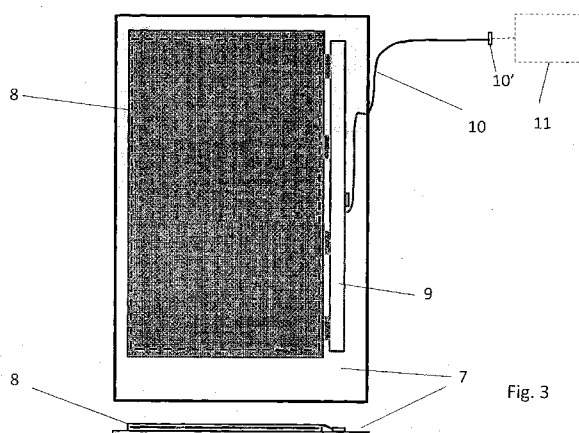


Fig. 3

(57) Abstract: A display module is provided comprising: a transparent member and at least one substantially transparent display panel fixedly mounted together, display panel provided by a display driving unit connectable by a cable to an external controller and operable to drive at least one display panel in response to the drive command from said external controller.

WO 2014/006490 A1

DISPLAY MODULE AND STRUCTURE WITH SUCH MODULE

TECHNOLOGICAL FIELD

The presently disclosed subject matter refers to transparent members such as pane, a window, a shop widow, a door, a wall, a ceiling, a floor, etc., having a display module for image producing incorporated therein.

PRIOR ART

US Patent No. 7,109,959 discloses a window with a display held by its frame.

WO2012/057457 discloses a construction of transparent display module incorporated in a door of a refrigerator.

10 SUMMARY OF THE PRESENTLY DISCLOSED SUBJECT MATTER

In accordance with one aspect of the presently disclosed subject matter, there is provided a display module comprising a transparent member and at least one substantially transparent display panel fixedly mounted together, display panel provided by a display driving unit connectable by a cable to an external controller and operable to drive at least one display panel in response to the drive command from said external controller.

In accordance with a further aspect of the presently disclosed subject matter the transparent member may have a greater surface area than the display panel.

In accordance with a further aspect of the presently disclosed subject matter the display module could comprise at least one non-transparent area, this non-transparent area could form a frame of the display module. Such non-transparent area could be formed by coating with non-transparent material or non-transparent member.

In accordance with a still another aspect of the presently disclosed subject matter the display module could comprise an additional transparent member and the display panel could be accommodated between the transparent members.

5 In accordance with a still another aspect of the presently disclosed subject matter the lighting module is mounted on the additional transparent member.

The display module could comprise a sealing and spacing arrangement sealingly fixing the transparent member to each other along their periphery at spaced apart relationship, thereby forming a transparent sealed cavity with a sealing frame surrounding.

10 The display module could be provided by a lighting module. The lighting module could include an optically clear waveguide and an edge-lit light source. The waveguide could be further provided by a diffusing layer with diffusing zones e.g. including spots, lines or printed dots.

Preferably, diffusing layer has a greater surface area than the diffusing zones.

15 In accordance with a still another aspect of the presently disclosed subject matter the diffusing zones cover about 5 – 10 % of the diffusing layer area.

The size of the printed dots and distances therebetween could be chosen to minimize Moire effect caused by superposition of the pattern of printed dots and pattern of display pixels.

20 The cable can provide transmitting high speed digital video signals corresponding to video interface standards for connecting an output of a graphic processing unit of the external controller to the driving unit of at least one said display panel. It could be a low voltage differential signaling cable (LVDS).

25 In accordance with another aspect of the presently disclosed subject matter, there can be provided a structure comprising a display module comprising a transparent member and at least one substantially transparent display panel fixedly mounted together, at least one display panel provided by a display driving

unit connectable by a cable to an external controller and operable to drive at least one display panel in response to the drive command from said external controller, wherein said display module configured to constitute at least one of the following a pane, a window, a shop window, a door, a wall, a ceiling, a floor of
5 the structure.

Such a structure can constitute a showcase having a main body, an opening at least one side of the main body and a storage chamber.

The storage chamber can be provided by illuminating assembly capable to provide substantially high brightness background.

10 A level of illumination can be of 6 - 10 times stronger than the level of illumination outside said showcase.

Further features of the module and structure described above are presented in the detailed description and claims of the application.

15 BRIEF DESCRIPTION OF THE DRAWINGS

In order to better understand the subject matter that is disclosed herein and to exemplify how it may be implemented in practice, embodiments will now be described, by way of non-limiting examples only, with reference to the accompanying drawings, in which:

20 FIG. 1 shows an example of a display box or showcase refrigerator, with a door in which modules in accordance with the presently disclosed subject matter can be mounted;

FIG. 2 is a schematic view of the door of display box or showcase refrigerator formed by display module;

25 FIG. 3 are schematic views of display module;

FIG. 4 are views of double glazed unit with display module;

FIG. 5 is a schematic view of display module assembled into the door of a showcase refrigerator;

FIG. 6 illustrates a schematic view of illuminating module of display module;

5 FIG. 7 is a cross sectional view of illuminating module in accordance with additional aspect of the present invention;

FIGS. 8A and 8B schematically illustrate examples of diffusing zones of illuminating module, and

10 FIG. 9 is a schematic cross section view of construction combining display module and illuminating module.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 FIG. 1 schematically illustrate an example of a structure, e.g. display box or showcase refrigerator 2, with a door in which modules 1 in accordance with the presently disclosed subject matter is mounted.

Showcase refrigerator 2 enables storage of goods G, e.g. beverages, food, etc. inside and a storage chamber 3 of main body 4 visible through transparent door while static or changeable visual or textual information I is displaying with module(s) 1 that may attract potential consumer attention.

20 As further shown in Fig. 2 display module 1 is forming a pane of a door 5 of showcase. Door 5 is further provided by two hinges 6 for mounting on main body of showcase and forming rotation axes for opening the door.

Fig. 3 illustrates one example of display module 1 formed by transparent member 7, at least one substantially transparent display panel 8 fixedly mounted together.

25 Display panel further provided by a display driving unit 9 connectable by a cable

10 to an external controller 11. Display driving unit 9 is operable to drive display panel 8 in response to the drive command from external controller 11 to create textual and/or pictorial information on display module 1. Preferably, transparent member 7 has a greater surface area than the display panel 8.

- 5 Display panel 8 can be standard OLED panel, LCD panel (comprising glass substrates with TFT and electrodes matrix, liquid crystal, and two polarizing films) or any other type of panel that can be substantially transparent (while operating or non-operating).

Display module 1 (Figs. 4, 5) can be further provided by non-transparent area(s)
10 12 forming e.g. a closed frame in the present example. It is clear, that non-transparent area 12 could be of any desired shape, e.g. in the form of open frame, border or strip associated with one or more edges of display module 1. Non-transparent areas on different sides of display module 1 may have different width, for example at the side where the driving unit 9 is located non-transparent
15 area is wider than at the opposite or other side display module 1 in order to hide driving unit 9 and connecting cables.

Non-transparent area(s) or frame 12 may be made by coating (for example printed, painted) or by gluing of non-transparent member, e.g. plastic film in appropriate areas of transparent member 7. Mounting of display panel 8 on
20 transparent member 7 provides mechanical protection of display panel, enables to minimize size of non-transparent area.

As further seen in Fig. 4 display module 1 may comprise an additional transparent member 7' and display panel 8 is accommodated between transparent members 7 and 7'. Transparent members 7 and 7' with spacers 13
25 and appropriate sealing (not shown) forms double glazed structure with transparent sealed cavity with a sealing frame surrounding. The advantages of assembling display panel 8 inside sealed double glazed structure are:

- The transparent display panel 8 and driving unit 9 are mechanically protected and don't require additional packaging means.
- The transparent display panel 8 and driving unit 9 are protected from the water condensing when the refrigerator door is open, caused by temperature difference between temperature of the door and outside air temperature, which happens when the transparent display panel is installed inside the refrigerator behind the glass door.
- Display module 8 sealed into double glazed structure is perfectly waterproofed, allowing outdoor using of the device.
- Sealed double glazed structures normally are used in the doors of show case refrigerators to provide thermal insulation and avoid water condensing on the transparent glass.

Transparent member 7 and or 7' may be made of any transparent material e.g. glass or plastic of appropriate shape.

- Signal cable 10 with connector 10', is used for connection of the display module to external controller 11. The signal cable should be long enough, for example to have a length 1 – 2 meters to reach external controller 11. Signal cable 10 provides transmitting high speed digital video signals corresponding to video interface standards for connecting an output of a graphic processing unit of the external controller 11 to driving unit 9 of at least one said display panel 8. Signal cable 10 can be so-called LVDS (low voltage differential signaling) cable.

- Fig. 5 illustrates structure, e.g. refrigerator 2' having display module 1 configured to constitute a pane of the refrigerator door instead of a regular double glazed unit. Display module 1 can be installed within metal (e.g. aluminum) frame 14 forming the door. Signal cable 10 can be hidden inside the frame 14 and pass through a hole (not shown) in top hinge 6. Hole can be located in the area of the axis of rotation of door. As further shown in the Fig. 5 external controller 11 is located on the top surface of the show case refrigerator 2.

External controller 11 typically includes a controller to receive and to process data and to form commands to driving unit 9 of at least one said display panel 8. Controller 11 may include additional or integrated communication unit to receive data, for example WiFi or 3G communication unit, TV tuner, connectors like USB or HDMI connectors or slots for memory cards. The following advantage of such a design when the display module 1 is separated from controller 11 and connected to controller 11 by long enough signal cable 10 can be provided:

- Less space on the frame is needed for electronic boards and narrow frame can be used.
- The thickness of display module 1 can be reduced.
- Standard electronic control boards of TVs (LCD) of any shape may be used.
- In the case of sealing of the display module, controller placed outside the module is still accessible and standard interface like USB, HDMI connectors or slots for memory cards may be used for data exchange.
- Power dissipation of display module itself is much smaller without controller and sealing doesn't cause overheating problems.

In case when LCD panel is used in display module 1, it could provide good visibility of the goods behind thereof along with video playing only when the space behind it is not dark and illuminated enough. To this end, white or silver background can be used inside storage chamber 3 (FIG. 1) and additionally, illuminating assembly capable to provide substantially high brightness background could be used.

The transparency of LCD panel usually is less than 15%. The level of illumination behind the LCD, inside the show case, should be in that case 6-10 times more than the level of illumination outside the show case. It may be a case that goods displayed behind display module 1 are located too close to display module 1 or are too dark. To enhance the illumination of the goods, located close to display module 1, and to add white background to the image on display module 1, a

transparent lighting module 15 shown in FIGS. 6 and 7 can be used. Transparent lighting module 15 can include optically clear waveguide 16 made for example from acrylic, polycarbonate or glass, having two surfaces 17 and 18, an edge-lit light source 19, for example smd LED strip, positioned at the edge of wave guide 16, and a diffusing layer (light scattering) 20 having shape of for example spots or lines and being in optical contact with one of the surfaces (17, 18) of waveguide 16. Preferably, diffusing layer 20 can be mounted on the front-facing surface 18 of waveguide 16.

The first purpose of diffusing layer 20 is to break down the total internal reflection in the waveguide 16 and to distribute light generally uniformly from its concentration as emitted from the light source 19 and re-direct to the object (goods) G located behind display module 1, providing sufficient illuminating of the object G.

The second purpose of diffusing layer (light scattering) 20 is to form zones of white background to the image displayed on display panel 8. For this purpose, light diffusing layer 20 can be made of diffusing material. It can be formed by printing, using white diffusing ink ("paint dots"), treatment of the surface 18 by chemical or laser etching, and V-groove processes, or optical coupling to film with white diffusing spots arrays. The total area of diffusing zones of diffusing layer 20 may be less than non-treated area to keep waveguide transparency to the observer 21, to provide eye-catching visual effects of seeing real objects together with changeable visual and/or textual information on display panel 8. For example, the total area of diffusing zones of diffusing layer 20 formed by printed dots may be in the range 5 – 10 % of total area of surface 18.

Size of printed dots and/or distance between them may be gradually changed along the surface depending of placement of light sources to provide uniformity of both light intensity in the direction to the object and visual uniformity of brightness of white diffusing spots which serve as display panel 8 (in case of LCD) backlight. Size of printed dots can be in the range of 0.05 – 1 mm.

Regular matrix of dots (as shown in Fig.9A) being placed behind display panel 8, e.g. LCD and regular structure of LCD pixels may cause Moire effect. Size of the dots and distances between them can be chosen to minimize this effect. For example the size of the dots can be approximately equal to the size of the RGB pixel. In this case every dot being placed behind LCD will correspond to three sub-pixels: one red, one green, and one blue. The size of the dots may be chosen also smaller than the width of sub-pixel, for example for the 42" high definition LCD panel the size of the dots may be 0.05 mm, distance between dots 0.2 mm while size of the color sub-pixel is about 0.125*0.5 mm. Such distance between dots will be below the resolution of the human eye for viewing from 1-2 meters. In this case the dots structure will be practically invisible. Randomness of the dots may be also or in addition used to avoid Moire effect (see Fig. 8B).

As shown at Fig.9, lighting module 15 may be placed outside of the glazed structure of display module 1 or may be sealed inside display module 1. In the first case protection from evaporated water, dust, dirt, fingerprints which cause spots, can be additionally provided.

CLAIMS:

1. A display module comprising:

a transparent member and at least one substantially transparent display panel
fixedly mounted together, said at least one display panel provided by a
5 display driving unit connectable by a cable to an external controller and
operable to drive said at least one display panel in response to the drive
command from said external controller.
2. The display module according to claim 1 wherein the transparent member
has a greater surface area than the display panel.
- 10 3. The display module according to claim 1 further comprising at least one
non-transparent area.
4. The display module according to claim 3 wherein said non-transparent
area is formed on said transparent member by coating with non-
transparent material.
- 15 5. The display module according to claim 3 wherein said at least one non-
transparent area is formed by non-transparent member.
6. The display module according to any one of the preceding claims further
comprising an additional transparent member and said display panel is
accommodated between the transparent members.
- 20 7. The display module according to claim 6 further comprising a sealing and
spacing arrangement sealingly fixing the transparent member to each
other along their periphery at spaced apart relationship, thereby forming a
transparent sealed cavity with a sealing frame surrounding.
8. The display module according to any one of the preceding claims further
25 comprising a lighting module.
9. The display module according to claim 8 wherein said lighting module
includes an optically clear waveguide and an edge-lit light source.
10. The display module according to claim 9 wherein said lighting module is
mounted on the said additional transparent member

11. The display module according to claim 9 wherein said waveguide, comprising a diffusing layer with diffusing zones.
12. The display module according to claim 11 wherein said diffusing zones formed by spots or lines.
- 5 13. The display module according to claims 11 wherein said diffusing zones formed by printed dots.
14. The display module according to any one of claims 10, 12 and 13 wherein said diffusing layer has a greater surface area than the diffusing zones.
15. The display module according to claim 14 wherein said diffusing zones
10 cover about 5 – 10 % of the diffusing layer area.
16. The display module according to any one of claims 13, 14 and 15 wherein size of said printed dots and distances therebetween is chosen to minimize Moire effect caused by superposition of the pattern of printed dots and pattern of display pixels.
- 15 17. The display module according to claim 1 wherein said cable provides transmitting high speed digital video signals corresponding to video interface standards for connecting an output of a graphic processing unit of the external controller to the driving unit of at least one said display panel.
- 20 18. The display module according to claim 17 wherein said cable is a low voltage differential signaling cable.
19. A structure comprising a display module according to any one of the preceding claims, wherein said display module configured to constitute at least one of the following a pane, a window, a shop widow a vitrine, a
25 door, a wall, a ceiling, a floor of the structure.
20. A structure of the claim 19 wherein said structure constitutes a showcase having a main body, an opening at least one side of the main body and a storage chamber.
21. A structure of the claim 20 wherein said storage chamber is provided by
30 illuminating assembly capable to provide substantially high brightness background.

22. A structure of the claim 21 wherein said illuminating assembly provides a level of illumination of 6 -10 times stronger than the level of illumination outside said showcase.

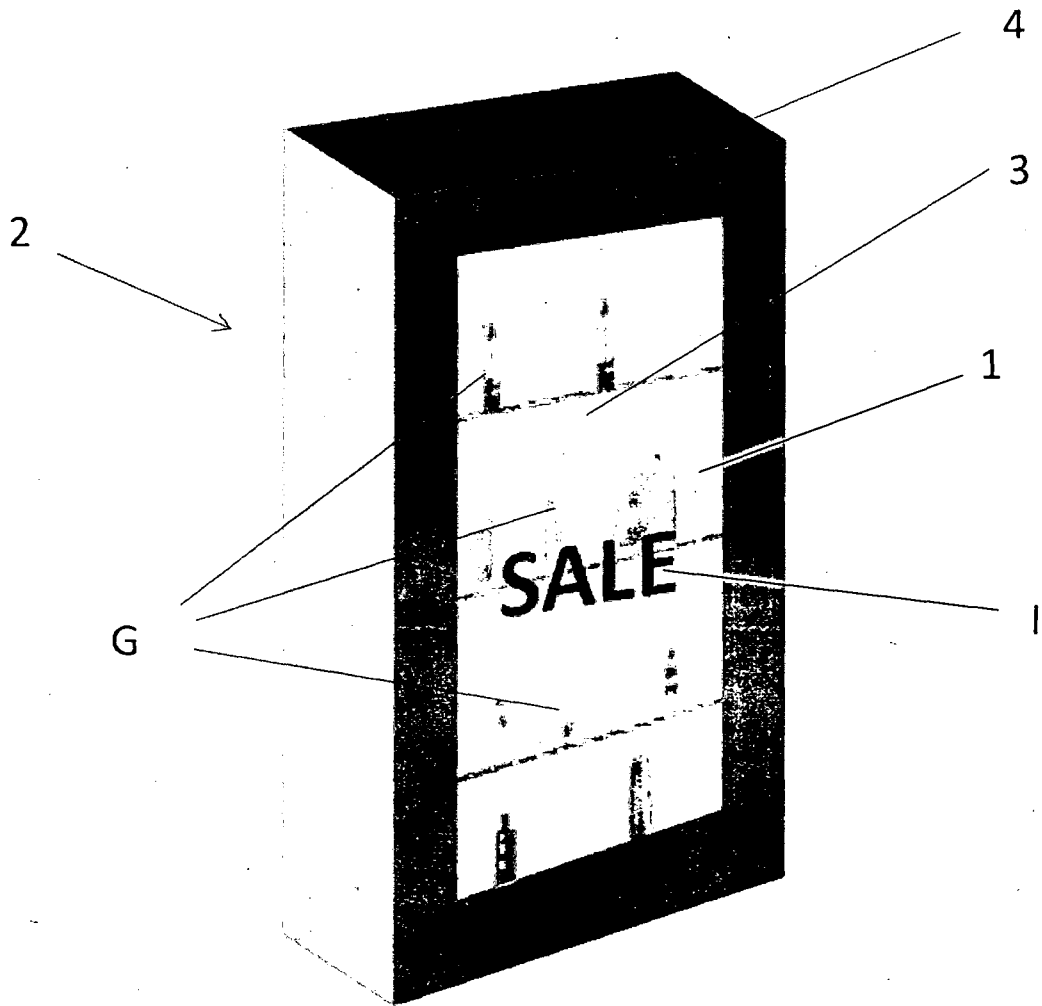


Fig. 1

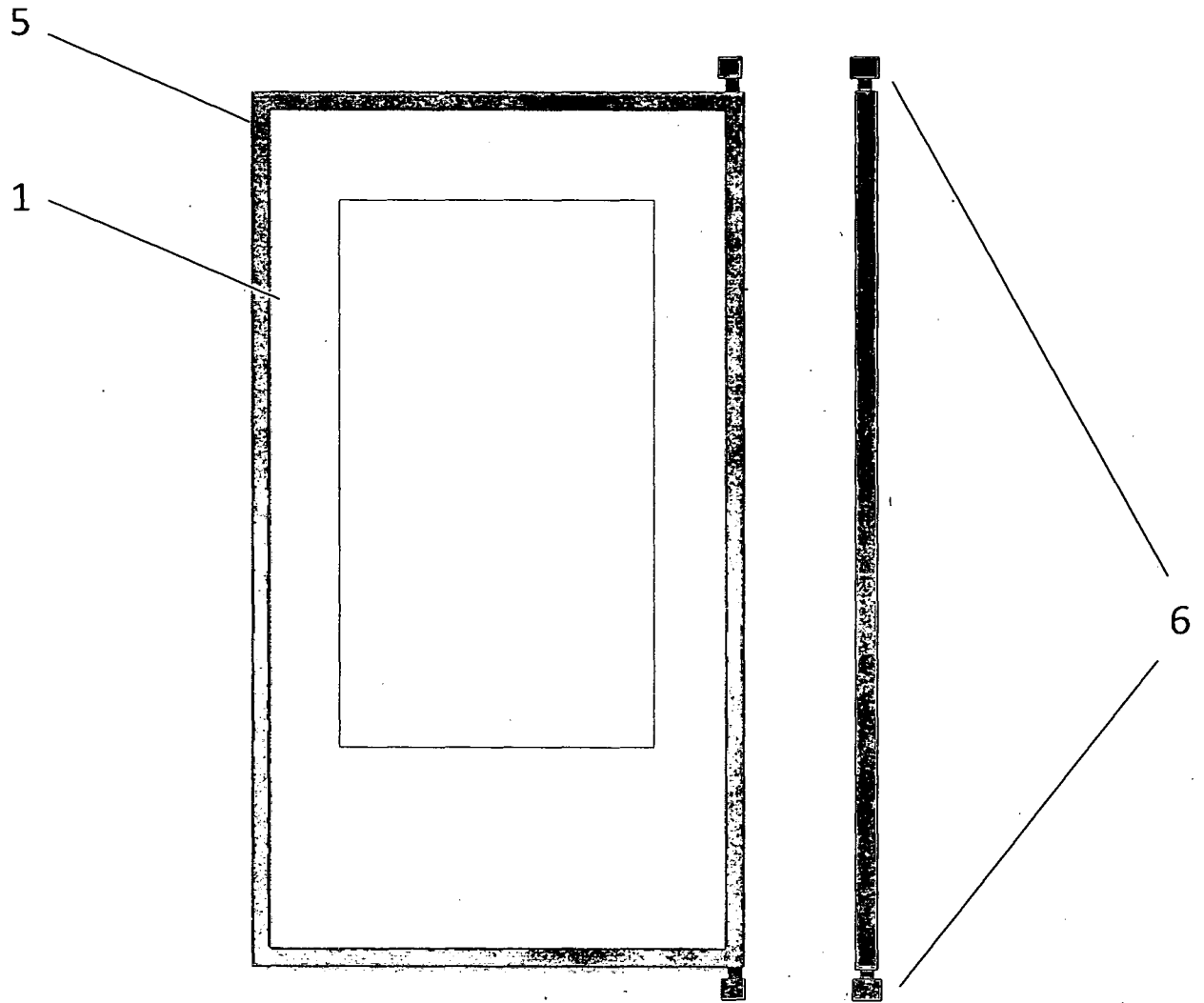


Fig. 2

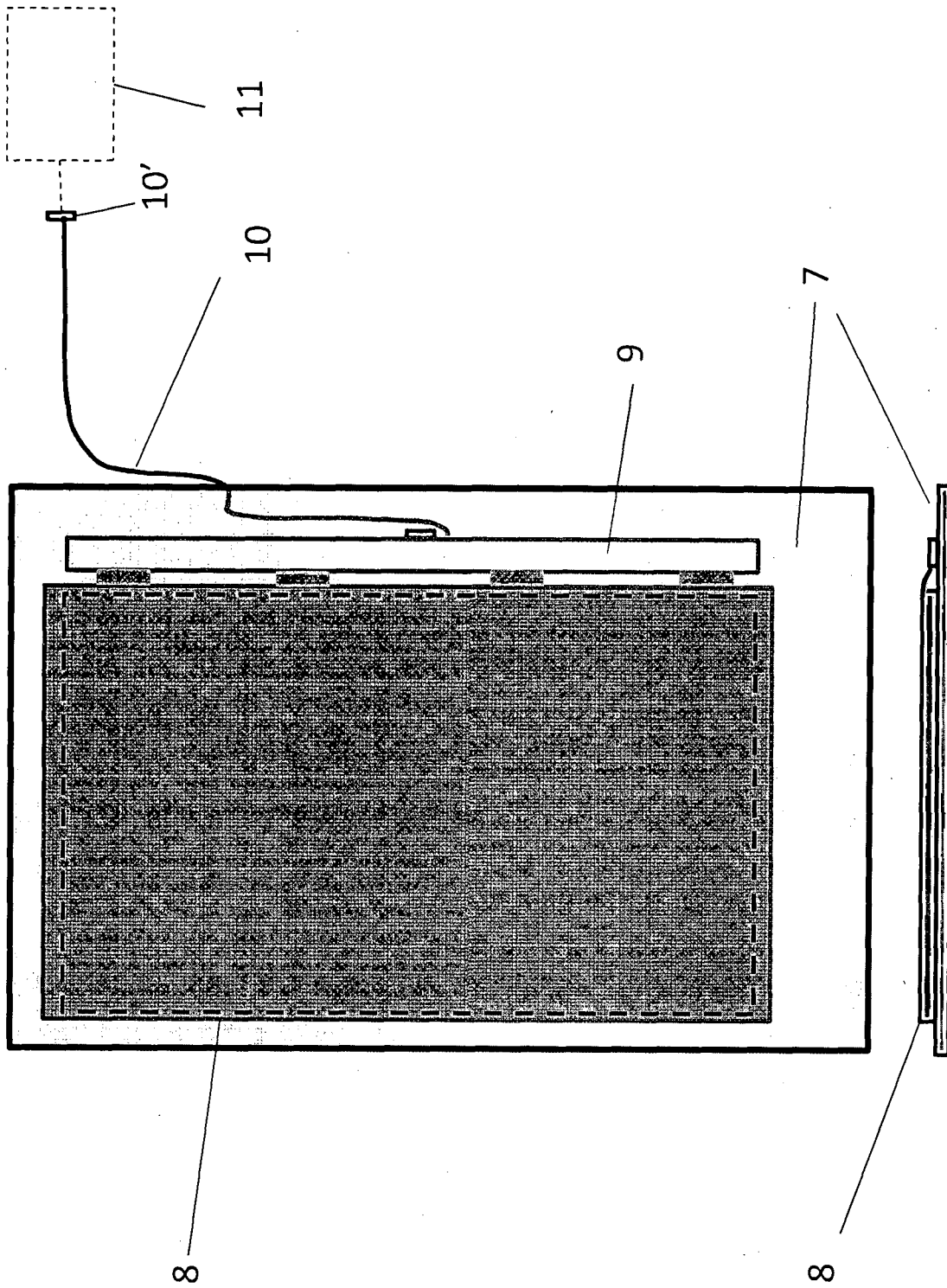


Fig. 3

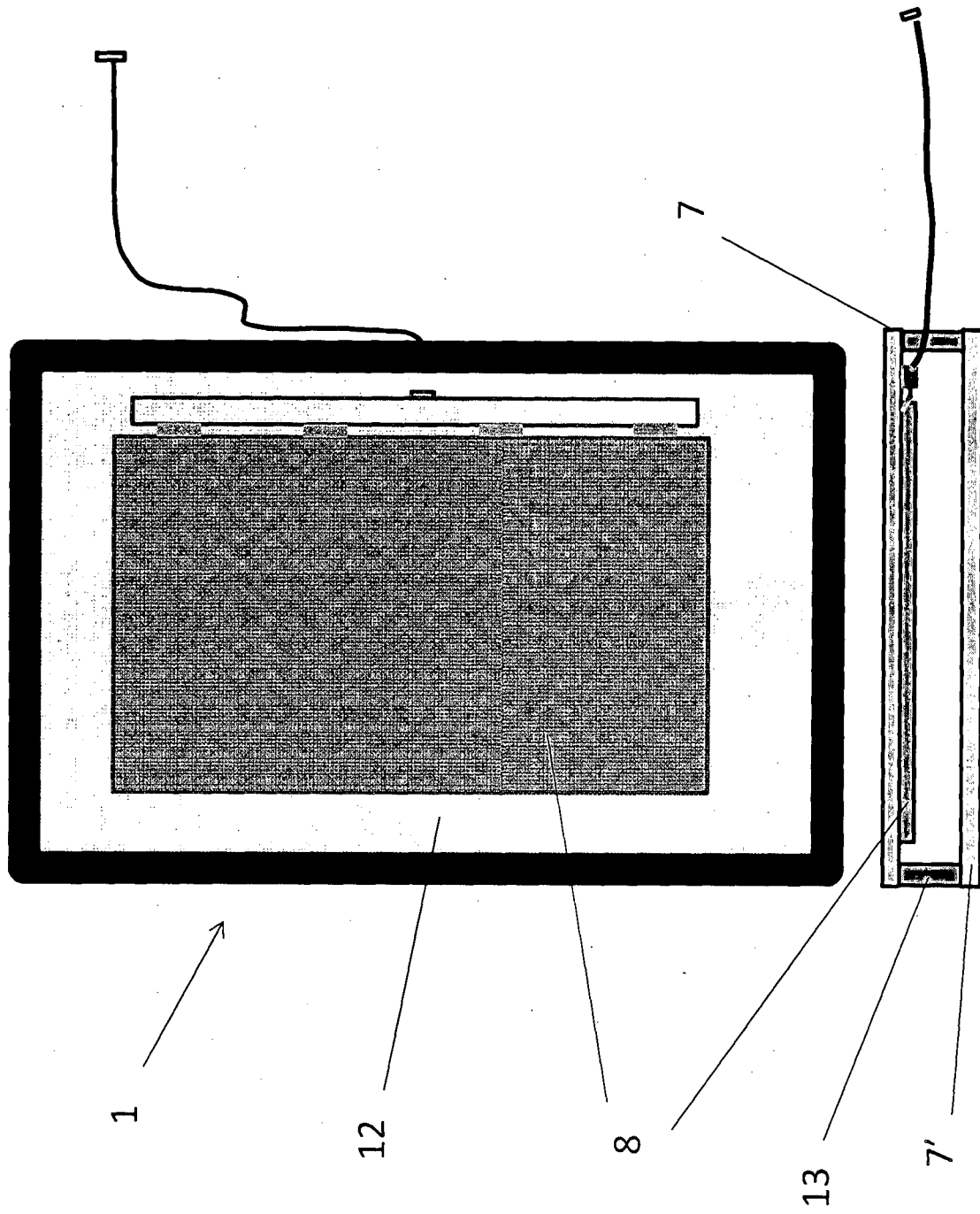


Fig. 4

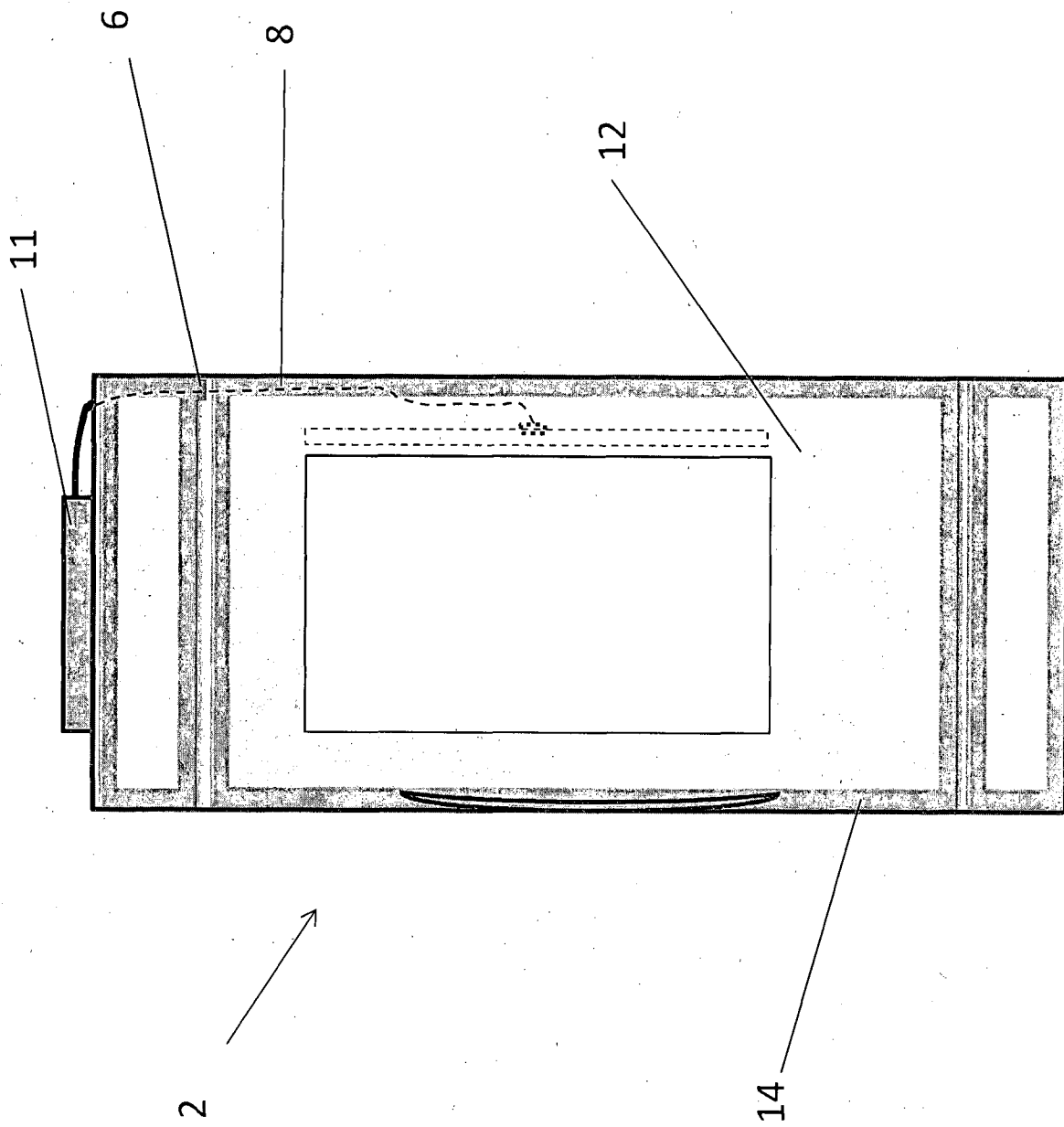


Fig. 5

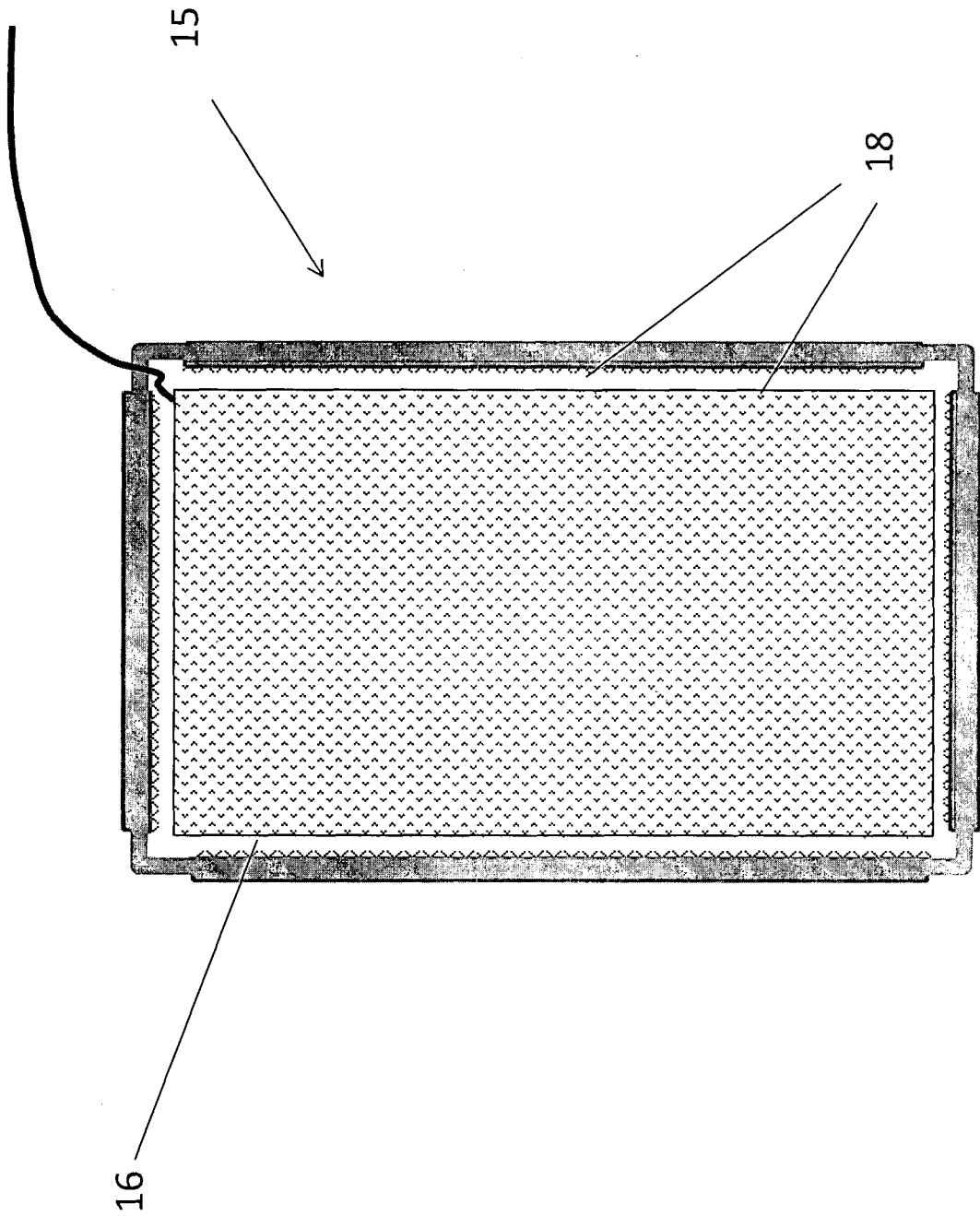


Fig.6

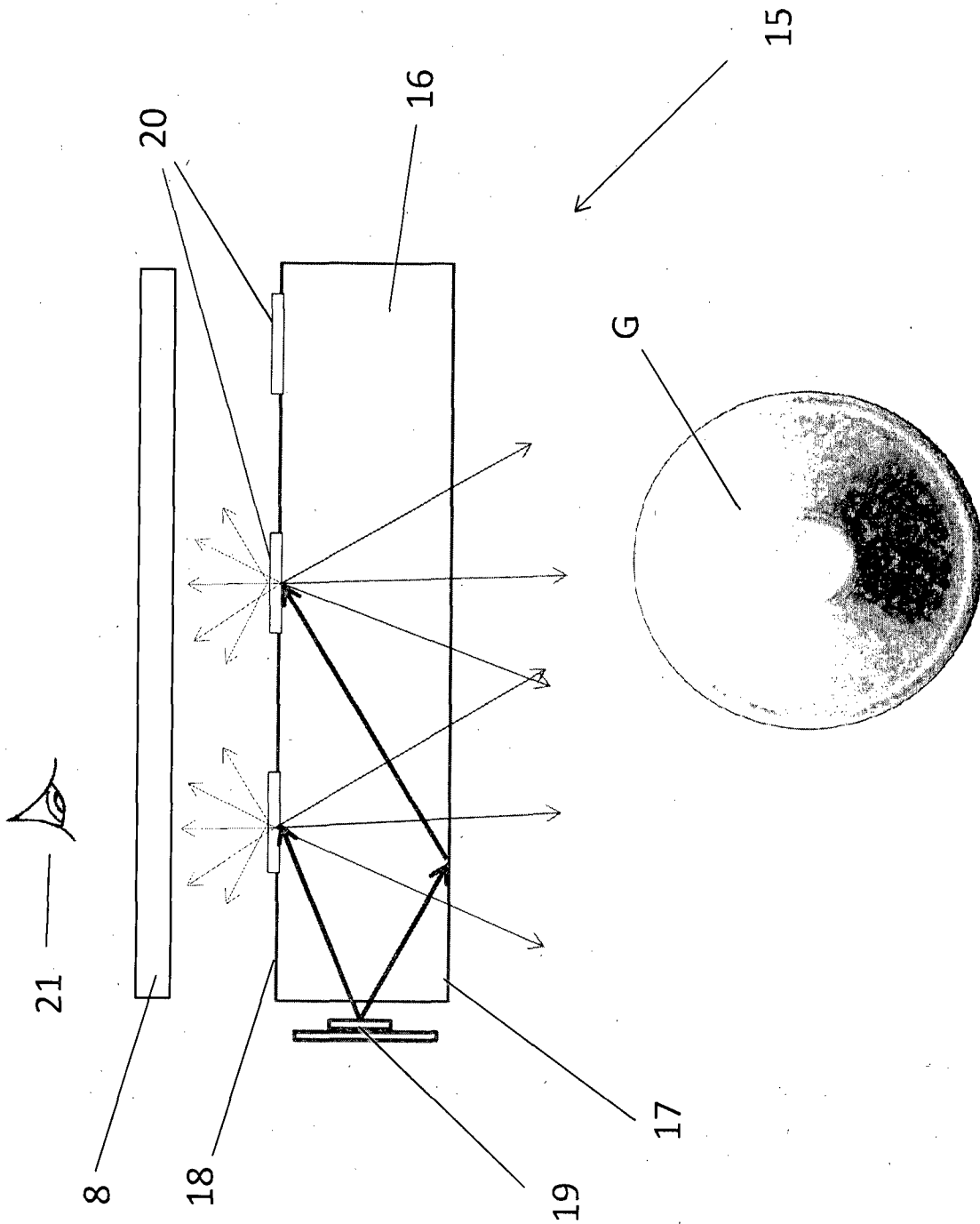


Fig. 7

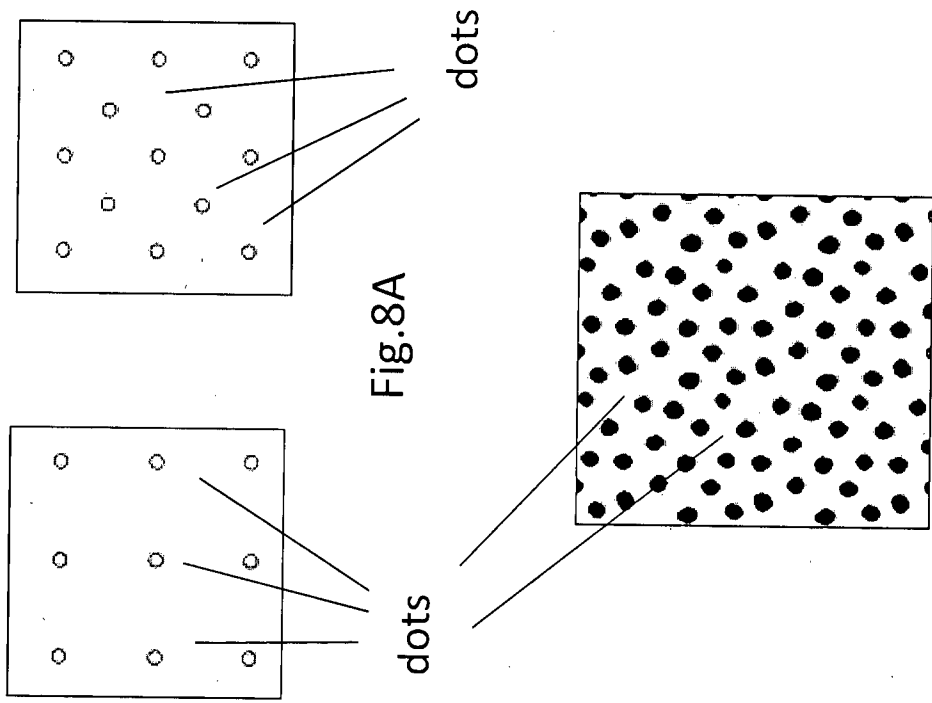


Fig.8B

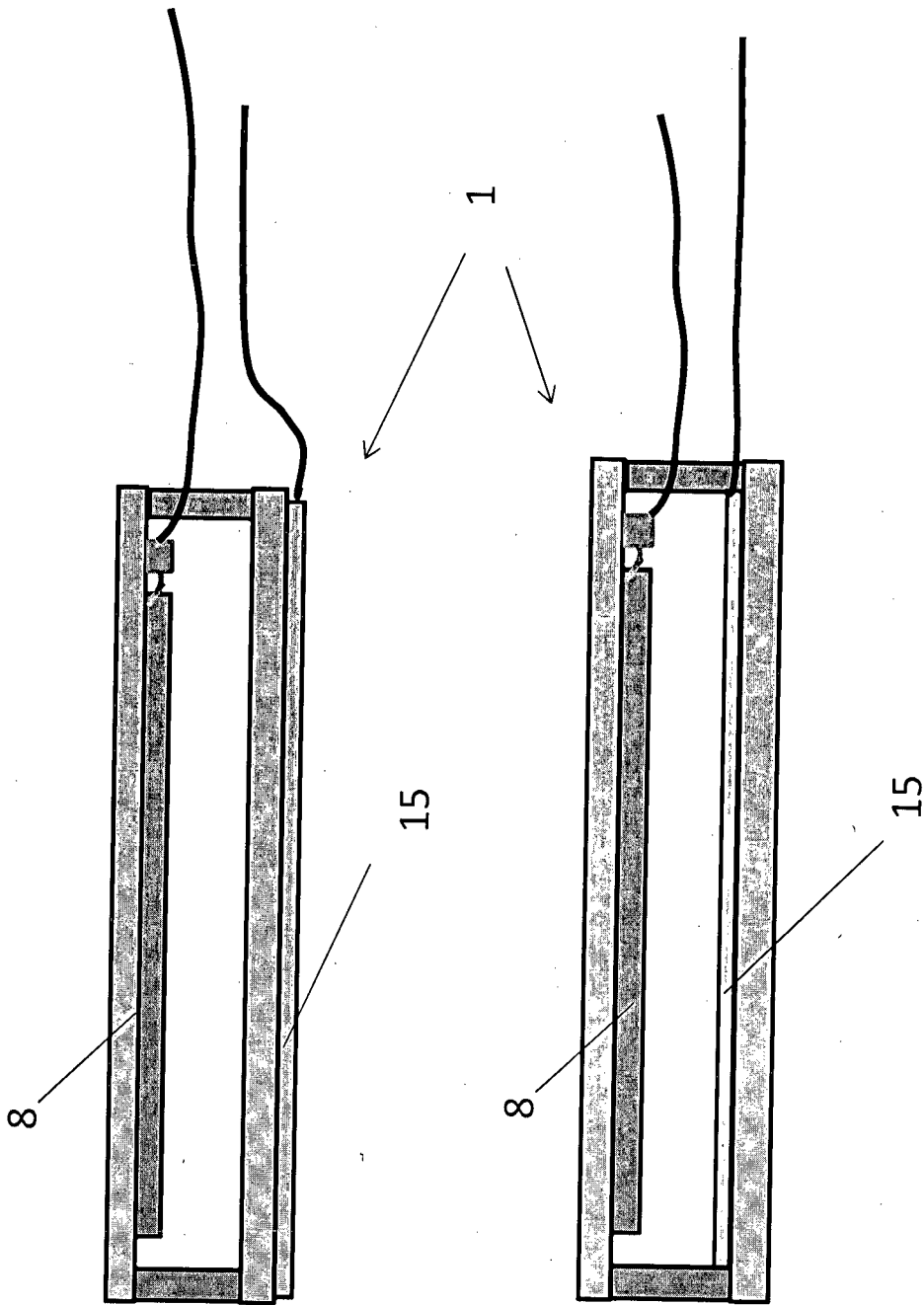


Fig.9

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2013/001458

A. CLASSIFICATION OF SUBJECT MATTER IPC (2013.01) G09F 9/00, G09G 3/20, G02B 6/00		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) IPC (2013.01) G09F 9/00, G09G 3/20, G02B 6/00, H05K 5/02		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Databases consulted: THOMSON INNOVATION, Esp@cenet, Google Patents		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2012057457 A1 SAMSUNG ELECTRONICS CO LTD 03 May 2012 (2012/05/03) whole document	1-8,17-22
Y	Whole document	9-16
Y	WO 2012075352 A1 3M INNOVATIVE PROPERTIES CO [US] 07 Jun 2012 (2012/06/07) Whole document	9-16
A	JP 2004294705 A FUJI PHOTO FILM CO LTD 21 Oct 2004 (2004/10/21) Abstract; Fig 1	1-22
A	WO 9708583 A1 PHILIPS ELECTRONICS NV [NL] 06 Mar 1997 (1997/03/06) Whole document	1-22
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Date of the actual completion of the international search 27 Nov 2013	Date of mailing of the international search report 28 Nov 2013	
Name and mailing address of the ISA: Israel Patent Office Technology Park, Bldg.5, Malcha, Jerusalem, 9695101, Israel Facsimile No. 972-2-5651616	Authorized officer LAHAV Ronen Telephone No. 972-2-5651732	

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2013/001458

Patent document cited search report	Publication date	Patent family member(s)	Publication Date
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