(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
29 November 2018 (29.11.2018)

WIPO | PCT

(10) International Publication Number
WO 2018/215726 A1

(51) International Patent Classification:
G09F 9/30 (2006.01) *F21S 4/15* (2016.01)
G09F 9/33 (2006.01)

(21) International Application Number:
PCT/GB2017/051455

(22) International Filing Date:
24 May 2017 (24.05.2017)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant: **CURB MEDIA LIMITED** [GB/GB]; 7 Hanson Street, London Greater London W1W 6TE (GB).

(72) Inventors: **GANJOU, Anthony**; c/o CURB Media Limited, 3rd Floor, 62 Buckingham Gate, London Greater London SW1E 6AJ (GB). **BRINSMEAD, Simon**; c/o CURB Media Limited, 3rd Floor, 62 Buckingham Gate, London Greater London SW1E 6AJ (GB).

(74) Agent: **BOULT WADE TENNANT**; Verulam Gardens, 70 Gray's Inn Road, London Greater London WC1X 8BT (GB).

(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, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, 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, SA, 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, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,

WO 2018/215726 A1

(54) Title: FLEXIBLE VIDEO DISPLAY

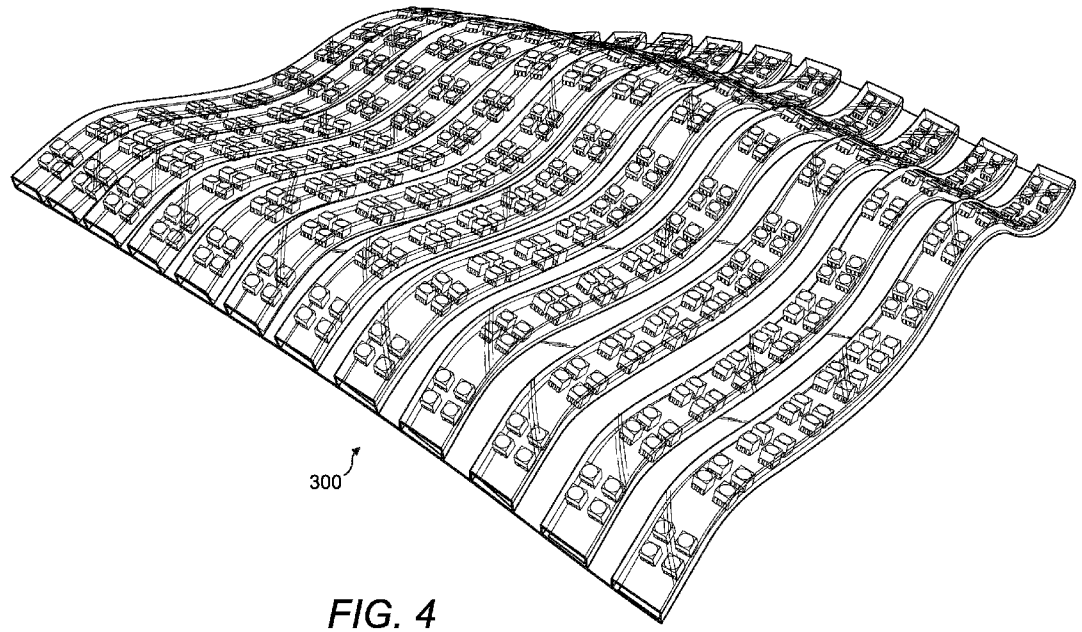

FIG. 4

(57) Abstract: A video display and method of manufacture the video display comprising a plurality of flexible elongate strips, each strip comprising a plurality of individually addressable pixels, wherein each pixel is formed from one or more light emitting diodes, LEDs. One or more electrical cables electrically coupled to each individually addressable pixel, the one or more electrical cables emerging from the strip. A first part of a two-part releasable fixture bonded to an outer surface of the strip. A flexible sheet have a surface at least partially covered with a second part of the two-part fixture and arranged to support the plurality of flexible elongate strips. One or more LED driving circuits. One or more electrical connectors removably coupled between the one or more electrical cables and the one or more LED driving circuits.

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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))*

Flexible Video Display

Field of the Invention

The present invention relates to a flexible video display and method of manufacture of such displays and large outdoor displays, in particular.

Background of the Invention

Large video display screens have advantages over projection screens as they tend to be much brighter. However, such screens can be very heavy and difficult to install. Therefore, large screens that are used within sporting arenas or for outdoor advertising, are generally permanently located. It may be impractical or very expensive to set up large display screens for temporary events or at locations that cannot support the weight of these screens without additional structural supports.

Large display screens that are used outdoors need to be waterproof and rugged. This also increases their weight and hinders maintenance, especially when individual pixels fail and need to be replaced. Furthermore, large flat panel video display screens are impractical to be used for and located on objects that are not flat. Where there is a requirement to provide a video display screen around an object that is not flat, then a typical solution is to use many smaller flat screens to provide the illusion of curves or other irregular shapes. However, this further complicates installation and maintenance as each separate screen needs to be located and addressed correctly in order to build the full video picture.

Flexible polymer-based video display screens are available but these have a high price and cannot individually form very large screens unless multiple individual flexible screens are used.

US2009/0146910 describes a modular flexible panel that is formed from mounting strands of lights to form a surface that provides full-motion video images. Nodes are connected by snap fittings to form an interconnecting linear array in the form of a grid pattern. Strands are mounted in small plastic housings and arrayed in increments along a

three wire conductor. Whilst this provides a semi-flexible array, there are many separate components and connections that must be made weatherproof and there exist many separate physical connections that are vulnerable to mechanical failure. Both requirements increase weight. There is also are requirement for a lighter display that can provide a brighter image.

Therefore, there is required a large video display screen that is lighter, preferably weatherproof and can more easily conform to irregular shapes and surfaces, whilst providing an image having sufficient brightness and clarity.

Summary of the Invention

A flexible video display unit or apparatus is provided that is formed from a plurality of flexible strips of pixels that may be individually controlled in terms of brightness and/or colour. These strips are attached to a flexible sheet, such as cloth, fabric or polymer film, for example. The strips are attached semi-permanently but they may be individually removed or replaced as necessary. This may be achieved by using a repositionable bonding system such as a hook and loop fastener or other method (e.g. repositionable adhesive). Each flexible strip forms a column or row of the video display or multiple strips can be used to build the size of each column or row for larger displays. Therefore, if a row or even an individual pixel within a flexible strip fails, then that particular strip may be replaced relatively easily without affecting the other pixels or strips.

Each strip may comprise an electrical connector or cable, which may be joined to control circuitry. Preferably, the electric connection between each flexible strip and its corresponding control circuit is also removable. For example, plug and socket type arrangements may be used. Each controller may control one or more flexible strips of pixels.

The individual pixels in each flexible strip may be formed from light emitting diodes (LEDs) or other suitable lighting element. The flexible strips may contain a potting compound or encapsulation to prevent water or other contaminants from affecting the pixels or the electrical connection to each pixel. Preferably, the encapsulation may be formed from a silicone sealant.

In accordance with a first aspect there is provided a video display comprising:

a plurality of flexible elongate strips, each strip comprising:

a plurality of individually addressable pixels, wherein each pixel is formed from one or more light emitting diodes, LEDs;

one or more electrical cables electrically coupled each individually addressable pixel, the one or more electrical cables emerging from the strip; and

a first part of a two-part releasable fixture bonded to an outer surface of the strip;

a flexible sheet have a surface at least partially covered with a second part of the two-part fixture and arranged to support the plurality of flexible elongate strips;

one or more LED driving circuits; and

one or more electrical connectors removably coupled between the one or more electrical cables and the one or more LED driving circuits. Therefore, the video display can be flexible, lighter and easier to repair or replace damaged pixels or groups of pixels. This allows the display to be installed in places and locations that may be unsuitable for rigid display panels. A further advantage is that the video display may be packed away or rolled up and transported more easily. Preferably, the flexible elongate strips may have a bending radius down to 20mm (without breaking or damaging the pixels or connections) but a range of 20mm to 50mm, 20mm to 100mm or 50mm to 100mm bending radius also provides advantages. The bending radius may also be as low as twice the width of the flexible elongate strip, for example.

There may also be an electrical connection to each pixel. The pixels may be formed on a flexible printed circuit board (PCB), for example. Electrical tracks on the PCB may link one pixel to another (to provide a data and power connection to each pixel) with the last pixel joining to the electrical cable or cables emerging from the strip, for example. The pixels may be electrically connected to each other and the cable or cables in different ways.

Preferably, a flexible seal or sealant encapsulates the plurality of LEDs and the electrical connections. The flexible sealant protects the video display from water, rain and other contaminants but also can protect the video display from mechanical damage, which further enhances flexibility and robustness.

Preferably, the two-part releasable fixture may be a hook and loop fastener. The makes is easier to replace individual rows of pixels should they fail. Hook and loop fasteners can be reused many times but are strong enough to form a permanent structure resisting the flexible strips from moving relative to each over and distorting an image displayed with the video display.

Optionally, the flexible sealant may be a jacket or sheath. This may form an outer sheath around each line of pixels. The jacket may be formed from extrusion or other moulding process. The jacket may be a silicone or PVC jacket, for example. Preferably, the jacket is transparent or translucent. Silicone or PVC allows movement without rupturing or splitting, which improves the flexibility of the video display, whilst reducing damage due to water, mechanical or electrical failure.

Preferably, the jacket may be filled with silicone sealant or other resin. This can be a chemically curing silicone sealant. The silicone jacket provides a case to retain the silicone sealant in liquid or gel form until is sets to a flexible rubber-like cured resin. This further waterproofs and strengthens each flexible strip. The electrical connections and cables may also be potted using this silicone sealant.

Optionally, the flexible sheet may be formed from fabric or other flexible medium. This may be a woven or non-woven fabric. In some examples, the fabric may be a synthetic material such as polyester, polyamide, polychloroprene, elastane or other polymer or mixture of polymers or mixture of polymers and natural fibres (e.g. cotton). The flexible sheet may be mounted or be part of flexible items such as the sails of yachts, for example.

Preferably, the LEDs may be surface mounting devices, SMD. Other types of LEDs may be used.

Preferably, the individually addressable pixels may be full colour pixels. The pixels may be able to individually form a range of colours. They may be formed from multiple different colour LEDs, for example.

Optionally, each pixel may comprise a plurality of LEDs. This may increase light output making the video display brighter and suitable for daylight use.

Preferably, the one or more LED driving circuits may be slave data card. This reduces the weight and size of the video display as power and more complex functions can be handled remotely by using cables, for example.

Preferably, each of the one or more LED driving circuits may be electrically coupled to a plurality of flexible strips. Therefore, this reduces the number and size or required circuits on the video display, which reduces weight and improves flexibility and portability.

Preferably, each flexible strip may be separately removable from the sheet. In other words, in case of a failure of a strip, pixel or pixels, the entire strip may be removed from the sheet and driving circuit. This strip or strips may be replaced and the video display can resume functioning without the need to replace, open or dismantle the entire display.

Preferably, the flexible strips are evenly spaced on the sheet. This reduces distortion of displayed images. However, the spacing of the flexible strips may be altered between strips or even along strips to form different visual effects (e.g. augmented reality).

Optionally, the pitch (separation) between pixels on the flexible strips is equal to the separate of the flexible strips on the sheet. Other sizing or arrangements may be used.

Optionally, the sheet may further comprise supports for the LED driving circuits. These LED driving circuits may be clipped or suspended from the sheet, for example. Preferably, these supports allow the LED driving circuits to be removed and replaced.

Advantageous, the video display may further comprise an electrical power loom connected to the LED driving circuits. The power may be supplied externally, e.g. external mains power cables or internally.

Optionally, the one or more electrical connectors may be flying leads. In other words, the LED driving circuits may have flexible cables emerging from their surfaces or edges. These flying leads may have plugs or sockets that mate with cables emerging from the flexible strips of pixels.

Optionally, the flexible strips may have a semi-circular, rectangular or square profile. Other shapes or profiles may be used. The semi-circular, square or rectangular profile

enables a greater area for the two-part fixture, which improves the stability of the video display, especially when it moves or flexes.

Preferably, the sheet may be covered with a continuous surface of the second part of the two-part fixture. In some examples, the strips of the second part may be bonded to or otherwise attached to the sheet. However, the use of a continuous sheet allows different configurations, arrangements, separation between strips (pitch) to be used for the same sheet. This also makes the manufacture of the display screen easier. The pitch may be easily varied by moving, adding, replacing or removing strips.

According to a second aspect there is provided a method for manufacturing a video display, comprising the steps of:

forming a plurality of flexible elongate strips by:

providing a plurality of individually addressable pixels, wherein each pixel is formed from one or more light emitting diodes, LEDs;

electrically connecting each individually addressable pixel to one or more electrical cables, wherein the one or more electrical cables are formed to emerge from the strip; and

bonding a first part of a two-part releasable fixture to an outer surface of the strip;

providing a flexible sheet with a second part of the two-part releasable fixture;

joining the first part of the two-part releasable fixture of the plurality of flexible elongate strips to the second part of the two-part releasable fixture on the flexible sheet; and

connecting the one or more electrical cables to one or more LED driving circuits using a removable electrical connector.

Optionally, the method may further comprise the step of encapsulating the plurality of LEDs and at least part of the one or more electrical cables with a flexible sealant.

Optionally, the step of encapsulating the plurality of LEDs may further comprise the steps of:

inserting the LEDs within a flexible tube; and

filling the flexible tube with a chemically curing sealant. This may be a silicone sealant, for example. The flexible tube may be a silicone sleeve, for example.

Optionally, the method of manufacture may further comprise the steps:

removing one or more flexible elongate strips from the flexible sheet by separating the first part of the two-part releasable fixture from the second part;

disconnecting the one or more electrical cables from the to one or more LED driving circuits;

replacing the removed one or more flexible elongate strips; and

reconnecting the one or more electrical cables to the one or more LED driving circuits. In other words, this is a method of fixing or repairing an existing display screen.

The display screen may be driven by a computer system that may include a processor such as a central processing unit (CPU). The processor may execute logic in the form of a software program. The computer system may include a memory including volatile and non-volatile storage medium. A computer-readable medium may be included to store the logic or program instructions. The different parts of the system may be connected using a network (e.g. wireless networks and wired networks). The computer system may include one or more interfaces. The computer system may contain a suitable operating system such as UNIX, Windows (RTM) or Linux, for example.

It should be noted that any feature described above may be used with any particular aspect or embodiment of the invention.

Brief description of the Figures

The present invention may be put into practice in a number of ways and embodiments will now be described by way of example only and with reference to the accompanying drawings, in which:

FIG. 1 shows a schematic diagram of a portion of a flexible strip of pixels;

FIG. 2 shows a perspective view of the flexible strip of pixels of figure 1;

FIG. 3 shows a perspective view of an array of pixels formed from a plurality of flexible strips of figures 1 and 2;

FIG. 4 shows a further perspective view of an array of pixels formed from the flexible strips of figures 1 and 2;

FIG. 5 shows a video display formed from an array of pixels;

FIG. 6 shows a further example video display;

FIG. 7 shows a schematic view of a controller of the pixels forming the video displays of figures 5 and 6;

FIG. 8 shows a schematic diagram of a portion of a video display including the flexible strips of pixels of figure 1 and the controller of figure 7;

FIG. 9 shows a schematic diagram of an alternative controller of pixels;

FIG. 10 shows a reel of a flexible strip of pixels before being used to form a video display; and

FIG. 11 shows a schematic diagram of the video display of figures 5 and 6 flexibly mounted to a hot air balloon, given by way of example only.

It should be noted that the figures are illustrated for simplicity and are not necessarily drawn to scale. Like features are provided with the same reference numerals.

Detailed description of the preferred embodiments

Large lighting displays and image or video display panels can be formed from an array of light emitting diodes (LEDs). Typically, each LED will be individually controlled to provide a specific light output and/or colour contributing to a light display, static or moving image. Each LED in the array will be supplied with power and a data connection. Controller integrated circuits (ICs) mange individual pixels (one or more LEDs) and provide an address for each pixel. LED controller circuits coordinate and manage groups of LEDs (e.g. a line or an array). For large displays multiple controllers will be used. A further overall controller or computer provides the image or video signal. This video signal can be received by the LED controller circuits (or an intermediate video card), which produce control signals for individual pixels.

Figure 1 shows a schematic diagram of a portion of a flexible elongate strip or strip 5 having a flexible ribbon 10 upon which is mounted a series of regularly spaced pixels 20. Each pixel is formed from four separate light emitting diodes (LEDs) 30. Three electrical cables 40 protrude from an end of the ribbon 10. Along the length of the ribbon 10 are conductors 50 that connect to each pixel. The ribbon 10 or support ribbon may be a continuous flexible support or formed from connected units or boards. The ribbon 10 may be formed from plastics material, fibre glass, rubber or any other flexible or articulated material. The strip 5 may form a flat bar or rod, a coiled or twisted roll or any other shape

supporting a linear array of pixels 20. The ribbon 10 may be formed as part of a continuous flexible printed circuit board (PCB), for example.

The electrical cables 40 and connectors 50 supply electrical power and data signals into the strip 5 and then on to each pixel 20, which are individually addressable. In other words, a controller can issue a signal or command for each pixel 20 to provide a particular brightness (off to maximum) and/or colour. Each command may be accompanied by a pixel address, for example.

Three separate pixels 20 are shown in figure 1. However, the arrow at the right side of the ribbon 10 in this figure indicates that only a portion of the strip 5 is shown. The strip 5 may extend to many tens, hundreds or thousands of separate pixels 20.

Figure 1 shows a subset of the components of a flexible elongate strip 5. The other components will be described with reference to the remaining figures. Figure 2 shows a perspective view of a portion of the flexible elongate strip 5. Again, only a subset of the components is shown in this figure. For example, the electrical cables 40 and connections 50 are not shown in this figure. The LEDs 30 are surface mounting devices (SMD) in this example. Other LED types may be used. The flexible ribbon 10 and pixels 20 are shown enclosed within a flexible tube or sleeve 100, which is transparent or substantially transparent, at least on the side where light is emitted from the pixels 20. This flexible tube 100 encapsulates the pixels 20 and electrical connections 50 and provides a mounting surface along a long edge of the strip 5 opposite the side of the flexible ribbon 50 upon which the LEDs 30 are mounted.

The flexible ribbon 10 and or the sleeve 100 may be formed from a resilient material such as rubber or a silicone compound (e.g. siloxane polymer such as PDMS). The flexible ribbon 10 may also be formed from rigid sheets (e.g. circuit boards or other plastics material) linked by electrical conductors such as wires, for example. An example IC driver chip that may be included and located within each pixel 20 (not shown in this figure) is the TLS3001 IC.

Figure 3 shows a perspective view of a series of flexible elongate strips 5 located on a flexible sheet 200. Figure 3 illustrates the separation of the pixels 20 along each strip 5 to be the same distance as the separation (centre to centre) of the strips 5, which in this

case is 20mm (i.e. a 20mm pitch). Various pitch distances can be used. For example, this can be arranged from 13.9mm to 100mm with all separations in between. Typically, the separation of strips 5 and the pixel interval along each strip 5 will be the same but this is not necessarily required.

Figure 4 is a perspective view of a video display 300 made up from a series of equally spaced strips 5, illustrating how the flexible sheet 200 and the flexible elongate strips 5 can flex together. Again, not all components are shown in this illustrative diagram. The sheet may also flex in two dimensions (e.g. along and across the direction of each strip 5). Furthermore, the strips may contain many more pixels than those illustrated in figure 4 and have many more strips located on the flexible sheet 200. The available brightness for the video display 300 can be increased by reducing the pitch, which requires more LEDs 30 per square metre of sheet 200. An automatic light sensor can be included which provides a signal allowing the brightness of the LEDs 30 to be increased or decreased dependent upon the ambient light. In this example implementation, a pitch of 20mm provides 10,000 candela per square metre (CD/m^2).

Figure 5 shows a larger number of strips 5 and pixels 20 forming a flexible display 300 with an example image being displayed upon it. Such a video display 300 is flexible enough to be rolled up for storage and transportation and deployed on to curved surfaces where necessary.

Figure 6 illustrates the use of such a larger scale video display 300 used for both flat surfaces and curved surfaces (at different times or simultaneously).

Figure 7 shows a schematic diagram of an LED driving circuit 400 (e.g. a slave circuit). A number of ports (plugs or sockets) 410 enable the LED driving circuit 400 to be coupled to the cable or cables 40 emerging from each flexible elongate strip 5; one port 410 per strip 5. Preferably, these ports allow a waterproof connection but also enable individual strips to be disconnected and reconnected when necessary. A communication and power cord 420 includes power cables 430 (two) and a communication cable 440 (one), which can be coupled to a remote controller or intermediate controller (not shown). Although each LED driving circuit 400 can manage multiple strips of pixels, each LED driving circuit 400 may be limited to a particular number (e.g. 8 to 12) and so a plurality of LED driving circuits 400 may be required for a video display 300. Tens or even hundreds

of LED driving circuits 400 may be coupled to a single or overall controller or video source, such as a computer, directly or indirectly. They may also form a network or daisy-chain passing on signals to other LED driving circuits, strips 5 or pixels 20.

The LED controller circuits 400 or slave data cards may be linked in series (each slave data card has a data input and a data output socket). A master data input leads to the input of the first slave data card (1), the output of card 1 then inputs to the input on the second slave data card (2) and so on (in the form of a daisy chain). The last card will only have an input from the previous card and so the output on the last card may be capped off.

A master controller can be placed between a video source (e.g. a laptop) and the slave data cards. The master controller receives the signal from the video source and processes the signal (e.g. slices it up). For example, a video display 300 that has 10 slave data cards in it where each strip 5 may be 100 pixels long. This example video display 300 is therefore 80 pixels tall (10 slave data cards with 8 strings or strips each) and 100 pixels wide. The slave data cards in this instance would run vertically down the left hand side and the strips would be running horizontally.

A computer or other device contains software to programme the master controller to be configured for a specific video display 300. This configuration will define a specific number of data cards per strip 5 (8 in this example), the number data cards (10 in this example) and for each with strips to contain a specific number of pixels (100 in this example. The master controller then slices up the video feed it receives from the laptop (or games console, TV receiver or another video source, preferably containing an HDMI output) into packets of data. The master controller then manages and directs the packet of data to each slave card, which pass through the chain until they arrive at the correct slave data card. The slave data cards then take those packets from the master controller and distribute that data down each of the eight strings or strips. The slave data cards slice the incoming packet into a further eight packets and directs the packet to a particular strip 5. The ICs in each pixel 20 then take the data and display the relevant colour and brightness for each pixel. An example master controller (C2.0) is described at http://www.ydeachn.com (retrieved 3 December 2015).

Figure 8 illustrates schematically a portion of the video display 300 including a single LED driving circuit 400 and several flexible elongate strips 5 located on the sheet

200. The ports 410 of the LED driving circuit 400 mate with corresponding connectors 460, which are formed on the ends of the communication and power cord 420 of each strip 5 (e.g. male and female connects at either the LED driving circuit 400 or at the end of the communication and power cord 420).

The LED driving circuit 400 is removably attached to the flexible sheet 200 by clips or other securing fixtures (not shown in this figure). For example, clips may be used that are formed from a plastics material to secure the LED driving circuit 400. These LED driving circuits 400 may be suspended from a lower edge of the video display 300 or be located on the rear of the video display 300, for example. Therefore, the LED driving circuit 400 do not interfere with the image.

Figure 9 shows a further example LED driving circuit 500. This is a schematic diagram that illustrates certain features of this alternative embodiment. Rather than ports 410 attached directly to a case of the LED driving circuit, cables or flying leads 520 are used to connect the LED driving circuit 500 to inline connectors 510, which mate with the connectors 460 at the end of each communication and power cord 420 of each strip 5. This arrangement reduces weight and size as a rigid case is not required to support the ports 410.

The LED driving circuit 400 of figure 7 may be provided with an outer sheath or other waterproofing layer (not shown in this figure). This may be a shrink wrap material, for example. The LED driving circuit 500 of figure 9 is potted using a silicone sealant to form a waterproof case or encapsulation 530 around the components and electrical connections used to connect with each flexible elongate strip 5.

Figure 10 shows a reel 540 of a single flexible elongate strip 5 illustrating its flexibility. These reels 540 may be used to store spare strips or replacements that may be used for the video display 300. Also shown in figure 10 is an example weatherproof or waterproof electrical connector 460 used to couple the power and communications cable 420 to the LED driving circuit 400, 500.

Figure 11 shows a schematic diagram of the video display 300 attached to the circumference of a hot air balloon envelope. Figure 11 illustrates some of the flexible elongate strips 5 forming the video display 300. A single communication and power cable

620 couples the LED driving circuits 400, 500 of the video display 300 to a computer 610 that provides the video and control signal to form an image on the video display 300.

Manufacturing the video screen 300 involves forming the components described with reference to the previous figures, including: a plurality of flexible elongate strips 5 having regularly spaced pixels 20, a plurality of LED driver circuits 400, 500, a flexible sheet 200, a control computer 610 and cabling 620 to connect the LED driver circuits 400, 500 to the drive computer 620. Additional components, mechanical connectors, intermediate connectors, signal processors and power supplies may also be required.

Each flexible elongate strip 5 is formed as follows. Four LEDs 30 and a control IC (e.g. TLS3001) are soldered to a circuit board together with associated electronic components and electrical connections to receive power (DC) and data signals. Each complete circuit board forms a single pixel 20. Pixels 20 are coupled together in a line using further electrical connections 50, which are flexible (e.g. sheathed wires). In this example embodiment, 300 pixels 20 are connected in this way. However, any number of pixels 20 may form a single strip 5. An electrical connection 40 is made to one end of the elongate flexible strip 5, which is terminated by the communication and power cord 420 and connector 460. This electrical connection 40 is in electrical communication with the power and data connections to each pixel 20. For example, each pixel 20 may have an address on the strip 5 (e.g. using the control IC), which may be addressable by and LED driver circuit 400, 500 and ultimately by the drive computer 620.

The electrical connection 40 may take the form of an enclosed cable terminated with a plug or socket connector 460, which can mate with a corresponding socket or plug (port 410, 510) of a LED driver circuit 400, 500. This plug and socket connection is formed to create a waterproof seal enclosing the electrical contacts.

The strip 5 of pixels 20 may be tested at this stage. This may be achieved by plugging the single strip 5 or a set of strips 5 in to an LED driver circuit 400, 500, which provide power and a test signal. Upon successful testing, the strip 5 may be completed.

Completion of the strip 5 involves weather and water sealing. This may be achieved by several methods. A simple seal may be achieved by sandwiching the strip 5 between a pair of sheets of plastics material with a pressure sensitive adhesive backing.

The sheets of plastics material may then be divided or cut to separate the encapsulated strips 5.

A more robust seal may be achieved, where further weatherproofing is required, by introducing the strip 5 into a tube or sleeve 100 formed from an extruded silicone material (in its cured state). The sleeve 100 covers the full length of the strip 5 with the communication and power cord 420 emerging from the sleeve 100. Further waterproofing is provided by filling the sleeve 100 with a liquid or gel silicone sealant that is then allowed to cure. Filling is achieved at a rate and pressure that prevents damage to the sleeve 100, components or electrical connections 50. Once cured, the strip 5 is individually operational but requires further manufacturing steps to allow it to be replaceably attached to the sheet 200.

A two-part releasable fixture is used to bond each strip 5 to the sheet 200. A first part is permanently bonded to a strip 5 and a second part is bonded to, layered upon or forms the sheet 200. In this example implementation, the two-part releasable fixture is a hook and loop fastener, such as that produced by Velcro Industries B.V. The loop part is attached to a surface of the sheet 200. The hook part is bonded to the strip 5. However, the outer surface of the strip 5 is silicone, which is difficult to bond with when set. This bond is achieved using further silicone sealant (uncured), which is applied to either the strip 5 or the rear side of the loop part. The loop part is cut or formed to substantially match the length and shape of the surface of the strip 5, which is opposite to or distal to the surface that emits light.

A particularly effective method of bonding to the strip 5 is to use a hook and loop fastener that is formed from a ribbon of material that has the hooks on one surface and the loops on an opposing surface (e.g. Velcro One Wrap http://www.velcro.com/products/ties-and-straps/900604__one-wrap-rolls retrieved 2 December 2015). A bead or layer of liquid silicone sealant is applied to the loop or soft side of the ribbon. This may be partially absorbed by the fibres. The ribbon is then applied to the strip 5. As the silicone cures it forms a bond with the sheath surface 100.

The sheet 200 may be formed from any fabric, fibrous or looped material that forms a temporary bond with hooks. This may be a continuous sheet of strips that are glued or sewn to the sheet or directly incorporated into the sheet 200. The strips 5 may now be

attached to the sheet. A guide or batten is placed between strips to provide accurate placement. In one example, the strips 5 may be 10mm wide with a pixel spacing or pitch of 20mm. Therefore, a 10mm wide batten is used to space the strips 5.

The LED driver circuits 400, 500 are attached to an edge of the sheet 200. This may also use hook and loop fasteners or other removable or replaceable clips. The edge of the sheet 200 may be reinforced or stiffened with additional fabric, wires, plastics material, webbing or stitching to maintain the shape of the video display 300 and to support the cabling and LED driver circuits 400, 500.

The LED driver circuits 400, 500 are then connected to the strips 5. The video display 300 may be packed up (e.g. rolled) ready for transportation or storage. When required, the video display 300 may be unrolled and attached to a structure or support (e.g. using hooks). A power supply and a data connection are provided to the video display 300 (either directly to each LED driver circuit 400, 500 or through a wiring loom or other intermediate controller device). The video display 300 is then ready to receive video signals.

Should a pixel 20 or strip fail then it may be replaced. After removing all power, the connector 460 of the defective strip 5 may be disconnected from its corresponding LED driver circuit 400, 500. The two parts of the releasable fixture joining the strip 5 to the sheet 200 may be separated. A new or repaired strip 5 may be placed in the same location on the sheet 200 (e.g. using a template or batten to maintain a correct position). The LED driver circuit 400, 500 may be reconnected to the replacement strip 5 and the video display 300 may be powered back on.

As will be appreciated by the skilled person, details of the above embodiment may be varied without departing from the scope of the present invention, as defined by the appended claims.

For example, other types of two-part fixtures may be used. Other types of sealant may be used (e.g. rubber, epoxy, resin, melted polymer, thermosetting plastics, etc.) Software or firmware may be used to maintain pixel refresh rates. Each pixel may be addressed using different techniques and protocols. One or more (e.g. two, three, five, six up to 10 or 20) LEDs may be used for each pixel. The light output may be 6000-

7500Cd/m^2. The hooks may be placed on the sheet and the loops on the underside of the strips, instead of the other way round, in some embodiments.

The two-part releaseable fixture may be an adhesive (e.g. pressure sensitive adhesive) or suction device on one or both parts. The second part may be a surface that bonds to the adhesive but allows easy separation (e.g. without damage) with sufficient force, for example.

Many combinations, modifications, or alterations to the features of the above embodiments will be readily apparent to the skilled person and are intended to form part of the invention. Any of the features described specifically relating to one embodiment or example may be used in any other embodiment by making the appropriate changes.

CLAIMS:

1. A video display comprising:

a plurality of flexible elongate strips, each strip comprising:

a plurality of individually addressable pixels, wherein each pixel is formed from one or more light emitting diodes, LEDs;

one or more electrical cables electrically coupled to each individually addressable pixel, the one or more electrical cables emerging from the strip; and

a first part of a two-part releasable fixture bonded to an outer surface of the strip;

a flexible sheet have a surface at least partially covered with a second part of the two-part fixture and arranged to support the plurality of flexible elongate strips;

one or more LED driving circuits; and

one or more electrical connectors removably coupled between the one or more electrical cables and the one or more LED driving circuits.

2. The video display, wherein each strip further includes a flexible sealant encapsulating the plurality of LEDs and the electrical connections.

3. The video display of claim 2, wherein the flexible sealant is a jacket.

4. The video display of claim 3, wherein the jacket is filled with silicone sealant.

5. The video display according to any previous claim, wherein the two-part releasable fixture is a hook and loop fastener.

6. The video display according to any previous claim, wherein the flexible sheet is formed from fabric.

7. The video display according to any previous claim, wherein the LEDs are surface mounting devices, SMD.

8. The video display according to any previous claim, wherein the individually addressable pixels are full colour pixels.

9. The video display according to any previous claim, wherein each pixel comprises a plurality of LEDs.

10. The video display according to any previous claim, wherein the one or more LED driving circuits are slave data cards.

11. The video display according to any previous claim, wherein each of the one or more LED driving circuits is electrically coupled to a plurality of flexible strips.

12. The video display according to any previous claim, wherein each flexible strip is separately removable from the sheet.

13. The video display according to any previous claim, wherein the flexible strips are evenly spaced on the sheet.

14. The video display according to any previous claim, wherein the pitch between pixels on the flexible strips is equal to the separate of the flexible strips on the sheet.

15. The video display according to any previous claim, wherein the sheet further comprises supports for the LED driving circuits.

16. The video display according to any previous claim, further comprising an electrical power loom connected to the LED driving circuits.

17. The video display according to any previous claim, wherein the one or more electrical connectors are flying leads.

18. The video display according to any previous claim, wherein the flexible strips have a semi-circular, rectangular or square profile.

19. The video display according to any previous claim, wherein the sheet is covered with a continuous surface of the second part of the two-part fixture.

20. A method for manufacturing a video display, comprising the steps of:

forming a plurality of flexible elongate strips by:

providing a plurality of individually addressable pixels, wherein each pixel is formed from one or more light emitting diodes, LEDs;

electrically connecting each individually addressable pixel to one or more electrical cables, wherein the one or more electrical cables are formed to emerge from the strip; and

bonding a first part of a two-part releasable fixture to an outer surface of the strip;

providing a flexible sheet with a second part of the two-part releasable fixture;

joining the first part of the two-part releasable fixture of the plurality of flexible elongate strips to the second part of the two-part releasable fixture on the flexible sheet; and

connecting the one or more electrical cables to one or more LED driving circuits using a removable electrical connector.

21. The method of manufacture of claim 20 further comprising the step of encapsulating the plurality of LEDs and at least part of the one or more electrical cables with a flexible sealant.

22. The method of manufacture of claim 21, wherein the step of encapsulating the plurality of LEDs further comprises the steps of:

inserting the LEDs within a flexible tube; and

filling the flexible tube with a chemically curing sealant.

23. The method of manufacture according to any of claims 20 to 22, further comprising the steps:

removing one or more flexible elongate strips from the flexible sheet by separating the first part of the two-part releasable fixture from the second part;

disconnecting the one or more electrical cables from the to one or more LED driving circuits;

replacing the removed one or more flexible elongate strips; and

reconnecting the one or more electrical cables to the one or more LED driving circuits.

24. A method of manufacture as substantially as described with reference to any of the accompanying drawings.

25. An apparatus substantially as described and shown in any of the accompanying drawings.

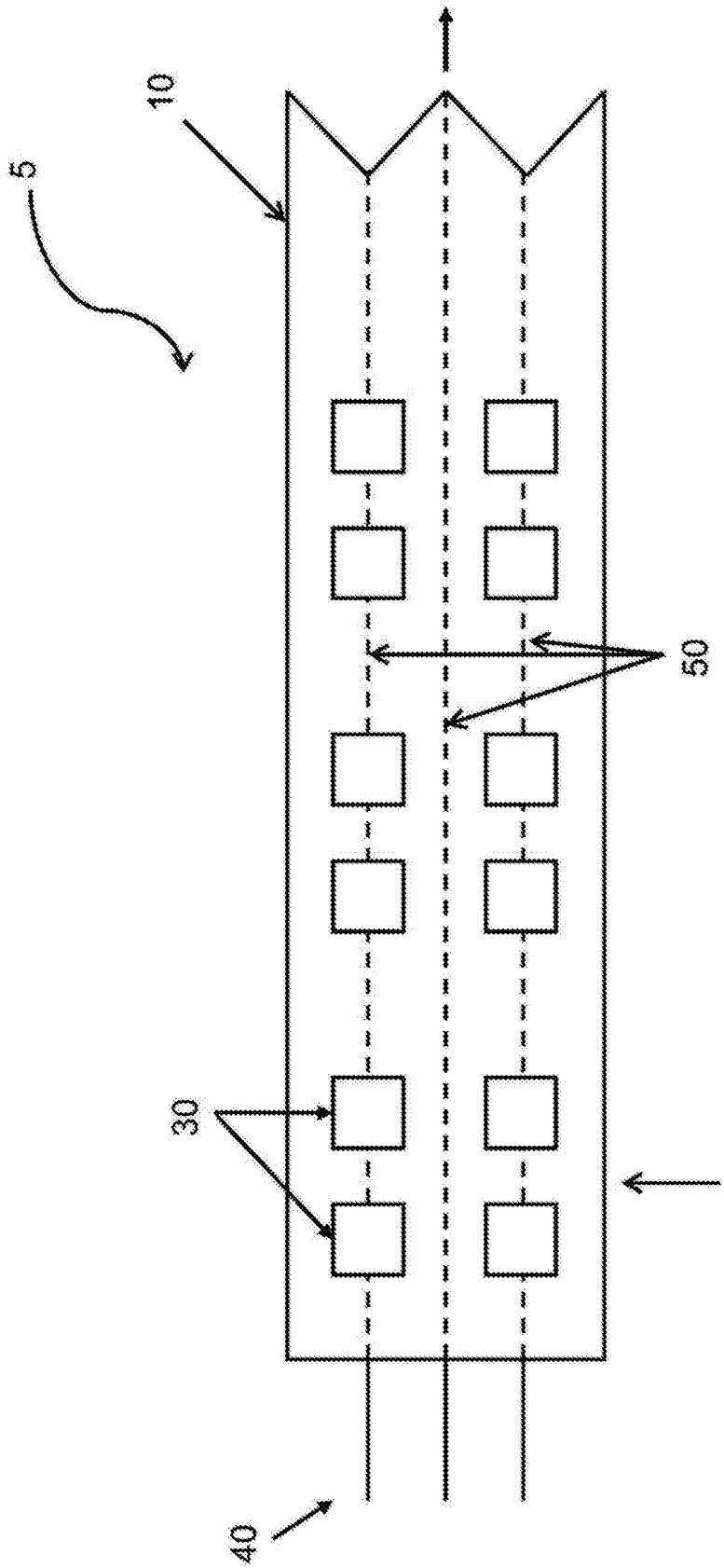

FIG. 1

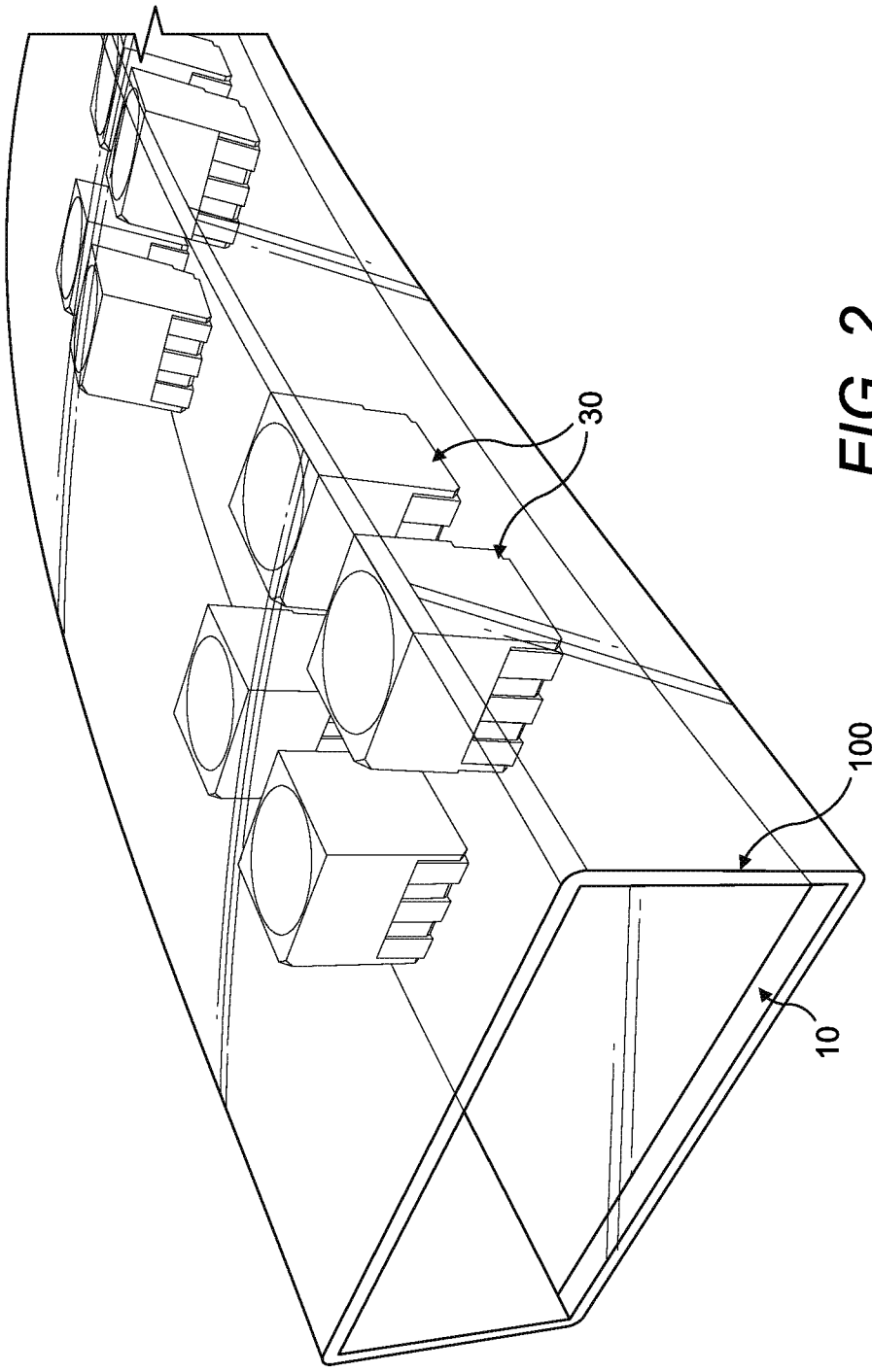

FIG. 2

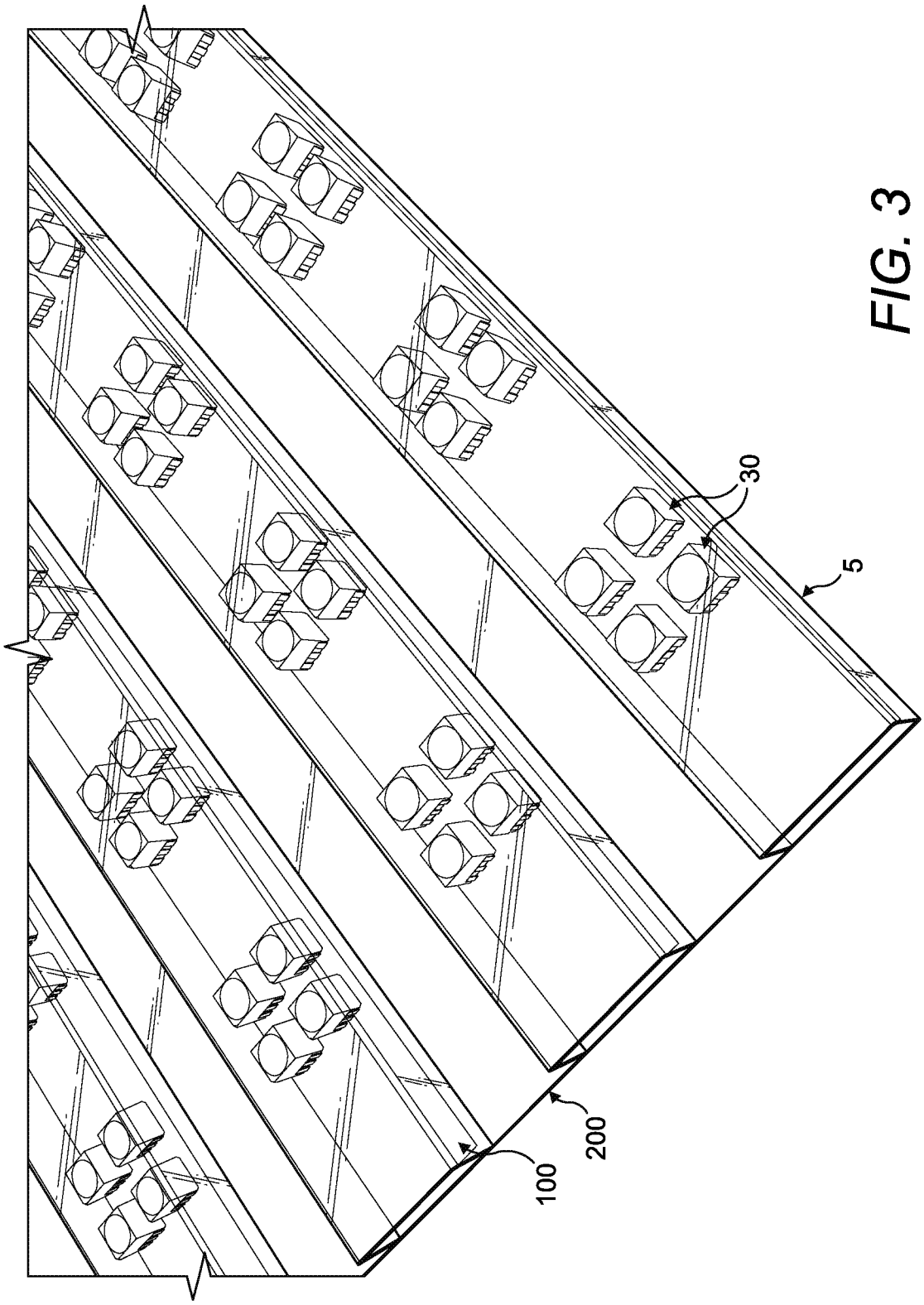

FIG. 3

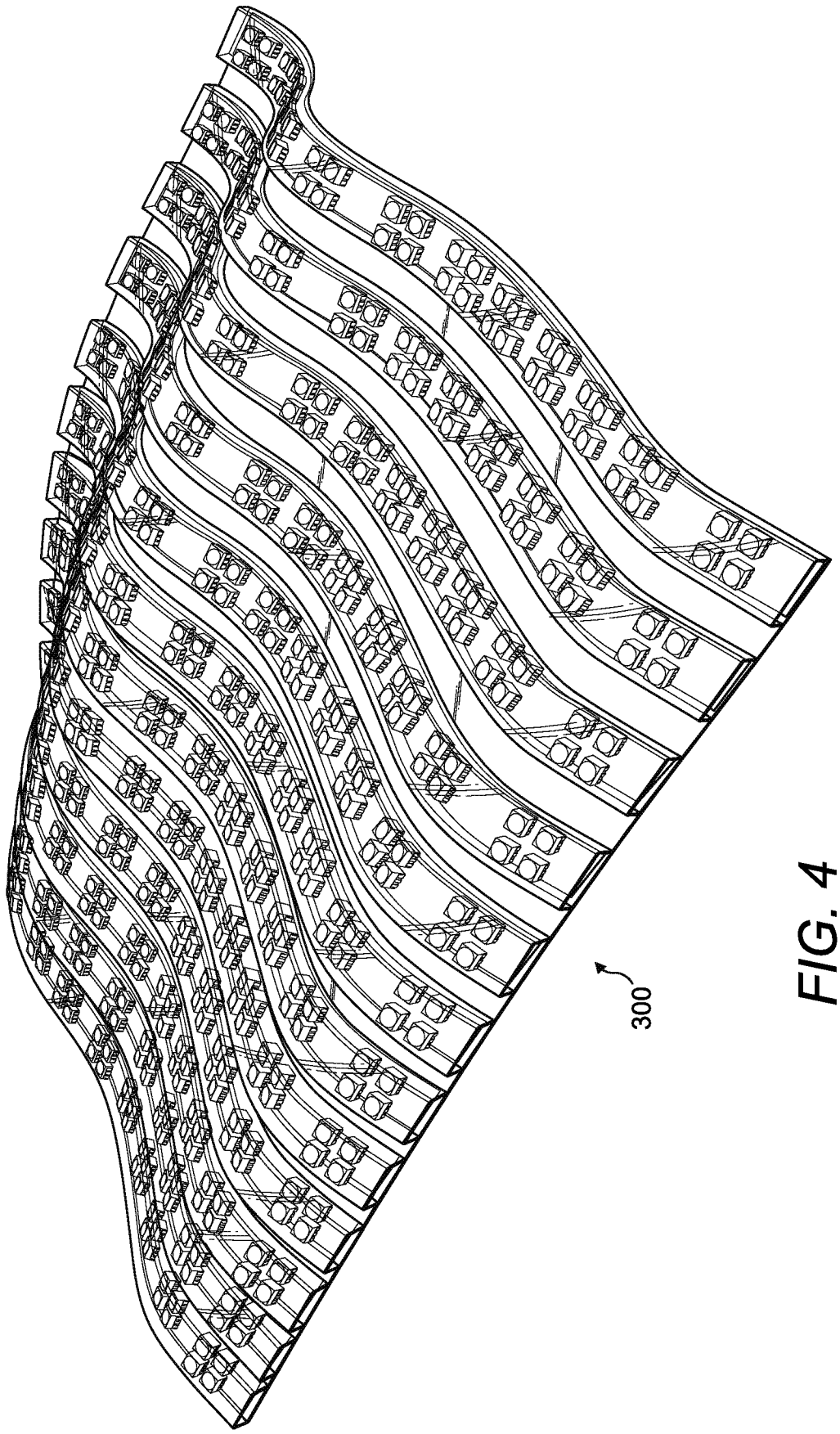

FIG. 4

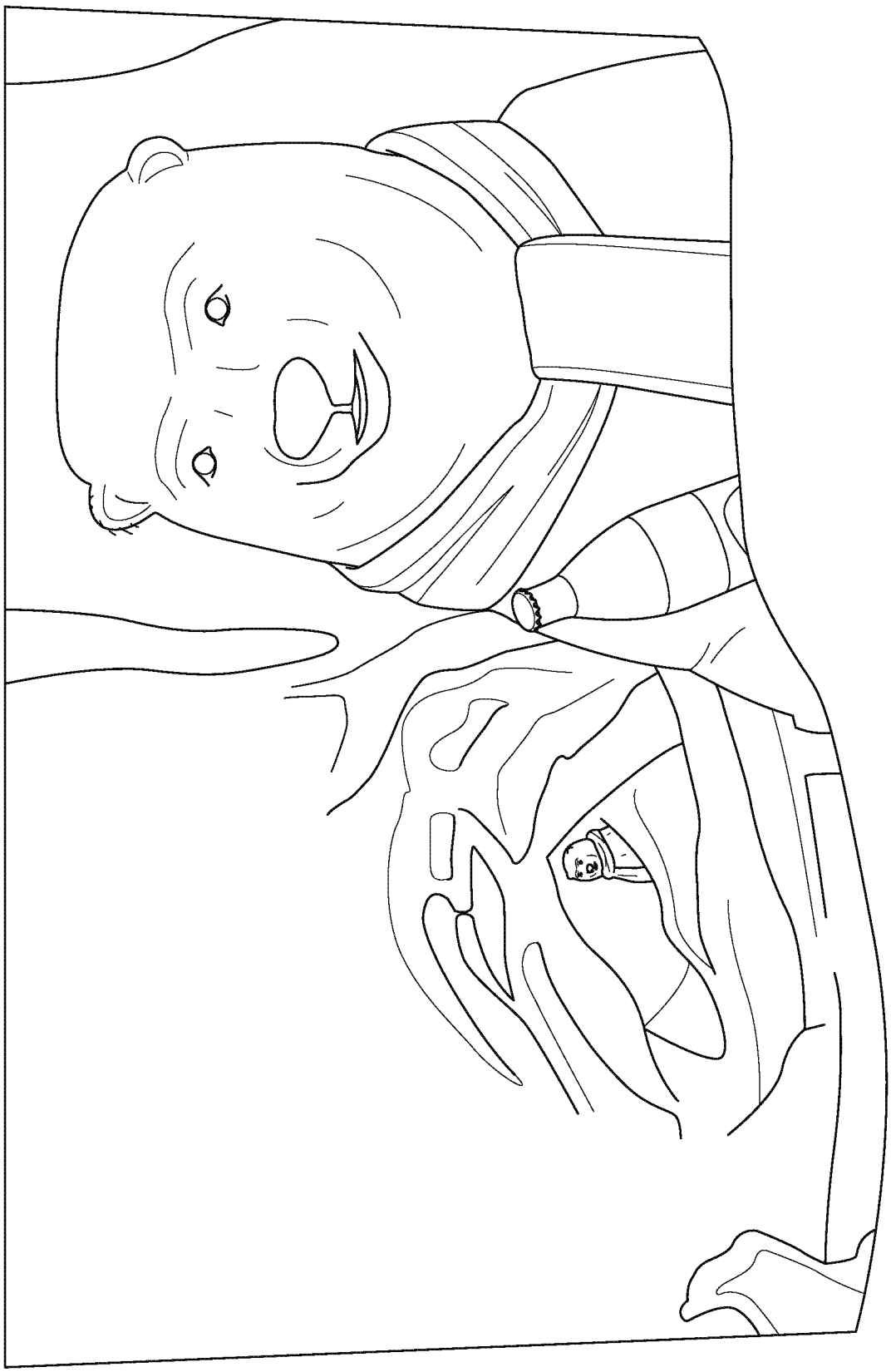

FIG. 5

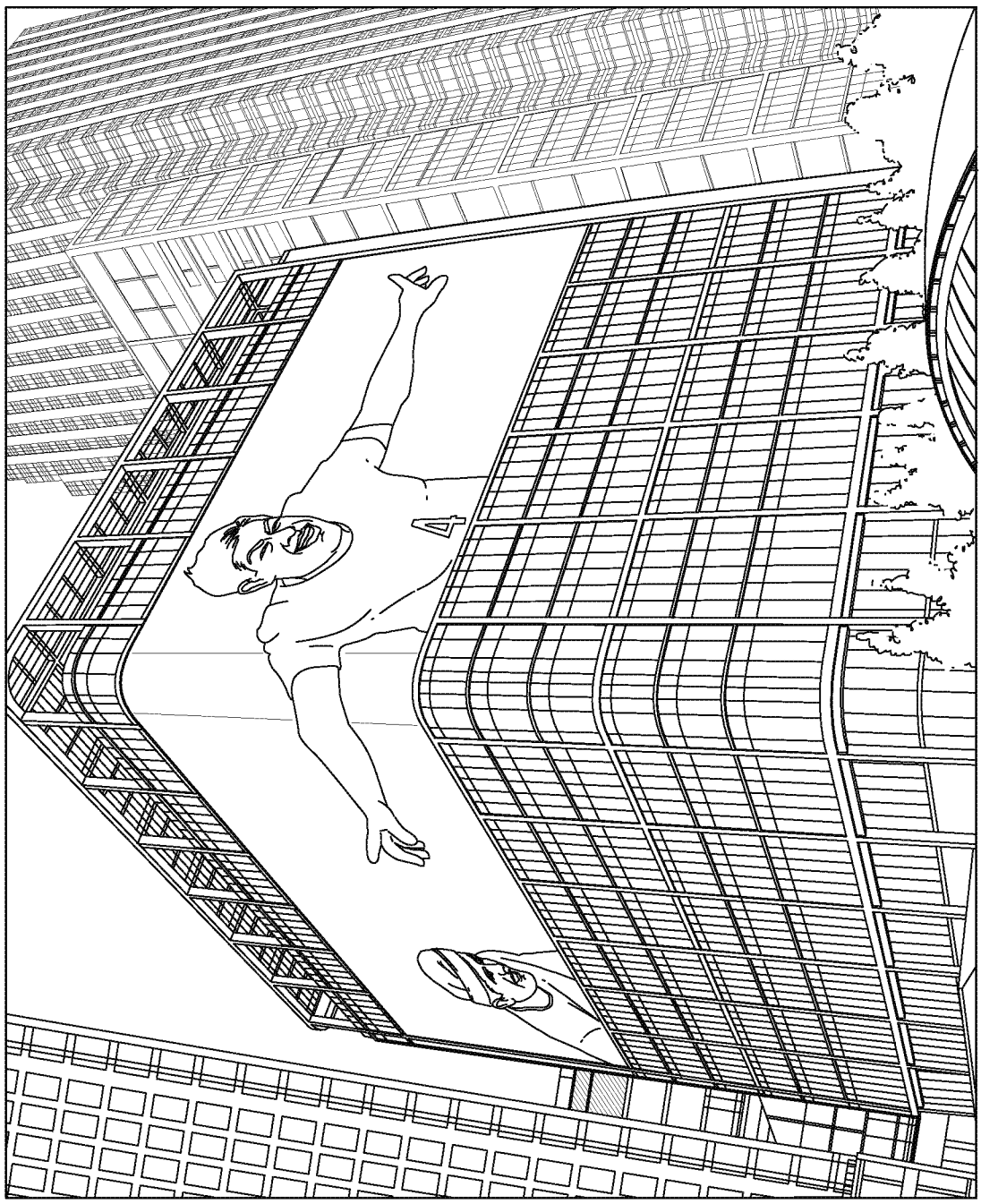

FIG. 6

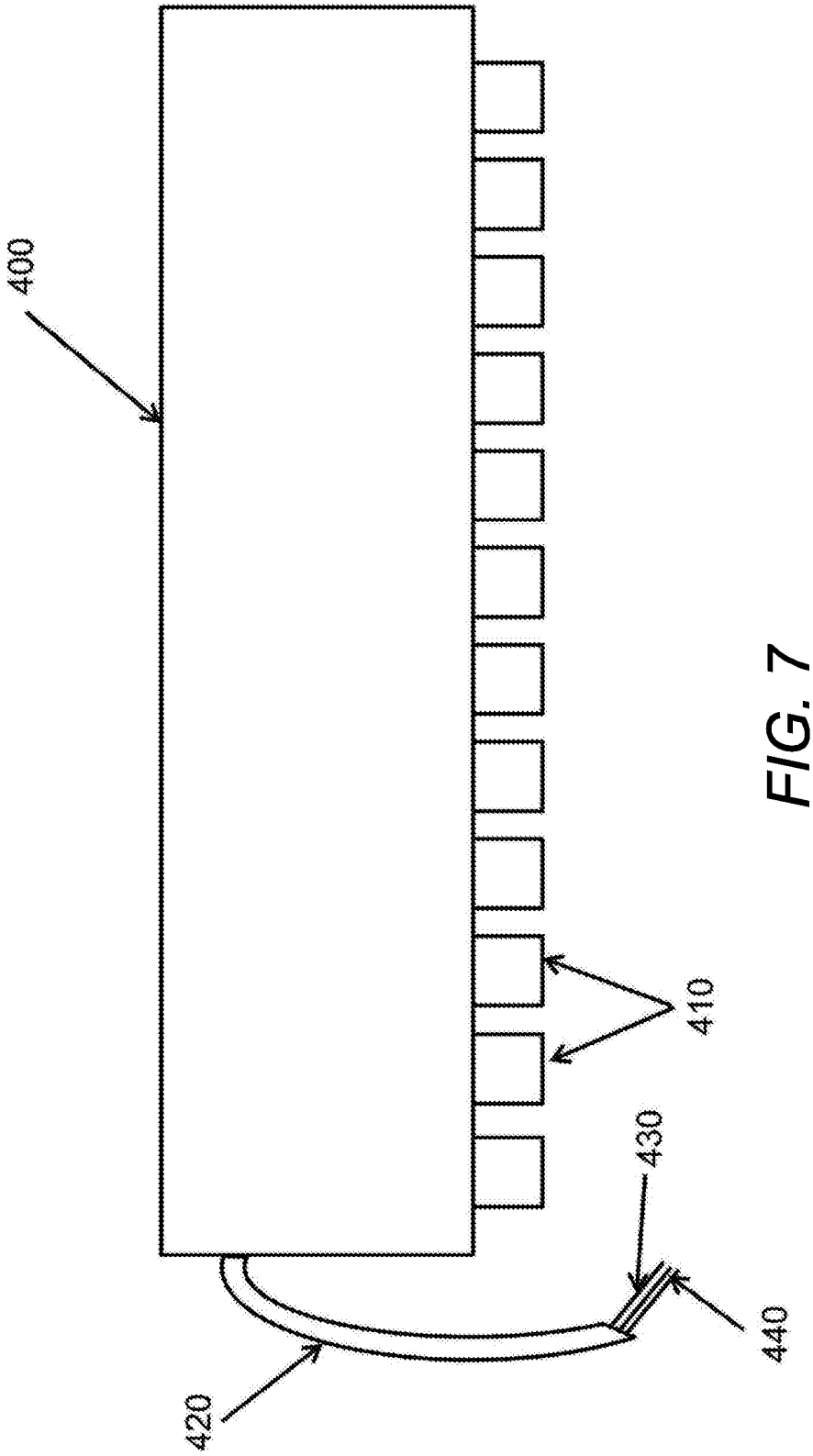

FIG. 7

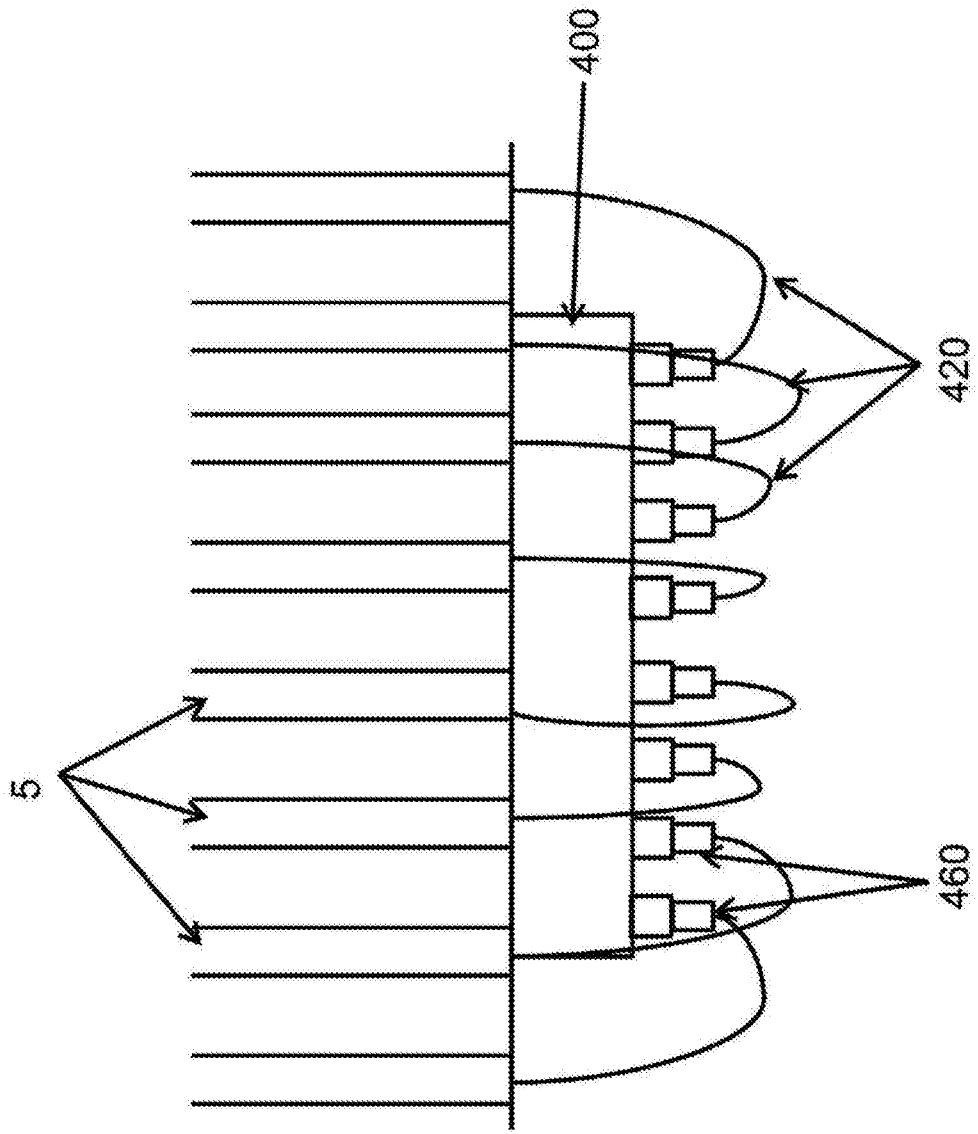

FIG. 8

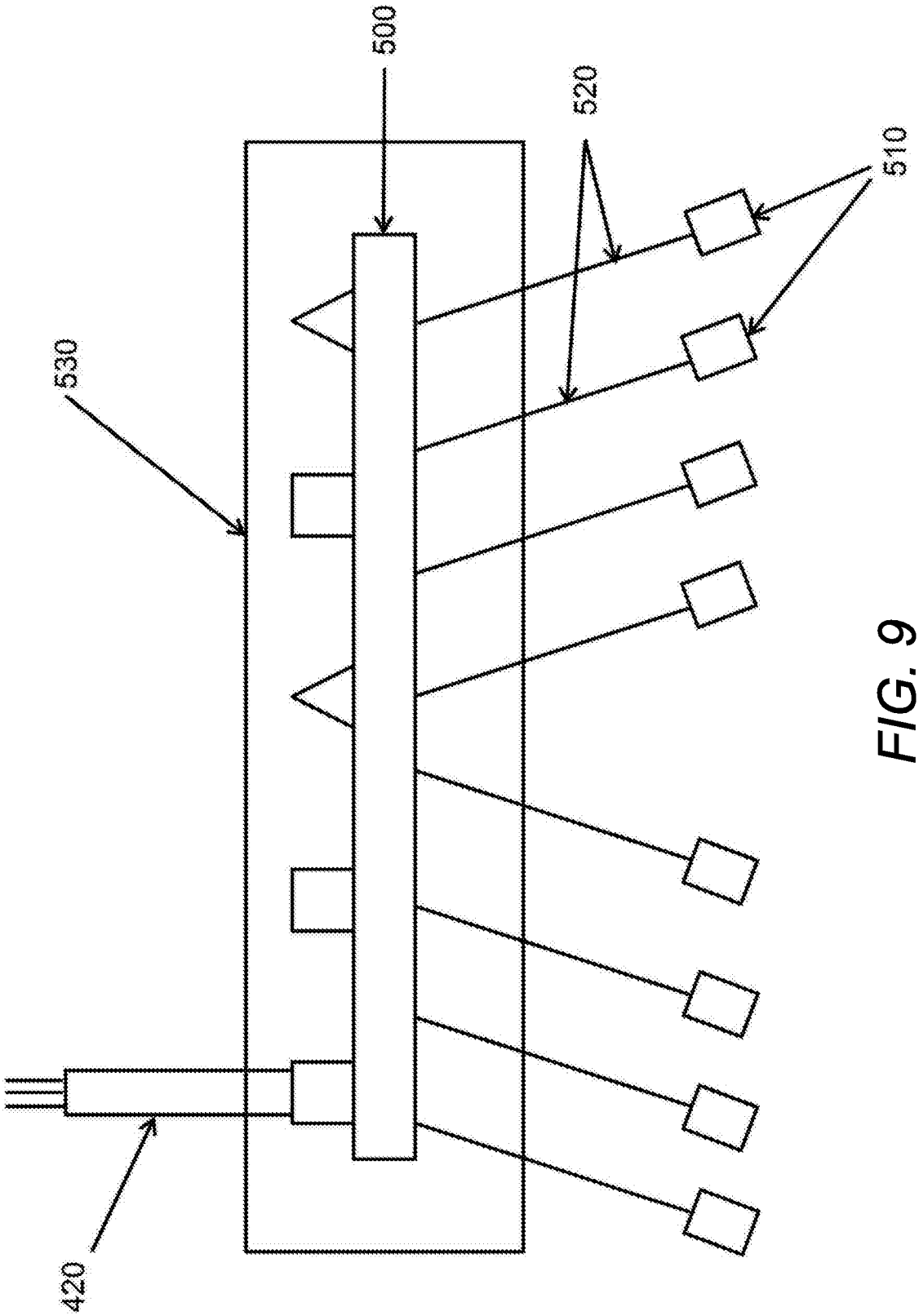

FIG. 9

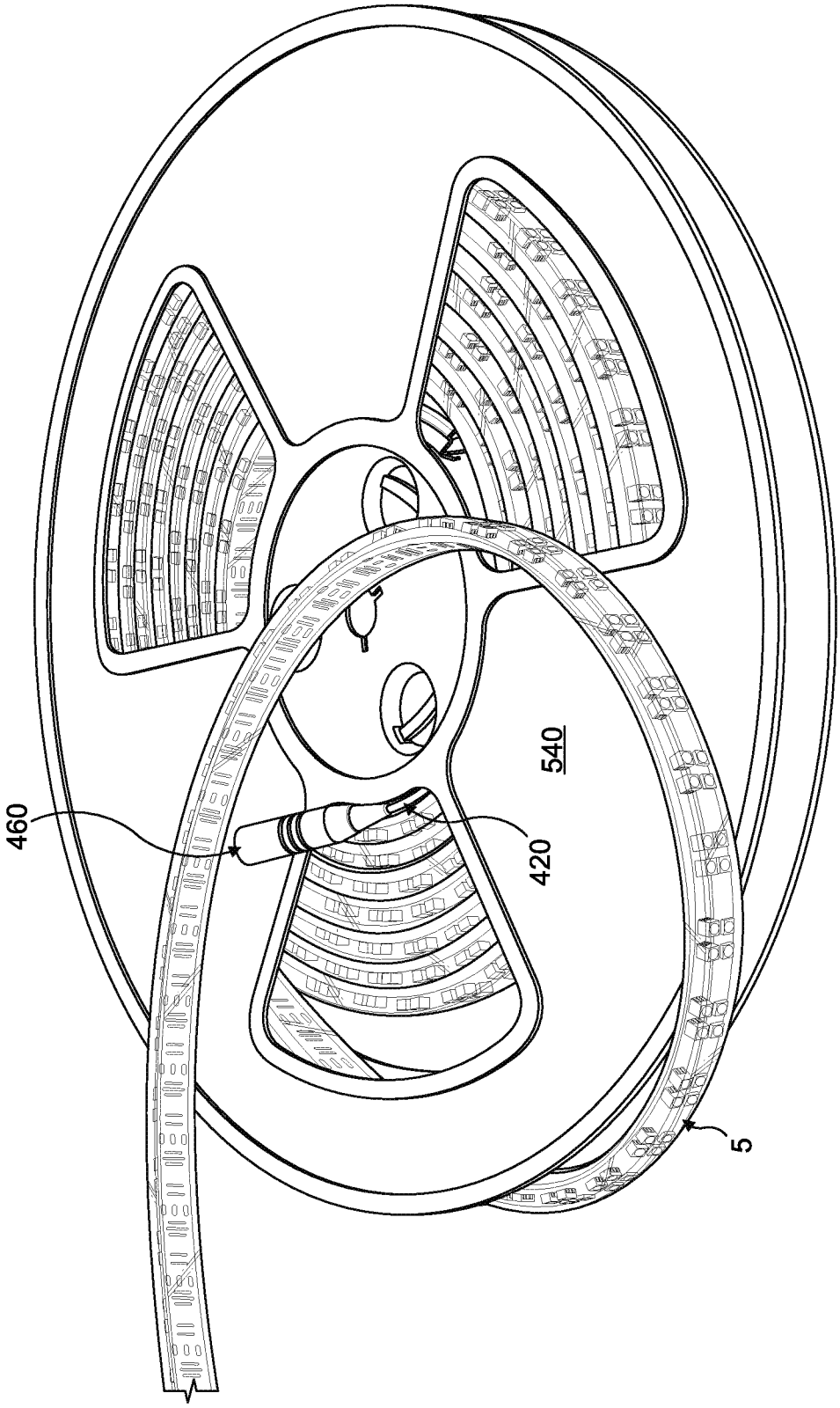

FIG. 10

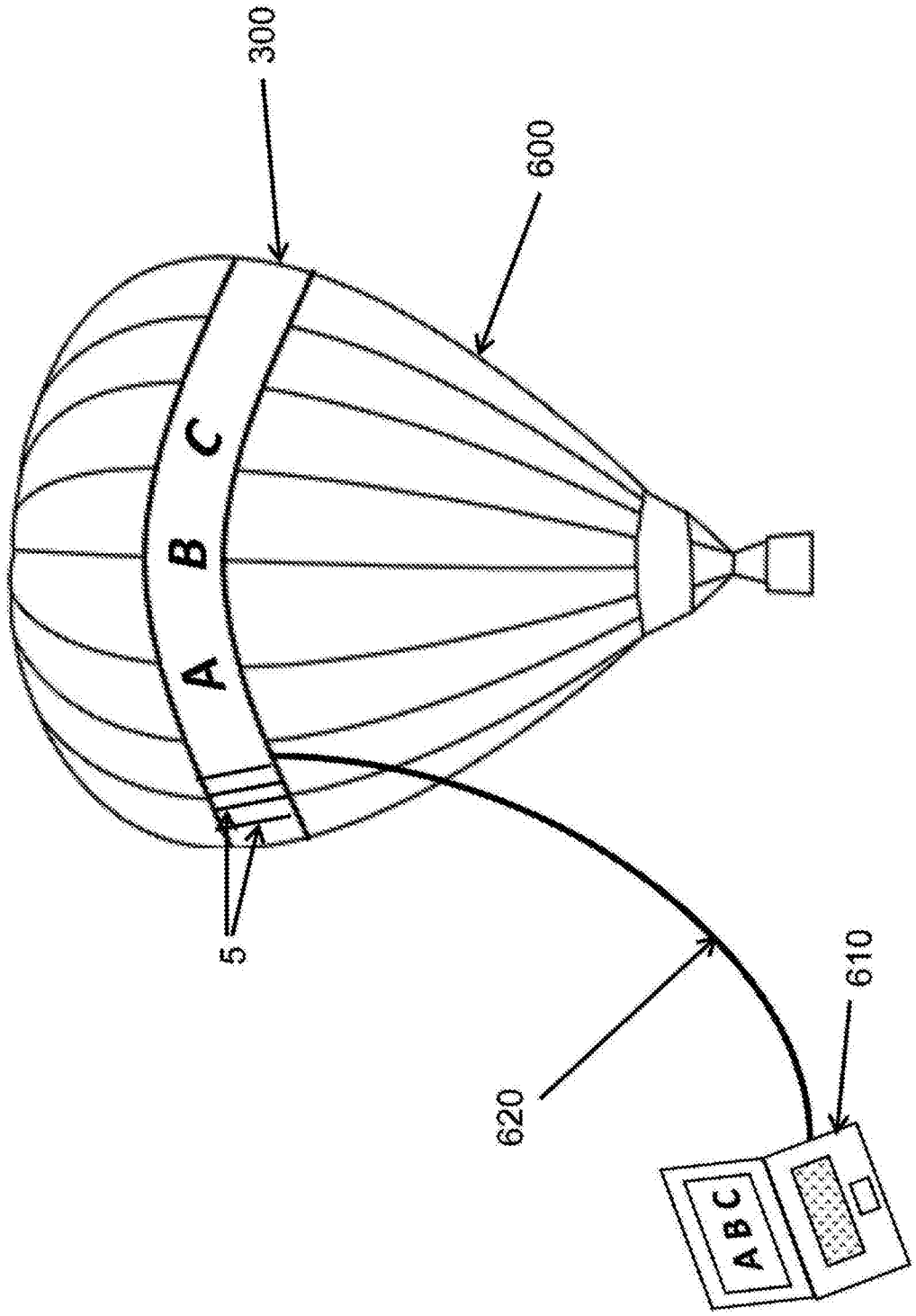

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2017/051455

A. CLASSIFICATION OF SUBJECT MATTER
INV. G09F9/30 G09F9/33 F21S4/15
ADD.

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)
G09F F21S

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2015/296174 A1 (FACCHINETTI ANDREA [US] ET AL) 15 October 2015 (2015-10-15) paragraph [0094]; figures paragraph [0013] paragraph [0056] paragraph [0059]	1,5-20, 23-25 2-4,21, 22

Y	DATABASE WPI Week 201058 Thomson Scientific, London, GB; AN 2010-K66024 XP002776901, -& CN 201 527 753 U (SHENZHEN SEETOP OPTOELECTRONIC CO LTD) 14 July 2010 (2010-07-14) abstract	2-4,21, 22

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 December 2017	09/01/2018

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Demoor, Kristoffel

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2017/051455

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2002/039290 A1 (LEMMENS WIM [BE]) 4 April 2002 (2002-04-04) paragraph [0010] - paragraph [0014]; figures 1,2,5	1-25
A	DE 298 09 187 U1 (SCHIMEK JOHANNES [AT]) 7 October 1999 (1999-10-07) figures 1,2,4 page 3, paragraph 3 page 5, paragraph 4 - page 6, paragraph 2	1-25
E	GB 2 545 174 A (CURB MEDIA LTD [GB]) 14 June 2017 (2017-06-14) the whole document	1-25

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2017/051455

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015296174 A1	15-10-2015	NONE	
CN 201527753 U	14-07-2010	NONE	
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GB 2545174 A	14-06-2017	NONE	